TERRESTRIAL AND FRESHWATER ECOLOGICAL BASELINE AND IMPACT ASESSMENT FOR THE PROPOSED BULSKOP PV FACILITY AND ASSOCIATED INFRASTRUCTURE GRID CONNECTION

BEAUFORT WEST, WESTERN CAPE

January 2022

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The Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA (GNR 320), as gazetted on 20 March 2020 provides guidelines on information that must be found in a compliance statement. These requirements are listed below for the aquatic theme biodiversity.

Item	Reference	Comment
The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP)	Pg 15	Pr Sci Nat
Must include contact details, CV, SACNASP number and field of expertise of specialist	Pg 15 & 117	Appendix
Signed statement of independence	Pg 116	Appendix
Initial site sensitivity verification: • Desktop Analysis using satellite imagery and available information • Onsite inspection, to include a description of current land use, vegetation found on-site and status quo of screening tool confirmation/dispute • Include photographs/evidence of land and environmental sensitivity	Section 6.2	-

Methodology used to undertake the site survey and prepare compliance statement, including equipment and modelling relevant	Section 4.2	-
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1 Introduction

The Biodiversity Company (TBC) was commissioned to conduct a terrestrial[1] (fauna and flora) and freshwater ecology baseline and impact assessment for the proposed Solar Photovoltaic (PV) grid connection near Beaufort West, Western Cape.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020) in terms of NEMA, dated 20 March and 30 October 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation" (Reporting Criteria). The National Web based Environmental Screening Tool has characterised the following for the facility:

- The terrestrial biodiversity theme as "high" sensitivity;
- The animal species theme as "high" sensitivity;
- The plant species theme as "medium" sensitivity; and
- The aquatic biodiversity theme as "low" sensitivity.

The purpose of these specialist assessments is to provide relevant input into the environmental authorisation process for the proposed activities associated with the development. This report, after taking into consideration the findings and recommendations provided by the relevant specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Project Description

The project is in the north-eastern part of the Western Cape and falls within the Beaufort West Local Municipality and Central Karoo District Municipality. The Solar PV facility intends to connect to the National Grid via the Droerivier Main Transmission Substation (MTS) (approximately 17.5 km west of the facility). The solar facility will consist of six 120 MW PV facilities namely:

- Bulskop PV;
- Hardeveld PV;
- Rosenia PV;
- Hoodia PV;
- Salsola PV; and
- Gamka PV.

[1] A separate Regime 2 avifauna report will be submitted for the authorisation process

The dominant land uses surrounding the study area includes livestock farming, urban developments, natural areas and protected areas such as the Steenbokkie Private Nature Reserve.

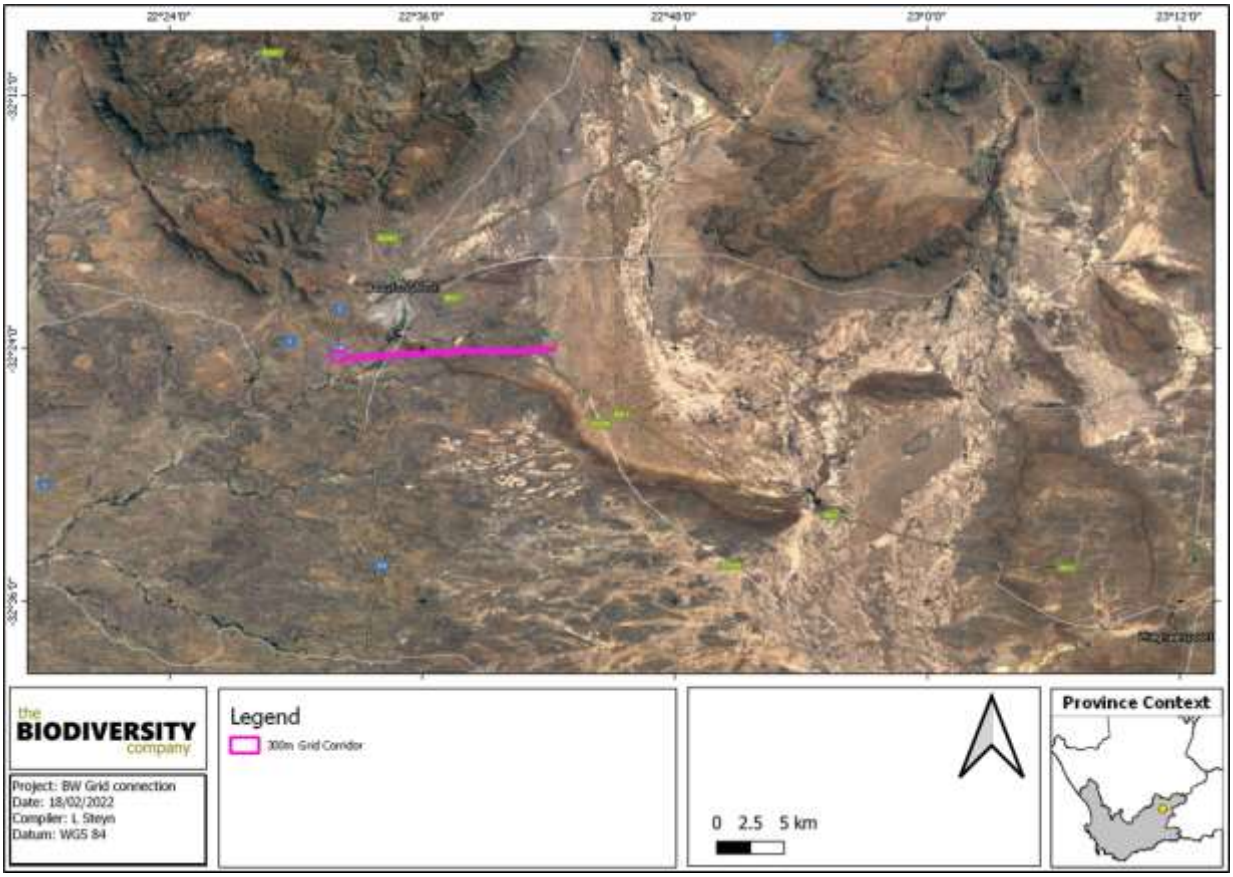


Figure 1-1: Locality of the study area

1.2 Project Context

Bulskop Grid (Pty) Ltd proposes the construction and operation of grid connection infrastructure for the proposed Bulskop PV cluster of six facilities near Beaufort West in the Western Cape Province. The grid connection infrastructure comprises the following:

- One Eskom collector substation/ switching station; and
- One double circuit 132 kV powerline from the Bulskop collector substation/ switching station to the Droerivier Main Transmission Substation (MTS).

Additional associated infrastructure will also be required for the grid connection solution, including access roads, feeder bays (inclusive of line bays, busbars, bussection and protection equipment), a fibre and optical ground wire (OPGW) layout, insulation and assembly structures.

A grid connection corridor of approximately 300 m wide and 17.5 km long is being assessed to allow for the optimisation of the grid connection and associated infrastructure., The grid connection infrastructure will be developed within the 300m wide grid connection corridor, which will allow for the avoidance of identified environmental sensitivities. The grid corridor will connect the 6 PV projects to the Droerivier MTS.

The six (6) PV facilities and grid connection were collectively (or jointly) surveyed, and the combined extent of these areas is referred to as the study area (see Figure 1-2). For the purposes of this report, the extent of the grid connection is referred to as the development area.

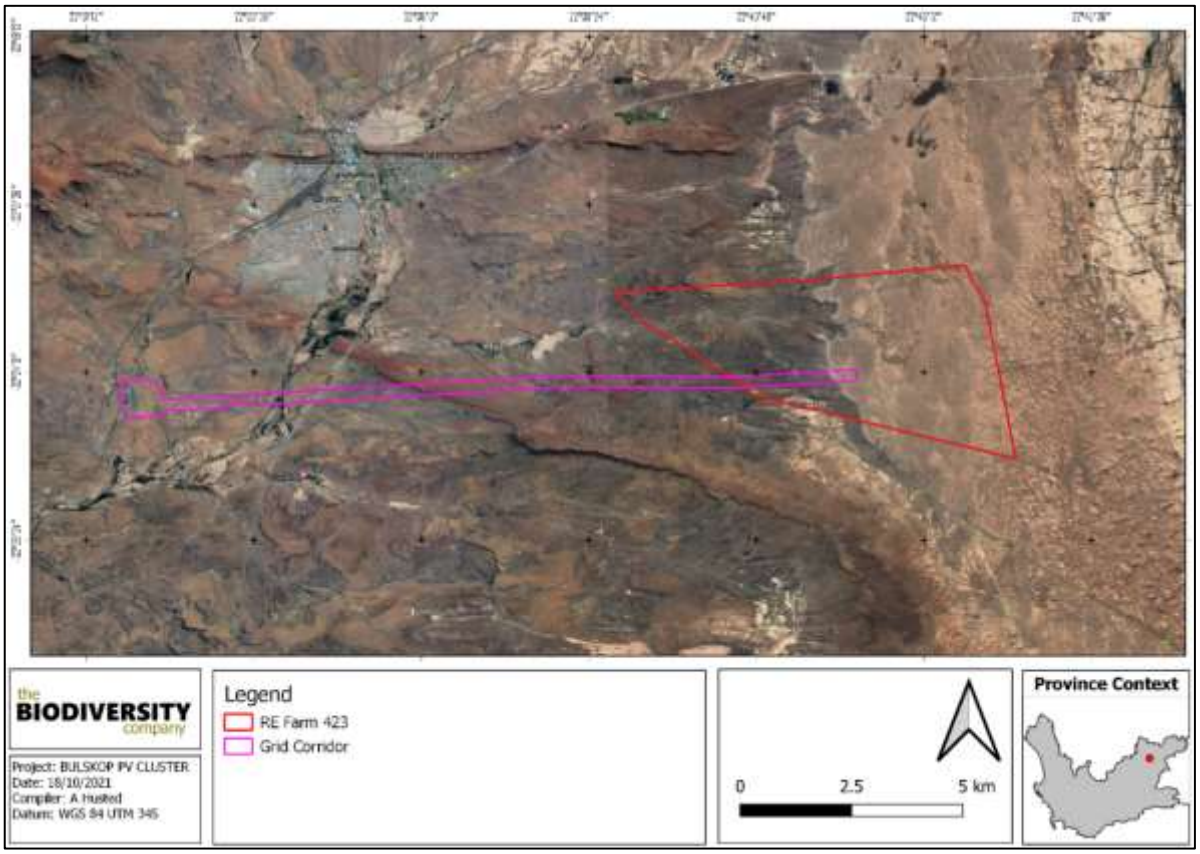


Figure 1-2: Grid connection study area

1.3 Strategic Transmission Corridors (EGI)

On the 16 February 2018 Minister Edna Molewa published Government Notice No. 113 in Government Gazette No. 41445 which identified 5 strategic transmission corridors important for the planning of electricity transmission and distribution infrastructure as well as procedure to be followed when applying for environmental authorisation for electricity transmission and distribution expansion when occurring in these corridors.

On 29 April 2021, Minister Barbara Dallas Creecy published Government Notice No. 383 in Government Gazette No. 44504, which expanded the eastern and western transmission corridors and gave notice of the applicability of the application procedures identified in Government Notice No. 113, to these expanded corridors. More information on this can be obtained from https://egis.environment.gov.za/egi. Figure 1-3 shows the study area overlap the central corridor.

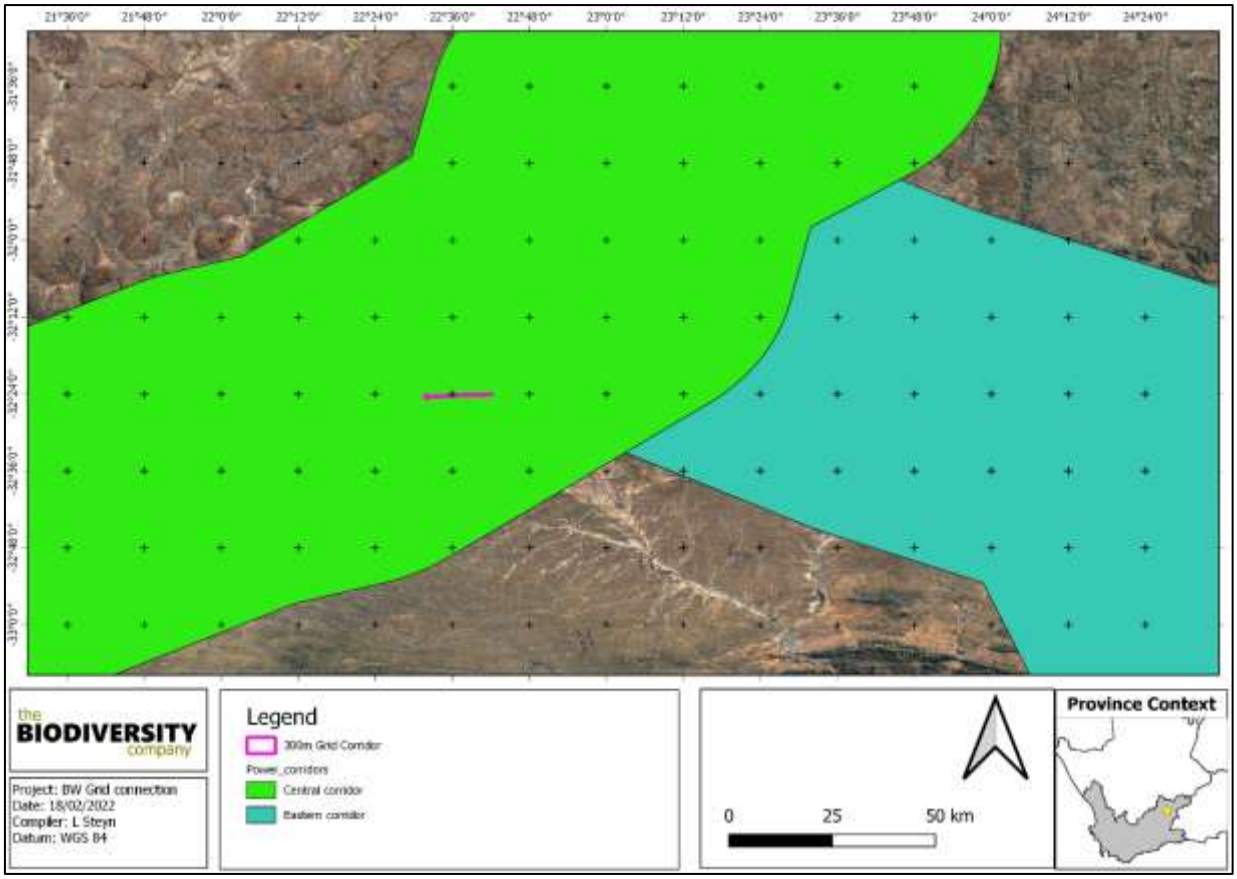


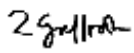
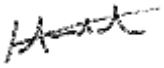
Figure 1-3: The grid connection in relation to the power corridor

1.4 Terms of Reference

The Terms of Reference (ToR) included the following:

- Description of the baseline receiving environment specific to the field of expertise (general surrounding area as well as site specific environment), by means of field work;
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (aquatic, fauna and flora) that occur in the study area, and the manner in which these sensitive receptors may be affected by the activity;
- Identify 'significant' ecological features within the proposed study area;
- Identification of conservation significant habitats around the study area which might be impacted;
- Screening to identify any critical issues (potential fatal flaws) that may result in project delays or rejection of the application;
- Provide a map to identify sensitive receptors in the study area, based on available maps and database information;
- Implementation of standard River Eco-status Monitoring Programme protocols for determination of Present Ecological State (PES) of aquatic areas: and
- Impact assessment with supporting mitigation measures.

2 Specialist Details

Report Name	**TERRESTRIAL AND FRESHWATER ECOLOGICAL BASELINE AND IMPACT ASESSMENT FOR THE PROPOSED BULSKOP PV FACILITY AND ASSOCIATED INFRASTRUCTURE GRID CONNECTION**
Submitted to	**Bulskop PV (Pty) Ltd**
Report Writer (Aquatic)	**Christian Fry**  Christian Fry has obtained an MSc in Aquatic Health from the University of Johannesburg and is a registered Professional Scientist (Pr. Sci. Nat: 119082). Christian has 6 years of experience conducting basic assessments, biomonitoring and EIAs for various sectors.
Report Writer (Terrestrial Ecology)	**Rudolph Greffrath**  Rudolph is a terrestrial ecology specialist with 14 years of experience in biodiversity baseline assessments, biodiversity action planning design and development, biodiversity off-set design and implementation, biodiversity strategy design, conservation management planning and implementation, IFC performance standards best practice, ecological restoration, ecosystems services and environmental impact assessments, across Africa. He is Pr Sci Nat registered (400018/17) in the following field of practice, Conservation Science.
Report Writer/Reviewer	**Andrew Husted**  Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field..
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2014 (as amended). We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

3 Key Legislative Requirements

The legislation, policies and guidelines listed below are applicable to the current project in terms of biodiversity and ecological support systems. The list below, although extensive, is not exhaustive and other legislation, policies and guidelines may apply in addition to those listed below (Table 3-1).

Table 3-1: A list of key legislative requirements relevant to these studies in the Western Cape

Region	Legislation
International	Convention on Biological Diversity (CBD, 1993)
	The Convention on Wetlands (RAMSAR Convention, 1971)
	The United Nations Framework Convention on Climate Change (UNFCC,1994)
	The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973)
	The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)
National	Constitution of the Republic of South Africa (Act No. 108 of 2006)
	The National Environmental Management Act (NEMA) (Act No. 107 of 1998)
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GNR 320 of Government Gazette 43310 (March 2020)
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GNR 1150 of Government Gazette 43855 (October 2020)
	The National Environmental Management Protected Areas Act (Act No. 57 of 2003)
	The National Environmental Management Biodiversity Act (Act No. 10 of 2004)
	The National Environmental Management: Waste Act, 2008 (Act 59 of 2008);
	The Environment Conservation Act (Act No. 73 of 1989) and associated EIA Regulations
	National Environmental Management Air Quality Act (No. 39 of 2004)
	National Protected Areas Expansion Strategy (NPAES)
	Environmental Conservation Act (Act No. 73 of 1983)
	Natural Scientific Professions Act (Act No. 27 of 2003)
	National Biodiversity Framework (NBF, 2009)
	National Forest Act (Act No. 84 of 1998)
	National Veld and Forest Fire Act (101 of 1998)
	National Spatial Biodiversity Assessment (NSBA)
	World Heritage Convention Act (Act No. 49 of 1999)
	National Heritage Resources Act, 1999 (Act 25 of 1999)
	Municipal Systems Act (Act No. 32 of 2000)
	Alien and Invasive Species Regulations, 2014
	South Africa's National Biodiversity Strategy and Action Plan (NBSAP)
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
	Sustainable Utilisation of Agricultural Resources (Draft Legislation).
	White Paper on Biodiversity
	National Water Act (NWA, 1998)

Provincial	Draft Western Cape Biodiversity Bill, 2019
	Western Cape Nature Conservation Laws Amendment Act, 2000 for provincially protected species.
	Western Cape Biodiversity Sector Plan 2017

4 Methodologies

All methodologies were informed by the Phase 2 Strategic Environmental Assessment for wind and solar PV energy in South Africa Protocol for the assessment and reporting of environmental impacts on terrestrial biodiversity (SEA 2019).

4.1 Terrestrial Assessment

4.1.1 Geographic Information Systems (GIS) Mapping

Existing data layers were incorporated into GIS software to establish how the proposed project might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:

- National Biodiversity Assessment (NBA) (Skowno *et al*., 2019);
- Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018);
- National Freshwater Ecosystem Priority Area (NFEPA) database (Nel *et al*., 2011); and
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al*., 2018).

Brief descriptions of the standardised methodologies applied in each of the specialist disciplines are provided below. More detailed descriptions of survey methodologies are available upon request.

4.1.2 Botanical Assessment

The botanical assessment encompassed an assessment of all the vegetation units and habitat types within the study area including the development area. The focus was on an ecological assessment of habitat types as well as identification of any Red Data species within the known distribution. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA), to access distribution records on southern African plants. This is a new database which replaces the old Plants of Southern Africa (POSA) database. The POSA database provided distribution data of flora at the quarter degree square (QDS) resolution. The Red List of South African Plants website (SANBI, 2020) was utilized to provide the most current account of the national status of flora. Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- A field guide to Wildflowers (Pooley, 1998);
- Guide to Grasses of Southern Africa (Van Oudtshoorn, 1999);
- Orchids of South Africa (Johnson & Bytebier, 2015);
- Guide to the Aloes of South Africa (Van Wyk & Smith, 2014);

- Mesembs of the World (Smith *et al.,* 1998);
- Medicinal Plants of South Africa (Van Wyk *et al.,* 2013);
- South African Wildflower guide 6: Karoo (Shearing, 2008);
- Field guide to Wildflowers of South Africa (Manning, 2019);
- National Web based Environmental Screening Tool;
- Freshwater Life: A field guide to the plants and animals of southern Africa (Griffiths & Day, 2016); and
- Identification guide to southern African grasses. An identification manual with keys, descriptions and distributions (Fish *et al.,* 2015).

Additional information regarding ecosystems, vegetation types, and Species of Conservation Concern (SCC) included the following sources:

- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2012);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Threatened or Protected Species Regulations;
- National Environmental Management Biodiversity Act (December 2011); and
- Red List of South African Plants (Raimondo *et al.,* 2009; SANBI, 2016).

The field work methodology included the following survey techniques:

- Timed meanders;
- Sensitivity analysis based on structural and species diversity; and
- Identification of floral red-data species.

4.1.3 Floristic Analysis

The late-dry season fieldwork, under extremely dry conditions, and sample sites were placed within targeted areas (i.e., target sites) perceived as ecologically sensitive based on the preliminary interpretation of satellite imagery (Google Corporation) and GIS analysis (which included the latest applicable biodiversity datasets) available prior to the fieldwork. The focus of the fieldwork was therefore to maximise coverage and navigate to each target site in the field to perform a rapid vegetation and ecological assessment at each sample site. Emphasis was placed on sensitive habitats, especially those overlapping with the proposed development area.

Homogenous vegetation units were subjectively identified using satelite imagery and existing land cover maps. The floristic diversity and search for flora SCC were conducted through timed meanders within representative habitat units delineated during the scoping fieldwork. Emphasis was placed mostly on sensitive habitats overlapping with the proposed development area.

The timed random meander method is a highly efficient method for conducting floristic analysis, specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost effective and highly suited for compiling flora species lists and therefore gives a rapid indication of flora diversity. The timed meander search was performed based on the

original technique described by Goff *et al.* (1982). Suitable habitat for SCC were identified according to Raimondo *et al.* (2009) and targeted as part of the timed meanders.

At each sample site notes were made regarding current impacts (e.g., livestock grazing, erosion etc.), subjective recording of dominant vegetation species and any sensitive features (e.g., wetlands, outcrops etc.). In addition, opportunistic observations were made while navigating through the study area.

4.1.4 Faunal Assessment

The faunal desktop assessment included the following:

- Compilation of expected species lists;
- Identification of any Red Data or Species of Conservation Concern (SCC) potentially occurring in the area; and
- Emphasis was placed on the probability of occurrence of species of provincial, national and international conservation importance.

Mammal distribution data were obtained from the following information sources:

- The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005);
- Bats of Southern and Central Africa (Monadjem *et al.,* 2010);
- The 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (www.ewt.org.za) (EWT, 2016); and
- Animal Demography Unit (ADU) - MammalMap Category (MammalMap, 2019) (mammalmap.adu.org.za).

The field survey component of the assessment utilised a variety of sampling techniques including, but not limited to, the following:

- Visual observations;
- Motion sensor cameras;
- Sherman small mammal traps;
- Identification of tracks and signs; and
- Utilization of local knowledge.

Site selection for trapping focussed on the representative habitats within the study area due to the large home ranges and foraging areas of animals. Sites were selected based on GIS mapping and Google Earth imagery and then final selection was confirmed through ground truthing during the surveys. Habitat types sampled included, disturbed and semi-disturbed zones, drainage lines and rocky outcrops.

4.1.5 Herpetology (Reptiles & Amphibians)

A herpetofauna desktop assessment of the possible species in the greater area was undertaken and attention was paid to the SCCs, sources used included the IUCN (2017) and ADU (2019). Herpetofauna distributional data was obtained from the following information sources:

- South African Reptile Conservation Assessment (SARCA) (sarca.adu.org);
- A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007);
- Field guide to Snakes and other Reptiles of Southern Africa (Branch, 1998);
- Atlas and Red list of Reptiles of South Africa, Lesotho and Swaziland (Bates *et al.,* 2014);
- A Complete Guide to the Frogs of Southern Africa (du Preez & Carruthers, 2009);
- Animal Demography Unit (ADU) - FrogMAP (frogmap.adu.org.za);
- Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland (Mintner *et al.,* 2004); and
- Ensuring a future for South Africa's frogs (Measey, 2011).

A herpetofauna field assessment was conducted in each habitat or vegetation type within the study area as well as the development area, as identified from the desktop assessment, with a focus on those areas which will be most impacted by the proposed grid connection development area (i.e., the infrastructure development). The herpetological field survey comprised the following techniques:

- Hand searching is used for reptile species that shelter in or under habitats. Visual searches, typically undertaken for species which activities occur on surfaces or for species that are difficult to detect by hand-searches or trap sampling.

4.2 Aquatic Ecology Assessment

Limited surface water was present throughout the study area, with the development area adjacent to the Hansrivier River which was absent of water during the survey. The lack of of surface water within the system limited the assessment to a catchment level assessment.

4.2.1 Surveys

A single survey was completed during the 6th to the 9th of September 2021. Standard methods utilised in the River Ecosystem Monitoring Programme (REMP) were used to establish the baseline PES of the considered river reaches. Details pertaining to the specific methodologies applied are provided in the relevant sections below.

4.2.2 Water Quality

Water quality was measured *in situ* using a calibrated handheld Extech ExStik II meter. The following constituents were measured: pH, electrical conductivity (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

4.2.3 Habitat Integrity and Riparian Delineation

The Intermediate Habitat Integrity Assessment (IHIA) model was used to assess the integrity of the habitats from a riparian and instream perspective as described in Kleynhans (1996). The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact-based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity are obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physico-chemical conditions and how these changes would impact on the natural riverine habitats.

The criteria and ratings utilised in the assessment of habitat integrity are presented in Table 4-1 and Table 4-2 respectively. The spatial framework for each IHIA was 5km up and downstream of the respective areas of interest, from the highest elevation to the lowest elevation within the watercourse.

Table 4-1: Criteria used in the assessment of habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of high flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon *et al*., 1993 in: DWS, 1999). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993 in: DWS, 1999) is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.

Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al*., 1992 in DWS, 1999)).
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also, a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 4-2: Descriptions used for the ratings of the various habitat criteria (Kleynhans, 1996)

Impact Category	Description	Impact Score
None	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1 - 5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11 - 15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16 - 20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21 - 25

The riparian delineation was completed according to DWAF (2005). Typical riparian cross sections and structures are provided in Figure 4-1. Indicators such as topography and vegetation were the primary indicators used to define the riparian zone. Elevation data was obtained from topography spatial data was also utilised to support the infield assessment.

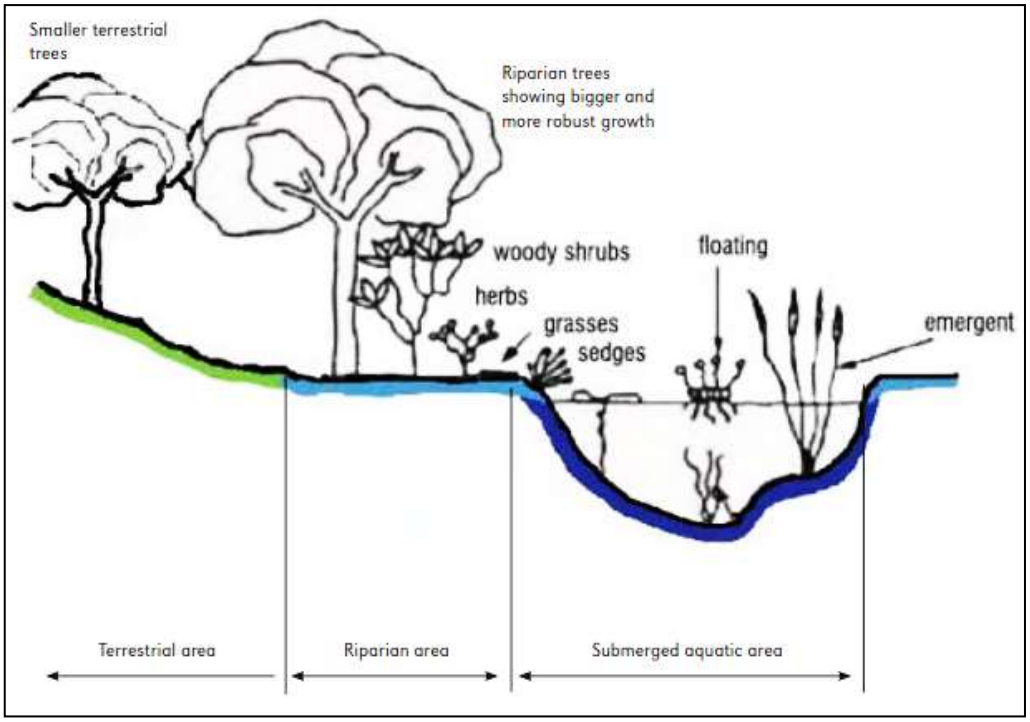


Figure 4-1: Riparian Habitat Delineations (DWAF, 2005)

4.2.4 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour et al. 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

4.2.4.1 South African Scoring System

The South African Scoring System version 5 (SASS5) was the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion et al. 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) (Figure 4-2) for the Karoo (Great Karoo) ecoregion (upper and lower). This method seeks to develop biological bands depicting the various ecological states and is derived

from data contained within the Rivers Database and supplemented with other data not yet in the database.

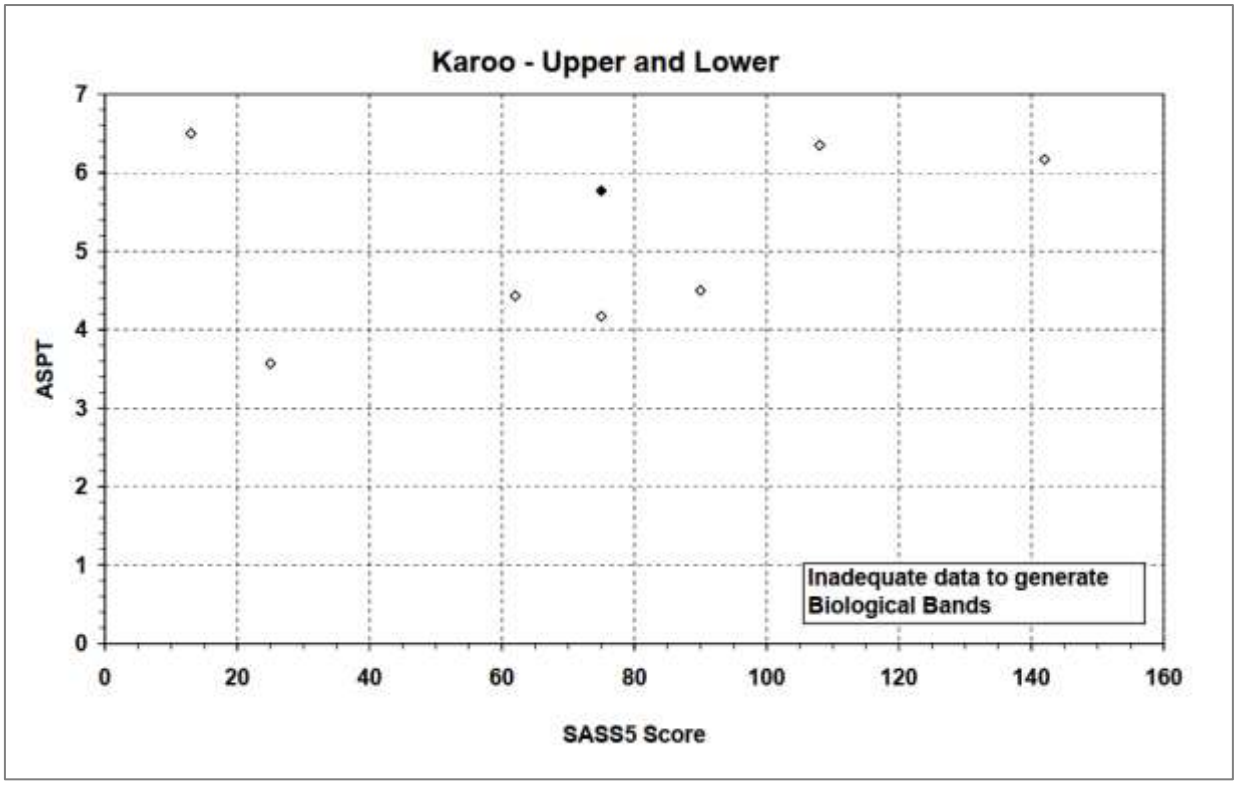


Figure 4-2: Guidelines used for the interpretation and classification of the SASS5 scores (Dallas, 2007)

4.2.4.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) was used to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the SQR. This does not preclude the calculation of SASS5 scores if required (Thirion, 2007). The four major components of a stream system that determine productivity for aquatic macroinvertebrates are as follows:

- Flow regime;
- Physical habitat structure;
- Water quality; and
- Energy inputs from the watershed riparian vegetation.

The results of the MIRAI will provide an indication of the current ecological category and therefore assist in the determination of the PES.

4.2.5 Present Ecological Status

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007). For the purpose of this assessment ecological classifications have been determined for biophysical attributes for the associated

water course. This was completed using the river ecoclassification manual by Kleynhans and Louw (2007).

4.3 Terrestrial Site Ecological Importance

The different habitat types within the assessment area were delineated and identified based on observations during the field assessment as well as available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes.

Site Ecological Importance (SEI) is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and Receptor Resilience (RR) (its resilience to impacts) as follows.

BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows. The criteria for the CI and FI ratings are provided in Table 4-3 and Table 4-4, respectively.

Table 4-3: Summary of Conservation Importance (CI) criteria

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare or Critically Rare species that have a global EOO of < 10 km^2. Any area of natural habitat of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent) of natural habitat of an EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population).
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population).
Medium	Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.
Low	No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC.
Very Low	No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.

Table 4-4: Summary of Functional Integrity (FI) criteria

Functional Integrity	Fulfilling Criteria
Very High	Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts with no signs of major past disturbance.
High	Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.

Medium	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.
Very Low	Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.

BI can be derived from a simple matrix of CI and FI as provided in Table 4-5

Table 4-5: Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)

Biodiversity Importance (BI)		**Conservation Importance (CI)**				
		Very high	**High**	**Medium**	**Low**	**Very low**
Functional Integrity (FI)	**Very high**	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor as summarised in Table 4-6.

Table 4-6: Summary of Resource Resilience (RR) criteria

Resilience	**Fulfilling Criteria**
Very High	Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed.
High	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.

Subsequent to the determination of the BI and RR, the SEI can be ascertained using the matrix as provided in Table 4-7.

Table 4-7: Matrix used to derive Site Ecological Importance (SEI) from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance (SEI)		Biodiversity Importance (BI)				
		Very high	High	Medium	Low	Very low
Receptor Resilience (RR)	Very Low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very High	Medium	Low	Very low	Very low	Very low

Interpretation of the SEI in the context of the proposed development activities is provided in Table 4-8.

Table 4-8: Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities

Site Ecological Importance (SEI)	Interpretation in relation to proposed development activities
Very High	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

The SEI evaluated for each taxon can be combined into a single multi-taxon evaluation of SEI for the assessment area. Either a combination of the maximum SEI for each receptor should be applied, or the SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. For the latter, justification of the SEI for each receptor is based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa.

4.4 Limitations

The following limitations should be noted for the assessment:

- A single season survey was conducted for the for the study area, which would constitute a dry season survey in very dry conditions. A recommendation has been provided to undertake a site walkover prior to clearing / preparation of the area to prevent damage or loss of protected species;
- This report presents the results for the grid connection, referred to as the development area;
- The general condition of the vegetation was heavily impacted by grazing and low rainfall in the current dry season;
- This assessment has not assessed any temporal trends for the project; and

- Whilst every effort is made to assess as much of the study area, this is not always possible. Therefore information was extrapolated from nearby sites and Google Earth imagery to address this limitation. A review of available datasets and literature was also undertaken.

5 Receiving Environment

5.1 Desktop Spatial Assessment

The following features describes the general area and habitat, this assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and SANBI. The desktop analysis and their relevance to this project are listed in Table 5-1.

Table 5-1: Desktop spatial features examined.

Desktop Information Considered	Relevant/Not relevant
Terrestrial Conservation Plan	The Grid Connection site overlaps with areas classified as: • CBA1; • ESA1; and • ONA.
Ecosystem Threat Status	The study area is situated within an ecosystem that are listed as LC
Ecosystem Protection Level	The study area is rated as *Poorly Protected*.
Protected Areas (SAPAD & SACAD)	The study area is in proximity to the Steenbokkie Private Nature Reserve and 6 km from the Karoo National Park
Important Bird and Biodiversity Areas	The study area lies near the Karoo National Park IBA
National Protected Areas Expansion Strategies (NPAES)	The study area is close to an area of the Upper Karoo NPAES
NBA wetlands and Rivers	Ecosystem threat status of wetlands in the proximity of the study area is classed as LC, while the protection level of these systems is classed as *Poorly Protected*. The threat status of the rivers close to the study area is classed as LT while the protection level is classed as *Poorly Protected*
Conservation Plan Aquatic	The study area overlaps with the following Aquatic features: • Farm Dam; • Drainage lines; • Hansrivier River; • Gamka River; and • Platdoring drainage plain
Ecosystem Threat Status	The study area is situated within an ecosystem that are listed as Least Threatened
Ecosystem Protection Level	The aquatic ecosystems associated with the study area (Gamka and Platdoring) are rated as poorly protected
NFEPA Rivers and Wetlands	Catchments assigned as an upstream management area
Strategic Water Source Areas (SWSA)	Irrelevant: The closest SWSA classified area is the Swartberg
SQR	Found in quaternary reach J21A and L11F
Succulent Karoo Ecosystem Programme (SKEP)	The study area overlaps with areas of SKEP mammal endemism and is close to areas of SKEP reptile endemism

5.1.1 Western Cape Biodiversity Spatial Plan

The Western Cape Biodiversity Spatial Plan (WCBSP) was updated in 2017. It classifies areas into Critical Biodiversity Area (CBA1), CBA2, Ecological Support Area (ESA1), ESA2, Other Natural Areas (ONA) and Protected Areas (PA). Figure 5-1 shows the various categories and what their main features are. Figure 5-2 shows that the development area overlaps with areas classified as:

- CBA1;

- ESA1; and
- ONA.

The development area is located directly adjacent to the Steenbokkie Private Nature Reserve.

MAP CATEGORY	DEFINITION	DESIRED MANAGEMENT OBJECTIVE	SUB-CATEGORY
Protected Area	Areas that are proclaimed as protected areas under national or provincial legislation.	Must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity. A benchmark for biodiversity.	n/a
Critical Biodiversity Area 1	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.	CBA: River CBA: Estuary CBA: Wetland CBA: Forest CBA: Terrestrial
Critical Biodiversity Area 2	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a functional, natural or near-natural state, with no further loss of natural habitat. These areas should be rehabilitated.	CBA: Degraded
Ecological Support Area 1	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Maintain in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.	ESA: Foredune ESA: Forest ESA: Climate Adaptation Corridor ESA: Coastal Resource Protection ESA: Endangered Ecosystem ESA: River ESA: Estuary ESA: Wetland ESA: Watercourse Protection ESA: Water Source Protection ESA: Water Recharge Protection
Ecological Support Area 2	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Restore and/or manage to minimise impact on ecological infrastructure functioning, especially soil and water-related services.	ESA: Restore from NN
ONA: Natural to Near-Natural	Areas that have not been identified as a priority in the current systematic biodiversity plan, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	Minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. Offers flexibility in permissible land uses, but some authorisation may still be required for high-impact land uses.	ONA: Natural to Near-Natural ONA: Degraded
No Natural Remaining	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructure functions, even if they are never prioritised for conservation action.	Manage in a biodiversity-sensitive manner, aiming to maximise ecological functionality. Offers the most flexibility regarding potential land uses, but some authorisation may still be required for high-impact land uses.	No Natural Remaining

Figure 5-1: Western Cape Biodiversity Spatial Plan categories (WCBSP, 2017)

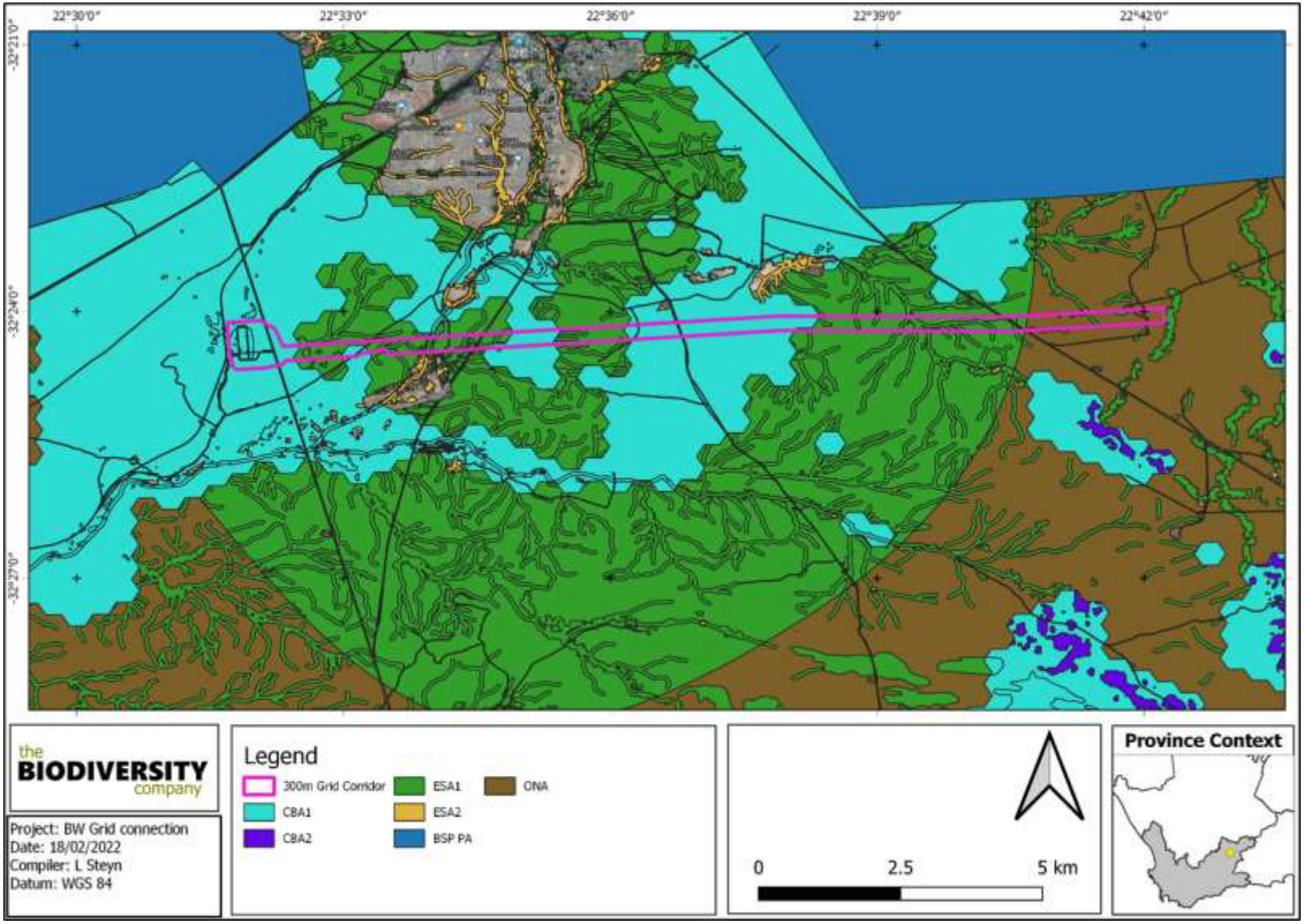


Figure 5-2: The study area superimposed on the Western Cape Biodiversity Spatial Plan (WCBCP, 2017)

5.2 Ecological Desktop Assessment

5.2.1 Vegetation Assessment

The study area is situated within two biomes: Azonal Vegetation and Nama Karoo Biome and (SANBI, 2018). The Azonal vegetation is formed in and around flowing and stagnant freshwater bodies. Habitats with high levels of salt concentration form a highly stressed environment for most plants and often markedly affect the composition of plant communities. Invariably, both waterlogged and salt-laden habitats appear as 'special', deviating strongly from the typical surrounding zonal vegetation. They are of azonal character.

The Nama Karoo Biome is found in the central plateau of the western half of South Africa. The geology underlying the biome is varied, as the distribution of this biome is determined primarily by rainfall. The rain falls in summer and varies between 100 and 520mm per year. This also determines the predominant soil type - over 80% of the area is covered by a lime-rich, weakly developed soil over rock. Although less than 5% of rain reaches the rivers, the high erodibility of soils poses a major problem where overgrazing occurs (SANBI, 2019).

The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Grazing rapidly increases the relative abundance of shrubs. Most of the grasses are of the C4 type and, like the shrubs, are deciduous in response to rainfall events (SANBI, 2019).

5.2.1.1 Vegetation Types

The study area including the development are both situated in the Gamka Karoo and the Southern Karoo Riviere vegetation types according to SANBI (2018) (Figure 5-4).

5.2.1.1.1 Gamka Karoo

Gamka Karoo vegetation type is found in the Western Cape, Eastern Cape and marginally in the Northern Cape. This vegetation type occurs on extremely irregular to slightly undulating plains covered with dwarf spiny shrubland dominated by Karoo dwarf shrubs (e.g. *Chrysocoma ciliata, Eriocephalus ericoides*) with rare low trees (e.g. *Euclea undulata*). It occurs at an altitude of 500-1100m.

Important Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are important in the Gamka Karoo (d=dominant):

Tall Shrubs: *Lycium cinereum* (d), *L. oxycarpum* (d), *Rhigozum obovatum* (d), *Acacia karroo*, *Cadaba aphylla*, *Lycium schizocalyx*, *Rhus burchellii*, *Sisyndite spartea*.

Low Shrubs: *Chrysocoma ciliata* (d), *Eriocephalus ericoides* subsp. *ericoides* (d), *E. spinescens* (d), *Felicia muricata* (d), *Galenia fruticosa* (d), *Limeum aethiopicum* (d), *Pentzia incana* (d), *Pteronia adenocarpa* (d), *Rosenia humilis* (d), *Aptosimum indivisum*, *Asparagus burchellii*, *Blepharis mitrata*, *Eriocephalus microphyllus* var. *pubescens*, *Felicia filifolia* subsp. *filifolia*, *F. muricata* subsp. *cinerascens*, *Galenia secunda*, *Garuleum bipinnatum*, *G. latifolium*, *Gomphocarpus filiformis*, *Helichrysum lucilioides*, *Hermannia desertorum*, *H. grandiflora*, *H. spinosa*, *Melolobium candicans*, *Microloma armatum*, *Monechma spartioides*, *Pentzia*

pinnatisecta, *Plinthus karooicus*, *Polygala seminuda*, *Pteronia glauca*, *P. sordida*, *P. viscosa*, *Selago geniculata*, *Sericocoma avolans*, *Zygophyllum microcarpum*, *Z. microphyllum*.

Succulent Shrubs: *Ruschia intricata* (d), *Aridaria noctiflora* subsp. *straminea*, *Crassula muscosa*, *Drosanthemum lique*, *Galenia sarcophylla*, *Kleinia longiflora*, *Ruschia spinosa*, *Gamka tuberculata*, *Sarcocaulon patersonii*, *Trichodiadema barbatum*, *Tripteris sinuata* var. *linearis*.

Semi parasitic Shrub: *Thesium lineatum*.

Herbs: *Gazania lichtensteinii* (d)*, Chamaesyce inaequilatera*, *Dicoma capensis*, *Galenia glandulifera*, *Lepidium africanum* subsp. *africanum*, *L. desertorum*, *Lessertia pauciflora* var. *pauciflora*, *Leysera tenella*, *Osteospermum microphyllum*, *Sesamum capense*, *Tetragonia microptera*, *Tribulus terrestris*, *Ursinia nana*.

Geophytic Herbs: *Drimia intricata*, *Moraea polystachya*.

Graminoids: *Aristida congesta* (d), *A. diffusa* (d), *Fingerhuthia africana* (d), *Stipagrostis ciliata* (d), *S. obtusa* (d), *Aristida adscensionis*, *Cenchrus ciliaris*, *Digitaria argyrograpta*, *Enneapogon desvauxii*, *Enneapogon scaber*, *Eragrostis homomalla*, *E. lehmanniana*, *E. obtusa*, *Tragus berteronianus*, *T. koelerioides*.

Biogeographically Important Taxa (*Endemic to Great Karoo Basin)

Succulent Shrubs: *Hereroa latipetala** (also found in Prince Albert Succulent Karoo), *H. odorata** (also found in Koedoesberge-Moordenaars Karoo), *Pleiospilos compactus* (southern and western limits of distribution), *Rhinephyllum luteum**, *Stapelia engleriana**.

Geophytic Herb: *Tritonia tugwelliae**.

Low Shrub: *Felicia lasiocarpa**.

Succulent Herbs: *Piaranthus comptus*, Tridentea parvipuncta* subsp. *parvipuncta**.

Graminoid: *Oropetium capense* (westernmost limit of distribution).

Endemic Taxa

Succulent Shrubs: *Chasmatophyllum stanleyi*, *Hereroa incurva*, *Gamka dregei, Ruschia beaufortensis*.

Low Shrubs: *Jamesbrittenia tenuifolia*.

Herb: *Manulea karrooica*.

Succulent Herb: *Piaranthus comptus*.

Conservation Status

According to Mucina & Rutherford (2006), this vegetation type is classified as Least Threatened. The national target for conservation protection for both these vegetation types is 16%, with about 2% statutorily conserved in the Karoo National Park and some in private reserves, such as Steenbokkie Private Nature Reserve.

5.2.1.1.2 Southern Karoo Riviere

The Southern Karoo Riviere vegetation type is found in the Western and Eastern Cape Provinces. This vegetation type occurs along narrow riverine flats supporting a complex of *Vachellia karroo* or *Tamarix usneoides* thickets (up to 5 m tall), and fringed by tall *Gamka*-dominated shrubland (up to 1.5 m high), especially on heavier (and salt-laden) soils on very broad alluvia. (Mucina & Rutherford, 2006).

Important Plant Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are important in the Southern Karoo Riviere (d=dominant):

Riparian thickets

Small Trees: *Vachellia (d), Searsia lancea (d).*

Tall Shrubs: *Diospyros lycioides (d), Tamarix usneoides (d), Cadaba aphylla, Euclea undulata, Grewia robusta, Gymnosporia buxifolia, Melianthus comosus.*

Low Shrub: *Asparagus striatus.*

Succulent Shrubs: *Lycium cinereum (d), Amphiglossa callunoides, Lycium hirsutum, L. oxycarpum.*

Rocky slopes of river canals

Graminoid: *Stipagrostis namaquensis (d).*

Alluvial shrublands & herblands

Low Shrubs: *Ballota africana, Bassia salsoloides, Carissa haematocarpa, Pentzia incana.*

Succulent Shrubs: *Malephora uitenhagensis (d), Gamka aphylla (d), S. arborea (d), Drosanthemum lique, Gamka geminiflora, S. gemmifera.*

Graminoids: *Cynodon incompletus (d), Cenchrus ciliaris, Cyperus marginatus.*

Reed beds

Megagraminoid: Phragmites australis (d).

Endemic Taxon

Alluvial shrublands & herblands

Graminoid: *Isolepis expallescens.*

Conservation Status of the Vegetation Type

The Southern Karoo Riviere vegetation type is classified as Least Threatened. The national target for conservation protection for this vegetation types is 24%, but only Only about 1.5% statutorily conserved in the Karoo National Park as well as in the Aberdeen, Bosberg, Commando Drift, Gamkapoort and Karoo Nature Reserves and in about 10 private reserves, mainly set up for game farming.

5.2.1.2 Plant Species of Conservation Concern

Based on the Plants of Southern Africa (BODATSA-POSA, 2019) database, 602 plant species have the potential to occur in the study area and its surroundings (Figure 5-3 and Table 5-2). Of these 602 plant species (Appendix B), 3 species is listed as being Species of Conservation Concern (SCC) (Table 5-2).

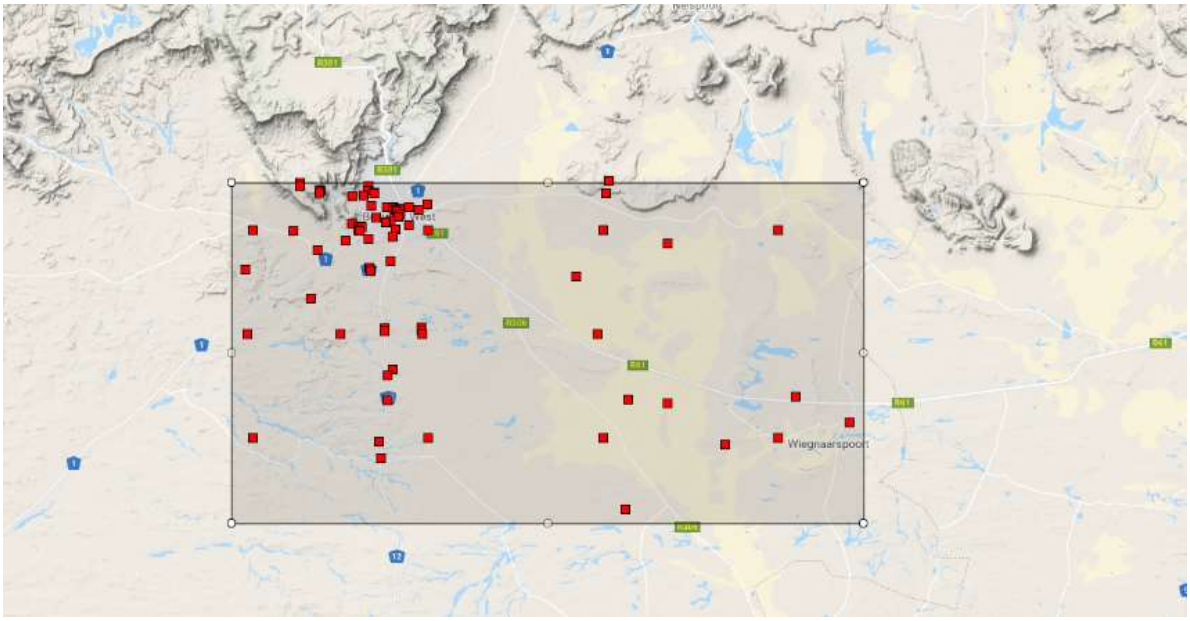


Figure 5-3: Map showing the grid drawn to compile an expected plant species list (BODATSA-POSA, 2021)

Table 5-2: Plant Species of Conservation Concern with the potential to occur in the study area

Family	Taxon	Author	IUCN	Ecology	Likelihood of occurrence
Aizoaceae	*Drosanthemum calycinum*	(Haw.) Schwantes	NT	Indigenous; Endemic	Moderate
Bruniaceae	*Audouinia esterhuyseniae*	(Powrie) A.V.Hall	VU	Indigenous; Endemic	Moderate
Rosaceae	*Cliffortia arborea*	Marloth	VU	Indigenous; Endemic	Moderate

Drosanthemum calycinum is a South African endemic found in the Western Cape. Its range stretches from Clanwilliam to Koeberg and Riversdale. This NT species occurs in lowland shales in the fynbos (Klak & Raimondo, 2006).

Audouinia esterhuyseniae occurs in shale soil on south facing slopes below sandstone cliffs. It's a South African endemic that is threatened by pine plantations (Raimondo & Turner, 2007).

Cliffortia arborea is found in the Northern and Western Cape, where this endemic species can be found on cliffs and ledges of dolerite, sandstone and shale. This species is threatened by cutting for firewood as well as by too frequent fires (Whitehouse & Raimondo, 2019).

The National Web based Environmental Screening Tool indicated four medium sensitive species for the study area (Table 5-3), none of which were recorded during the field assessment.

Table 5-3: National Screening Tool sensitive species

Sensitivity rating	Species Name
Medium	*Ruschia beaufortensis*
Medium	Sensitive species 383
Medium	*Peersia frithii*
Medium	Sensitive species 1212

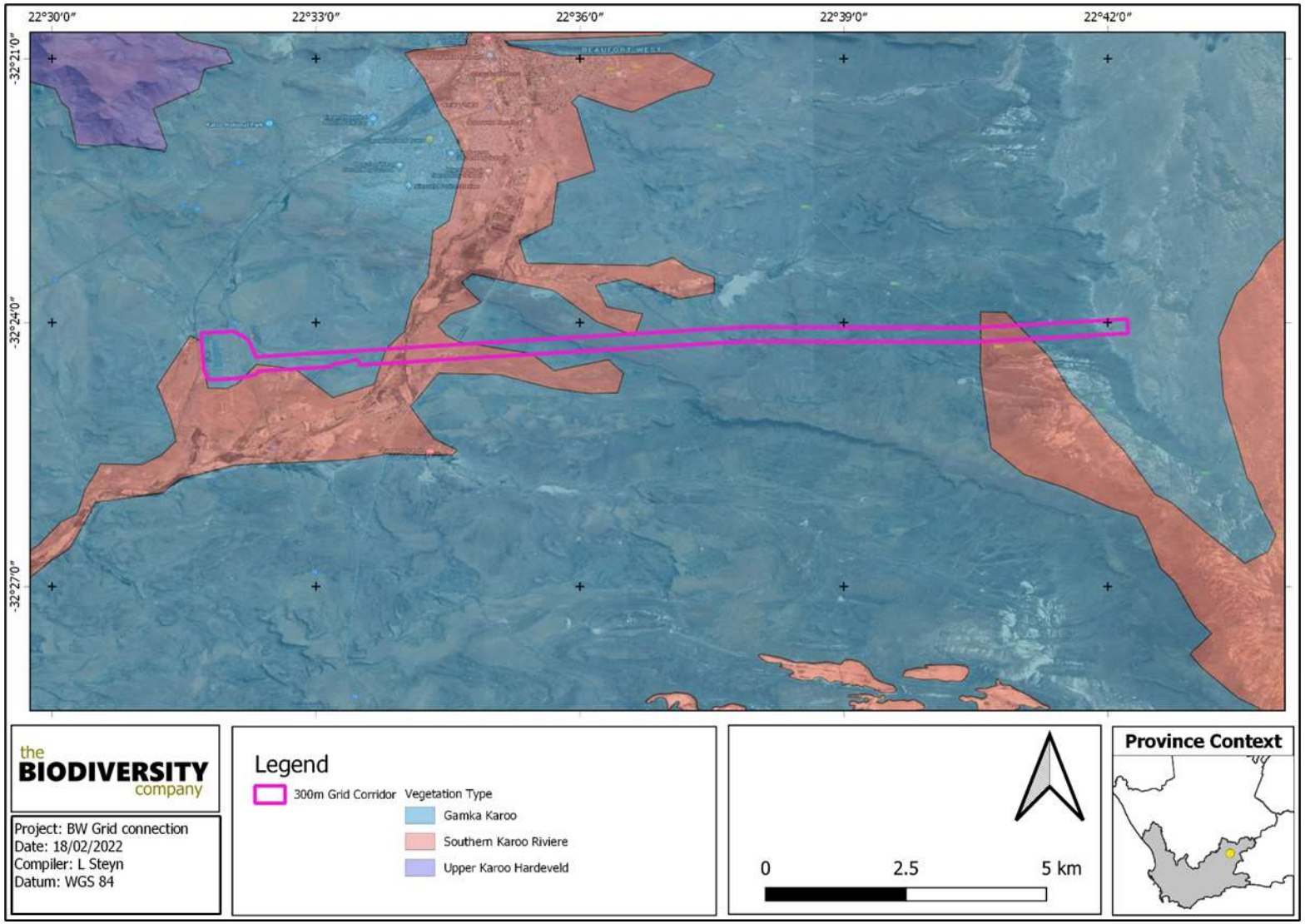


Figure 5-4: The study area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2018)

5.2.2 Faunal Assessment

5.2.2.1 Mammals

The IUCN Red List Spatial Data (IUCN, 2017) lists 59 mammal species that could be expected to occur within the study area and surrounds. Species generally restricted to protected areas such as game reserves were not expected to occur in the study area and were removed from the list (Appendix C).

Of the 59 mammal species, ten (10) are listed as being of conservation concern on a regional or global basis (Table 5-4). Two of the species are expected to have a low likelihood of occurrence due to a lack of suitable habitat and the proximity to urban areas and pressures.

Table 5-4: List of mammal Species of Conservation Concern that may occur in the study area as well as their global and regional conservation statuses.

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Aonyx capensis	Cape Clawless Otter	NT	NT	Moderate
Bunolagus monticularis	Riverine Rabbit	CR	CR	Moderate
Felis nigripes	Black-footed Cat	VU	VU	Moderate
Graphiurus ocularis	Spectacular Dormouse	NT	LC	Moderate
Leptailurus serval	Serval	NT	LC	Low
Panthera pardus	Leopard	VU	VU	Low
Parahyaena brunnea	Brown Hyaena	NT	NT	Moderate
Parotomys littledalei	Littledale's Whistling Rat	NT	LC	High
Pelea capreolus	Grey Rhebok	NT	NT	Low
Poecilogale albinucha	African Striped Weasel	NT	LC	High

Aonyx capensis (Cape Clawless Otter) is the most widely distributed otter species in Africa (IUCN, 2017). This species is predominantly aquatic, and it is seldom found far from water. Based on the adsence of perennial streams and rivers in study area, the likelihood of occurrence of this species occurring in the study area is low.

Bunolagus monticularis is CR both regionally and internationally. This species is endemic to semi-arid central Karoo regions of South Africa, where they inhabit dense riparian growth along seasonal rivers. It should be noted that distribution maps are based on broad habitat types, whereas subpopulations in the northern part of the distribution are always associated with alluvial floodplains and narrow belts of riverine vegetation adjacent to seasonal rivers on a scale that is unlikely to fit within these broader habitat types (Collins et.al. 2016). Based on suitable habitat (predominantly) within the grid connection area, combined with their known presence in the Karoo National Park, a moderate likelihood of occurrence was allocated to it. Threats from ongoing habitat degradation and fragmentation due to detrimental land-use practices and habitat transformation, including energy development has led to their decline. Specific threats to the river ecosystems include overgrazing and anthropogenic land and river transformation, which leads to the degradation and fragmentation of Riverine Rabbit habitat.

The field assessment of the site indicated that there is minimal suitable habitat for the Riverine Rabbit present within the site as the only drainage lines located within Bulskop Grid

development footprint are along with main access road, which are gravelly in nature with limited hydrophytic vegetation or silty banks that provide habitat for this species. The EWT Riverine Rabbit records database indicates that there have not been any historical sightings from the site or immediate surrounds. As such, the site is considered low suitability for this species and an impact on this species is not expected to occur within the site development footprint.

Felis nigripes (Black-footed cat) is endemic to the arid regions of southern Africa. This species is naturally rare, has cryptic colouring is small in size and is nocturnal. These factors have contributed to a lack of information on this species. Given that the highest densities of this species have been recorded in the more arid Karoo region of South Africa, the habitat in the study area can be regarded as suitable for the species and the likelihood of occurrence is rated as high.

Graphiurus ocularis (Spectacular Dormouse) is categorised as NT on a regional scale. This species is endemic to South Africa, where it occurs widely in Northern Cape, Eastern Cape, and Western Cape provinces, with a single record from the North-West province. The species is associated with the sandstone formations of the Cape, which have many vertical and horizontal cracks and crevices in which to shelter and nest. The likelihood of occurrence within the study area is rated as moderate as some smaller sections of suitable habitat can be found.

Leptailurus serval (Serval) occurs widely through sub-Saharan Africa and is commonly recorded from most major national parks and reserves (IUCN, 2017). The Serval's status outside reserves is not certain, but they are inconspicuous and may be common in suitable habitat as they are tolerant of farming practices provided there is cover and food available. In sub-Saharan Africa, they are found in habitat with well-watered savanna long-grass environments and are particularly associated with reedbeds and other riparian vegetation types. Suitable habitat, along with sufficient food sources can be found parts of the study area, but not the development area, therefore the likelihood of occurrence is rated as low.

Parahyaena brunnea (Brown Hyaena) is endemic to southern Africa. This species occurs in dry areas, generally with annual rainfall less than 100 mm, particularly along the coast, semi-desert, open scrub and open woodland savanna. Given its known ability to persist outside of formally protected areas the likelihood of occurrence of this species in the study area is moderate to good. The presence of moderate to large herbivores on adjacent properties increases the likelihood of occurrence of this species.

Parotomys littledalei (Littledale's Whistling Rat) is listed as NT on a regional scale. This diurnal species occurs in shrubland and is dependent on ground cover. Littledale's Whistling Rat is herbivorous only, feeding on fresh plant material, including annuals, succulent perennials, non-succulent perennials, and grasses. The presence of ground cover increases their likelihood of occurrence in the study area.

Poecilogale albinucha (African Striped Weasel) is usually associated with savanna habitats, although it probably has a wider habitat tolerance (IUCN, 2017). Due to its secretive nature, it is often overlooked in many areas where it does occur. There is sufficient habitat for this species in the study area and the likelihood of occurrence of this species is therefore considered to be high.

5.2.2.2 Herpetofauna (Reptiles & Amphibians)

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2019) 61 reptile species have the potential to occur in the study area (Appendix D). One of the expected species is a SCCs (IUCN, 2017).

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the Animal Demography Unit (ADU, 2020) 13 amphibian species have the potential to occur in the study area (Appendix F). No amphibian SCCs are expected to occur in the study area.

Table 5-5: Reptile SCC expected in the study area

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Psammobates tentorius verroxii	Tent Tortoise	NT	NT	Confirmed

Psammobates tentorius veroxii (Tent Tortoise) is categorised as NT both locally and internationally. This species can be found in low densities in the Karoo and semi-desert areas of South Africa and Namibia. It is threatened because of the pet trade and destruction of its habitat. This species was confirmed in the development area, which can be attributed to the presence of mesembryanthemums plant, which is suitable food sources for this species.

6 Field Survey

6.1 Terrestrial Assessment

The field survey for flora and fauna (mammals, amphibians and reptiles) was conducted during the week of 6th to 9th of September 2021. During the survey the assessment of floral and faunal communities was conducted throughout the extent the study area, including the extent of the grid connection development area. The area was ground-truthed on foot, which included spot checks and meanders in pre-selected areas to validate desktop data. Photographs were recorded during the site visits, and some are provided under the results section in this report. All site photographs are available on request.

6.1.1 Land Use and Disturbance

The main impact to the vegetation and habitat types within and surrounding the development area is grazing. According to Jan Vlok, Richard Dean and Sue Milton many areas in the Karoo still have a high vegetation cover, but that species composition has altered significantly due to overgrazing (Skowno et. al. 2009). It could be argued that these areas contribute little to the biodiversity of the region, and that many more habitat types are under threat (Skowno et. al. 2009).

Disturbances noted along the powerline route include poor farming practices, overgrazing and associated erosion problems, farm roads, rubbish dumping, disturbances (spoiling and earthworks) caused by road works, off-road vehicle activities (south of Beaufort West) and alien infestation (mainly along rivers). The existing powerlines also contribute to the impact on Karoo vegetation, through continuous maintenance activities.

Van der Merwe et al. (2008) noted that inadequate farming practices, due to lack of infrastructure such as fencing, pose a serious threat to the vegetation. Esler et al. (2006)

further added that “although damage can happen fast, recovery in the Karoo is very slow, as it depends mainly upon unpredictable rainfall events”.

Presently about 12% of the Karoo district’s ecosystems are transformed or degraded, with mining, agriculture and urbanization the main reasons of biodiversity loss (Skowno et. al. 2009). Recently, the prospects of uranium mining and shale gas exploration have also come under the spotlight.

6.1.2 Vegetation Assessment

A total of 65 tree, shrub and herbaceous plant species were recorded in the study area during the field assessment (Table 6-2). Plant species specific to the habitat types can be seen in Figure 6-2 to Figure 6-5.

The list of plant species recorded to date is by no means comprehensive, as limited data collection time and timing of the study proved to be limitations. This floristic analysis conducted to date is however regarded as a sound representation of the local flora for the study area under current conditions.

The vegetation can be broadly categorised into a) riverine bush dominated by thickets of Sweet Thorn *Vachellia karroo* b) dry and arid flats covered by *Aristida congesta* grass and Karoo shrubs. The study area traverses the following main vegetation types, both of which are classified as Least Threatened:

- Southern Karoo Riviere occurs on alluvial soils and is characterised by the presence of grasses and low, mostly thorny shrubs. On site, this azonal vegetation unit is embedded into the surrounding Grassland biome and is called Alluvial plains; and
- Gamka Karoo. This vegetation unit consists of sparsely vegetated, gently sloping plains dominated by microphyllus shrubs and grasses of the genera Aristida and Eragrostis.

Perennial and non-perennial streams and drainage lines with associated riparian vegetation occur extensively across the study area and are also important ecological corridors. The plains, bottomlands of riverine flats associated with the Southern Karoo Riviere, are bisected by an extensive network of predominantly dry drainage lines. These landscapes are also prone to extensive lateral surface flow during periodic rainfall events, the lateral flow of water along these drainage lines are of importance to maintain ecological connectivity.

Sensitive landscapes most notable where stream and rivers are present or where rocky outcrops are located will be affected by the powerline.

In the Southern Karoo Riviere the following prominent species were recorded, namely *Pentzia incana*, *Felicia muricata, Searsia lancea, S. burchellii, S. pyroides, Drosanthemum hispidum, D. lique, Delosperma multiflorum, Ruschia spinosa, Lycium pumilum, L. horridum and L. oxycarpum*. All these species are widespread and common. *Delosperma multiflorum* (recorded on the rocky areas) and *Searsia pyroides* are restricted to the drainage lines of study area. Alien species recorded include *Prosopis glandulosa*, *Atriplex nummularia, Opuntia elata* and *Cylindropuntia fulgida var. mamillata*.

Gamka Karoo is the main vegetation type found more prominently along the powerline corridor, with plant cover ranging between 15 and 35%. Tree and tall shrub species recorded

in Gamka Karoo include *Vachellia karroo, Searsia burchellii, S. lancea, S. longispina, Lycium hirsutum, L. oxycarpum, Grewia robusta, Diospyros lycioides* and *Gymnosporia buxifolia*.

Low shrub species and annuals recorded in Gamka Karoo include *Berkheya spinosa, Pentzia incana, Rosenia humilis, Geigeria filifolia, Asparagus striatus, A. retrofractus, Hermannia cuneifolia, Galenia glandulifera, Drosanthemum lique, Rhigozum obovatum, Barleria stimulans*, *Blepharis mitrata, Aptosimum indivisum, Monsonia camdeboense, Gomphocarpus filiformis, Hoodia gordonii, Aloe claviflora, Adromischus sphenophyllus, Crassula muscosa, Euphorbia mauritanica* and *Lacomucinaea lineata.*

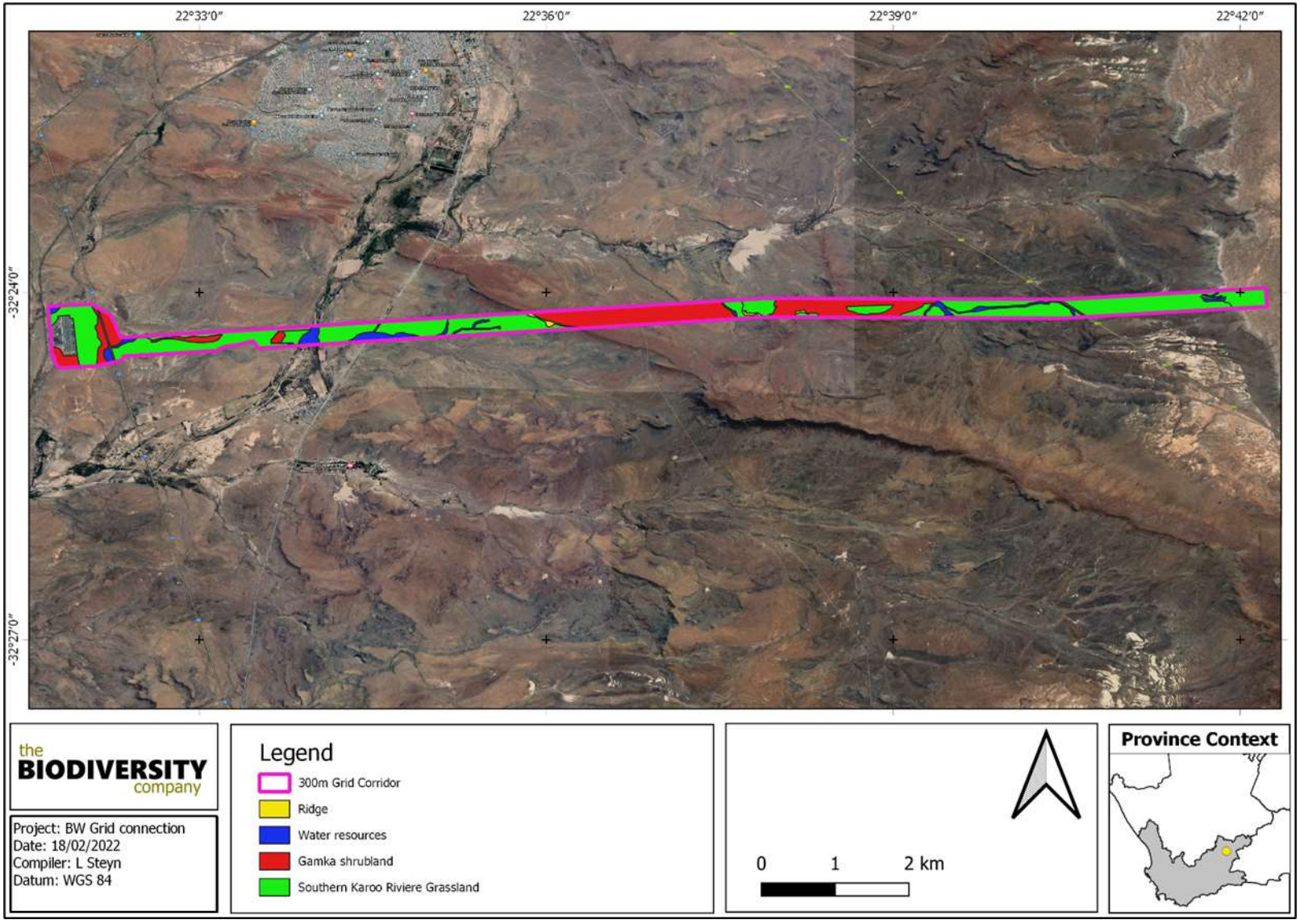


Figure 6-1: Grid connection devlopment area vegetation delineations and habitat types

6.1.2.1 Protected Plant Species

Field work revealed no red data protected plant species within the development area. The three expected red data species as listed above were not encountered. A total of 7 endemic and 17 threatened species were recorded Table 6-1.

Table 6-1: Threatened and endemic plant species

Species	Common Name	Threat Status (SANBI, 2017)
Aloe claviflora		LC
Ammocharis coranica	Ground Lily	LC
Anacampseros albidiflora		LC
Aptosimum procumbens	Karoo Violet	LC
Aridaria noctiflora subsp. Straminea		LC
Barleria stimulans		LC
Euphorbia stellispina		LC
Gonialoe variegata	Kanniedood Aloe	LC
Grewia robusta		LC
Hermannia cuneifolia		LC
Kleinia longiflora		LC
Lycium hirsutum		LC
Lycium horridum		LC
Lycium oxycarpum		LC
Monsonia camdeboense		LC
Tylecodon wallichii		LC
Zygophyllum microcarpum		LC

Table 6-2: Trees, shrubs and grasses recorded in the development area

Species	Common Name	Gowth Form	Threat Status (SANBI, 2017)	SA Endemic	Alien Category
Aloe claviflora			LC		
Ammocharis coranica	Ground Lily		LC		
Andromischus sphenophyllus	Pigs ear				
Anacampseros albidiflora			LC	Endemic	
Aptosimum procumbens	Karoo Violet		LC		
Argemone mexicana	Yellow-flowered Mexican poppy				Nemba Cat 1 B
Aridaria noctiflora subsp. Straminea			LC		
Aristida adscensionis		Grass			
Aristida congesta		Grass			
Aristida diffusa		Grass			
Aristida scabrivalvis	Purple Three Awn	Grass	Pioneer Increaser 2		
Asparagus burchellii	Wild Asparagus	Shrub		Endemic	
Asparagus striatus				Endemic	
Astroloba robusta					
Atriplex nummularia	Salt bush				Nemba Cat 2
Barleria stimulans			LC	Endemic	
Blepharis mitrata	Klapperbosisie				
Cadaba aphylla					
Carissa haematocarpa					
Cenchrus ciliaris		Grass			
Chloris virgata	Fathe top Chloris	Grass	Pioneer Increaser 2		
Cylindropuntia fulgida					Nemba Cat 1 B
Datura stramonium	Thorn Apple				Nemba Cat 1 B
Digitaria eriantha	Common finger Grass	Grass	Increaser 3 Climax		

Drosanthemum hispidum					
Drosanthemum lique				Endemic	
Enneopogon desvauxii	Eight day Grass	Grass	Pioneer Sub climax Increaser 2		
Eragrostis bicolor	Speckled Vlei Grass	Grass	Sub Climax Increaser 2		
Eragrostis lehmanniana		Grass			
Eragrostis obtusa	Dew Grass	Grass	Pioneer Sub-climax Increaser 2		
Euphorbia mauritanica	Geelmelkbos				
Euphorbia stellispina			LC	Endemic	
Europs subcarnosus subs vulgaris					
Gomphocarpus filiformis					Weed
Gonialoe variegata	Kanniedood Aloe		LC		
Grewia robusta		Tree	LC	Endemic	
Gymnosporia buxifolia					
Hermannia cuneifolia			LC		
Hermania spinosa	Steekbossie				
Hoodia gordonii	Ghaap		DDD		
Kleinia longiflora			LC		
Lycium hirsutum			LC		
Lycium horridum			LC		
Lycium oxycarpum			LC	Endemic	
Monsonia camdeboense			LC	Endemic	
Opuntia ficus-indica					Nemba Cat 1 B
Pegolettia retrofracta	Perdebos				
Phragmites australis					
Prosopis glandulosa	Mesquite				Nemba Cat 1 B
Rhigozum obovatum	Yellow Pomegranite				

Rosenia humilis					
Ruschia intricata	Doringvygie			Endemic	
Ruschia spinosa					
Salsola calluna	Swartganna			Endemic	
Salsola tuberculata				Endemic	
Sarcocaulon patersonii					
Schimdtia kalahariensis	Kalahari sour Grass	Grass	Pioneer Increaser 2		
Schimdtia pappharoides	Sand Quick	Grass	Sub Climax Climax Increaser 2		
Searsia burchellii	Karoo Kuni-bush				
Searsia lancea					
Stipagrostis ciliata		Grass			
Stipagrostis obtusa	Small Bushman Grass	Grass	Increaser 3 Climax		
Tylecodon wallichii			LC	Endemic	
Vachellia karroo		Tree			
Zygophyllum microcarpum			LC		

Figure 6-2: Some of the flora species recorded in the Drainage lines: A) Lycium horridum, B) Searsia lancea, C) Searsia burchellii, D) Hibiscus microcarpus, E) Vachellia karroo.

Figure 6-3: Some of the flora species recorded in the Rocky Outcrops/Ridges Vegetation Type: A) Euphorbia stellispina, B) Crassula muscosa C) Adromischus sphenophyllus, D) Anacampseros albidiflora.

Figure 6-4: Some of the flora species recorded in the Karoo Riviere Plain. A) Hermannia spinosa, B) Ballota africana C) Pegolettia retrofracta, D) Asparagus burchellii.

Figure 6-5: Some of the flora species recorded in the Gamka Shrublands Vegetation Type. A) Ruschia intricata, B) Gonialoe variegata C) Galenia africana, D Salsola calluna)

6.1.2.2 Alien and Invasive Plants

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition, and function of these systems. Therefore, it is important that these plants are controlled and eradicated by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species.

The National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. In August 2014, the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). The Alien and Invasive Species Regulations were published in the Government Gazette No. 37886, 1 August 2014, and was amended in September 2020 in the Government Gazette No. 43726. The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.

- Category 1b: Invasive species requiring compulsory control as part of an invasive species control program. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management program. No permits will be issued.

- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.

- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

Note that according to the regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- Notify the competent authority in writing

- Take steps to manage the listed invasive species in compliance with:

- Section 75 of the Act;
- The relevant invasive species management programme developed in terms of regulation 4; and
- Any directive issued in terms of section 73(3) of the Act.

Five (5) alien and/or invasive plants were recorded during the field survey within the development area. It is recommended that an Alien Plant Species Management Plan be implemented within the study area and as part of the EMPr to prevent the construction activities and movement exacerbating the infestation.

6.1.3 Faunal Assessment

The faunal assessment was completed based on the desktop review and infield biodiversity surveys which were conducted across the development area.

6.1.3.1 Mammals

Six (6) mammal species were recorded in the general study area during the survey; based on either direct observation, interviews with land owners or the presence of visual tracks & signs (Table 6-3 and Figure 6-6).

Table 6-3: Mammal species recorded in the study area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2020)
Otocyon megalotis	Bat-eared Fox	LC	LC
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Raphicerus campestris	Steenbuck	LC	LC
Antidorcas marsupialis	Springbuck	LC	LC
Sylvicapra grimmia	Duiker	LC	LC
Lepus capensis	Cape Hare	LC	LC

Figure 6-6: Mammal species recorded

6.1.3.2 Herpetofauna

The five reptile species recorded in the general study area during the surveys are listed in Table 6-4 and Figure 6-7. The Tent tortoise with a conservation status of Near Threatened, was recorded on site. No amphibian species were recorded. The only screening report sensitive reptile species was Boulenger's cape tortoise (*Chersobius boulengeri)* this species was not encountered.

Table 6-4: A list of herpetofauna recorded in the general study area

Species	Common Name	Conservation Status		
		CITES	Regional (SANBI, 2016)	IUCN (2017)
Reptiles				
Dipsina multimaculata	Dwarf Beaked Snake		LC	LC
Panaspis wahlbergi	Cape Girdled Lizard		LC	LC
Pedioplanis lineoocellata	Spotted Sand Lizard		LC	LC
Psammobates tentorius verroxii	Tent Tortoise		**NT**	**NT**
Stigmochelys pardalis	Leopard Tortoise	App II	LC	LC

Figure 6-7: The reptile species recorded in the general study area

6.1.3.3 Invertebrates

The Invertebrate species recorded in the study area during the surveys are listed below in Table 6-5 depicted below in Figure 6-8.

Table 6-5: Invertebrate species recorded

Species, Family	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
	Reptiles		
Argyraspodes argyraspis	-	LC	LC
Messor capensis	Harvester Ant	LC	LC
Gorgyrella spp.and Stasimopus spp.	Trapdoor Spider	LC	LC
Araneidae	Orb Web Spider	LC	LC

Figure 6-8: Clockwise from Top: Argyraspodes argyraspis, Trapdoor spider nest and door. Below left, Harvester Ant (Messor capensis), right, Orb Web Spider

6.2 Aquatic Assessment

6.2.1 Topographical Data

Topographical data (from the surveyor general) for the quaternary degree squared (QDS 3222) was reviewed for the identification of water resources (Figure 6-9). According to the National Water Act (NWA, 1998) a water resource can include a watercourse, surface water, estuary or aquifer. The topographical data does indicate the presence of water resources within the study area, with a portion of the grid corridor traversing the Gamka River and also drainage networks. The eastern area of the corridor extends into the dry Platdoring drainage plain.

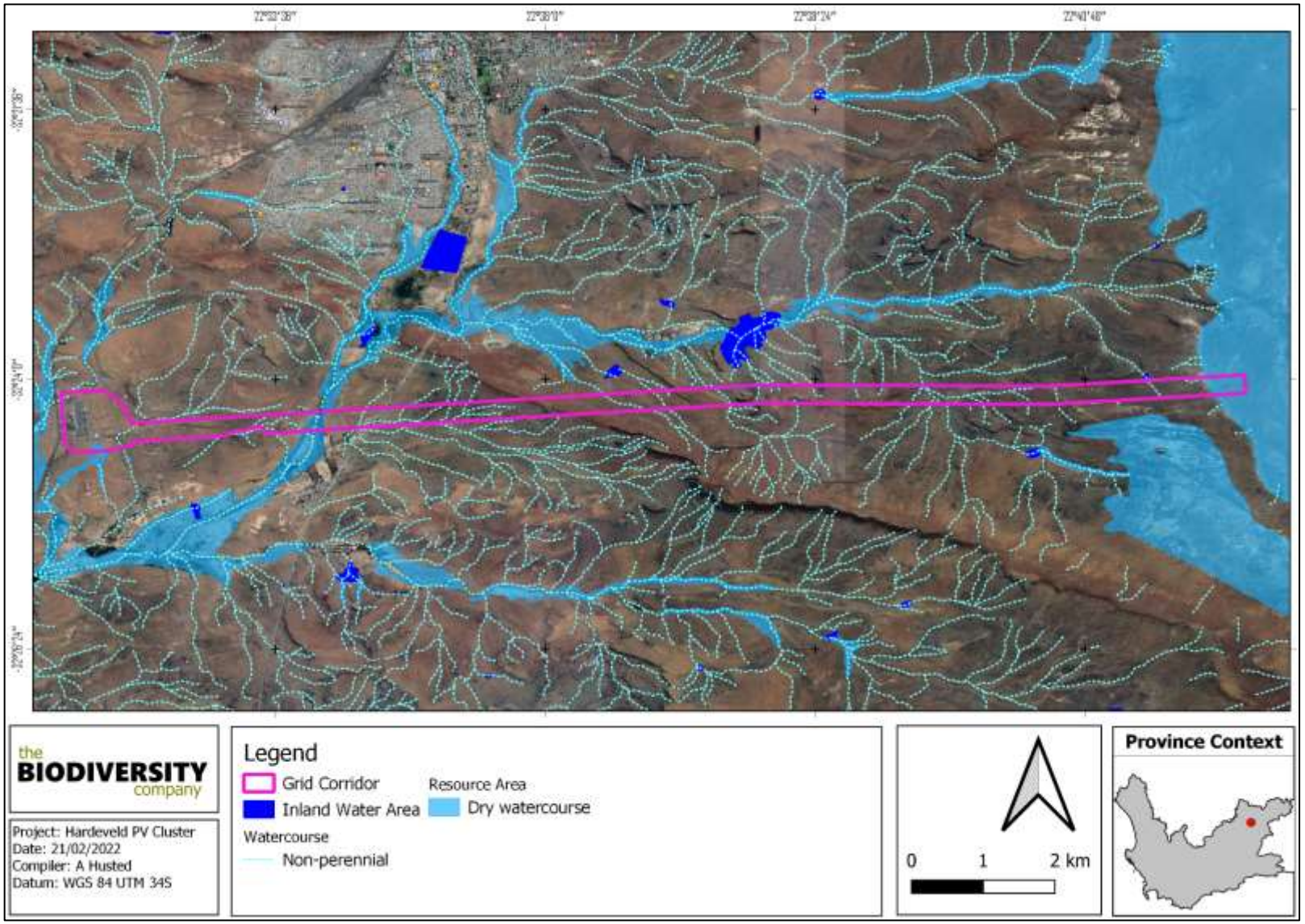


Figure 6-9: The inland water features and river lines / areas for QDS 3222

6.2.2 Ecosystem Protection Level

The Ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Skowno *et al*., 2019).

The study area was superimposed on the ecosystem protection level map to assess the protection status of aquatic ecosystems. Based on Figure 6-10 the aquatic ecosystems associated with the larger surrounding area are rated as *Poorly Protected*. This means that these ecosystems are considered not to be adequately protected in areas such as national parks or other formally protected areas. The Grid Connection traverses the Gamka River.

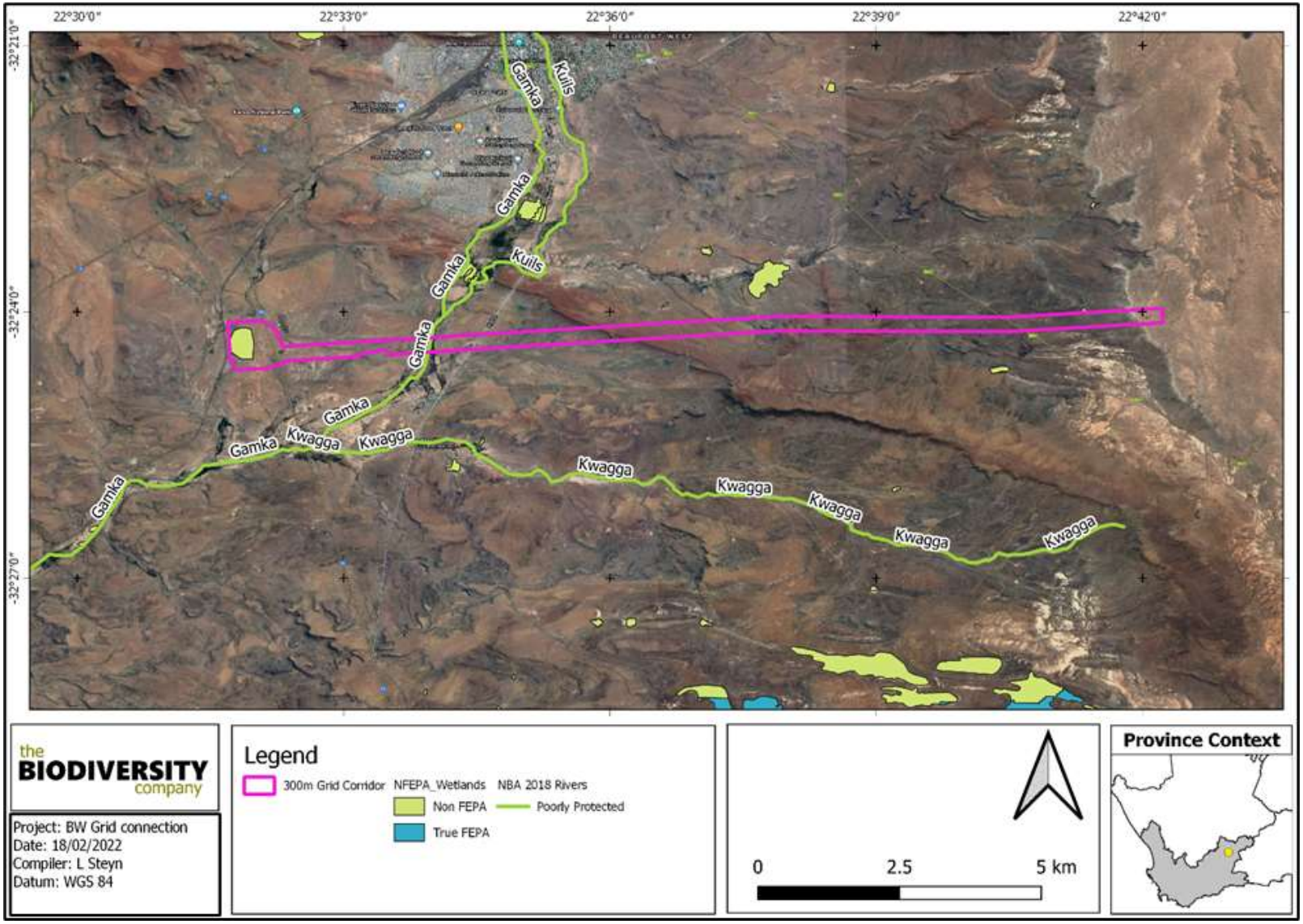


Figure 6-10: The protection status of rivers associated with the study area (PP - Poorly Protected)

6.2.3 Hydrological Setting

The study area is predomanatly located in the Breede-Gouritz Water Management Area (WMA8) (NWA, 2016), and the Great Karoo ecoregion. However, the eastern part of the study area drains into the Mzimvubu-Tsitsikamma WMA (WMA8). The greater study area is located across the J21A quaternary catchment, which drains numerous drainage lines including the Hansrivier River in a south westerly direction into the Gamka River, which eventuates into the Gouritz River. The development area is situated on a non-perennial plain within the Southern Karoo Riveire vegetation types, which drains in a northernly direction into the L11F Platdoring catchment.

The study area falls along the watershed between the two J21A and L11F catchments and the proposed powerline crosses numerous drainage lines which drain into the Hansrivier and Gamka River. Temperatures for the region range from average lows of 4°C during winter periods (April – October) and average highs of 29°C during the summer periods (October-March) (Figure 6-11). Rainfall patterns indicate a mean annual precipitation of 210 mm (weatherbase.com), with summer and winter rainfall periods and peak rainfall periods occurring between December and March (Figure 6-12). Rainfall averages indicate poor rainfall between June 2017 and October 2019.

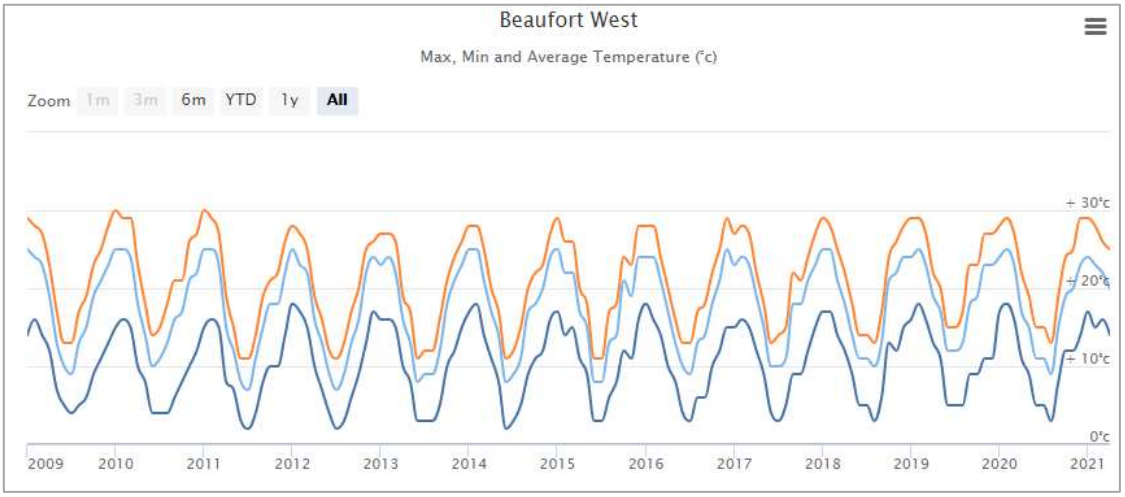


Figure 6-11: Illustration of historical average temperatures (obtained from Worldweather.com)

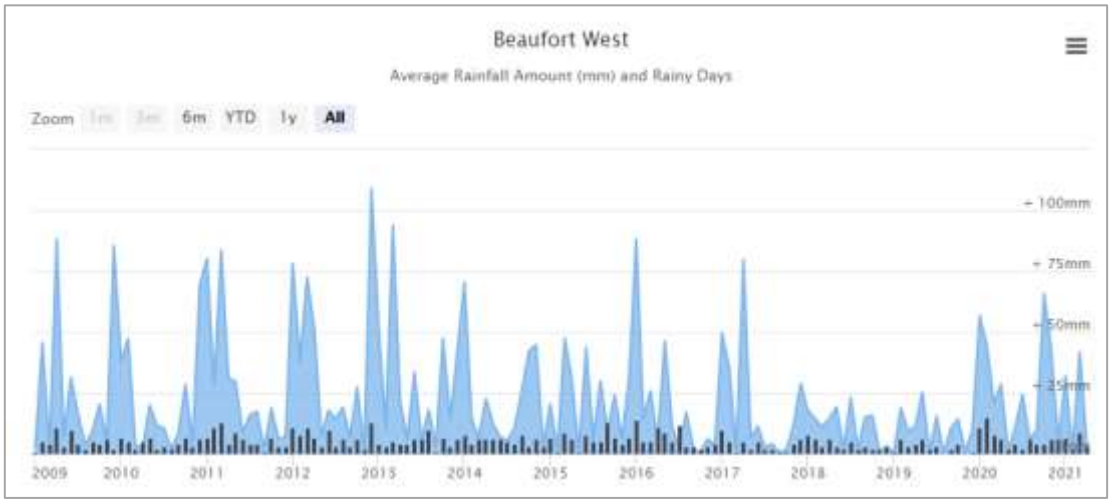


Figure 6-12: Illustration of average precipitation and rainy days (obtained from Worldweather.com)

The grid corridor and most of the Farm portion 423 RE falls within the J21A-7479 sub-quaternary reach (SQR), which is represented by a reach of the Gamka River (Table 6-7). According to desktop information (DWS, 2021), the Gamka River reach is rated as moderately modified (class C). Ecological importance is rated high, and ecological sensitivity as very high. Aquatic taxa within the reach are largely tolerant to arid conditions. The non-marginal consists of a densely vegetated mixed *Vachellia* forest and terrestrial shrubs (DWS, 2021). Minor modifications to instream and riparian habitat continuity occur within the reach, with some degree of flow and riparian zone modifications. Sensitivity of the stream size and riparian vegetation to water level and flow changes are rated as very high, with a highly intolerant vertebrate community sensitive to water levels changes.

Table 6-6: Desktop data pertaining to the ecological condition and classification of the Platdoring catchment (DWS, 2021)

Table 6-7: Desktop data pertaining to the ecological condition and classification of the Gamka catchment (DWS, 2021)

River	Gamka
SQR	J21A-7479
Present Ecological Status	Moderately modified (class C)
Ecological Importance	High
Ecological Sensitivity	Very high
Catchment impacts contributing to PES (DWS, 2021)	Impacts from several (some large) farm dams. The Pap, Springfontein and Walkers Dams are on contributing SQs. There is extensive irrigated cultivation, the town of Beaufort West and wastewater effluent in the SQ upstream of the site. Marginal predominantly phragmites. Non-marginal zone of Acacias, tamarisk and terrestrial shrubs. Impacts: Farm dams, irrigated cultivation, grazing, abstraction.
Ecological Importance Comments	Least disturbed braided river with well established marginal and non-marginal vegetation. The non-marginal consists of a densely vegetated mixed acacia forest and terrestrial shrubs. Marginal zone consists of obligate riparian *Juncus effusus*, *Ficinia indica* and *Phragmites australis*. Pooled water in multiple channels and very wide floodplain. Critical Biodiversity Area.
Ecological Sensitivity Comments	The river channels and drainage lines of this area provide key refuge, corridor and general habitat to a wide variety of mammals, reptiles and birds. These areas require at least some water to persist. The marginal contains *Juncus effusus*, *Ficinia indica*, *Phragmites australis*, *Cynodon dactylon*. Obligate riparian species dominate this zone. This SQ falls into the Gamka River and Floodplain Vegetation Unit (Vlok). The vegetation of the Gamka River and floodplain unit is most similar to the Touws River unit as it also has its main catchment in the Nama Karoo. There are not many freshwater streams feeding into this river and it thus naturally carried less fresh water. Periodic floods deposited deep silt beds from the Great Karoo in the floodplain, where Sweet Thorn trees (*Vachellia karoo*) and grasses such as *Cynodon dactylon* and *Stipagrostis namaquens*is are prominent amongst Ganna (*Salsola aphylla*). Some interesting annuals occur in the floodplain, such as *Manulea chysantha*, some of these annuals and other herbs are more typical of the Nama Karoo from which their seed is periodically washed during floods. It remains a mistery why they are not more abundant in the adjacent river systems. The main stream is currently badly infested with Nerium oleander and *Tamarix chinensis* and *Tamarix ramosissima* are also abundant in certain sites. *Tromotriche choanantha* is a rare succulent that occurs on the vertical cliffs where this river cuts through the Rooiberg.
Longitudinal Zonation	Upper foothills
River Flow type	Non-Perennial

6.2.4 National Freshwater Ecosystem Priority Areas

The watercourses considered in this assessment fall into a single river FEPA, as the Hansrivier and Gamka Rivers are designated as upstream management areas.

According to Nel *et al.* (2011), "*Upstream Management Areas, shown in very pale green, are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale".*

6.2.5 Sampling Points

The aquatic environments throughout the study area were considered as ephemeral with two sites assessed on the Gamka River (K1 and K2) presenting residual pools (Figure 6-13 and Table 6-8). K1 was sampled during the low flow period (April 2021) and K2 during the high flow September 2021. Water quality, instream biotope diversity and macroinvertebrate analyses were conducted at the site. Photographs at representative drainage lines and crossing points within the powerline footprint were taken to characterise habitat. Site photos and Global Positioning System (GPS) coordinates are presented in Table 6-8.

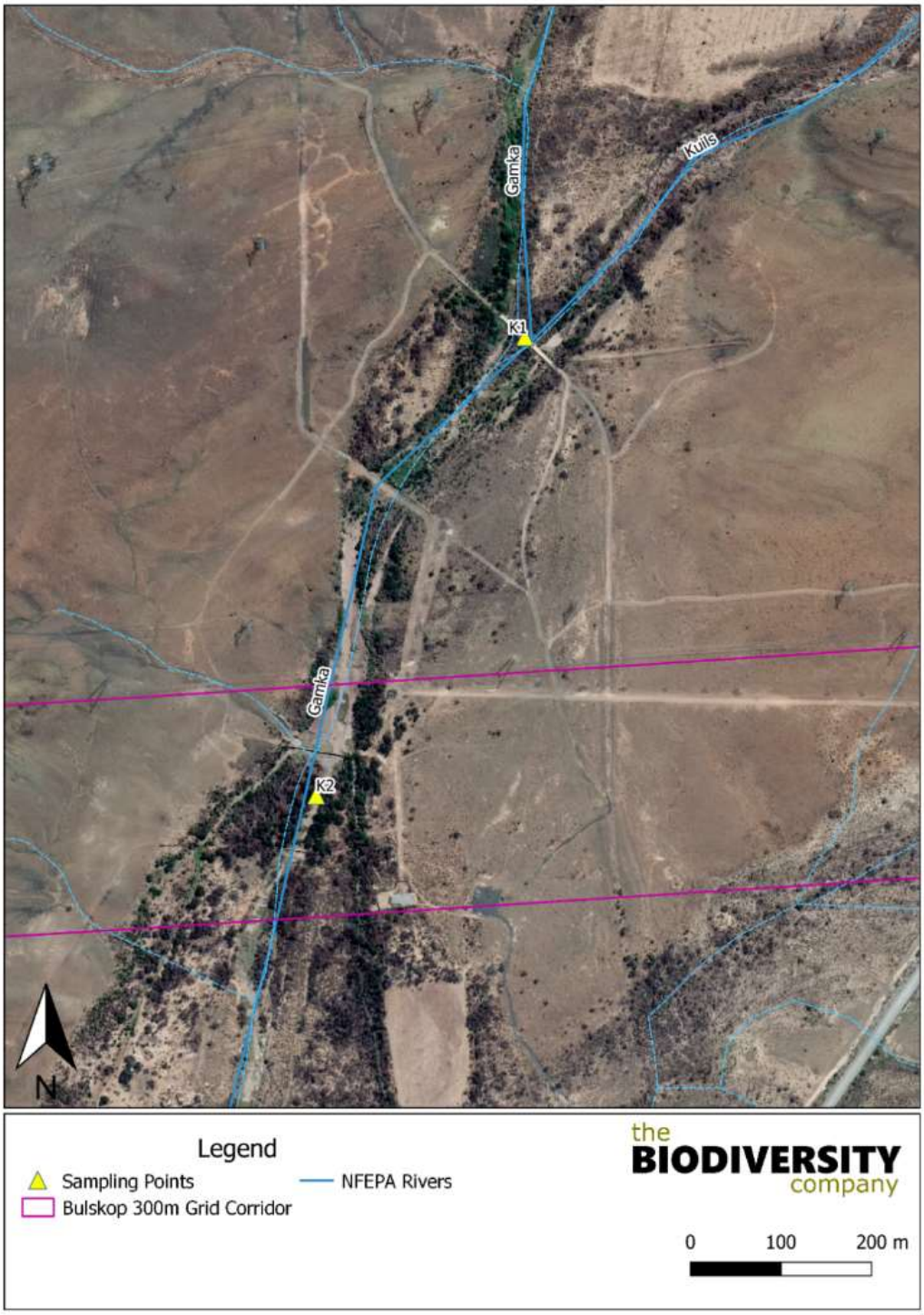


Figure 6-13: Illustration of the aquatic sampling point on the Gamka River

Table 6-8: Photographs and coordinates of photo points and sampling point K1 and K2

	Site Photographs	
	K1	**K2**
Upstream view		
Downstream View		
GPS Coordinate	32°24'1.96"S 22°34'6.96"E	32°24'21.52"S 22°33'59.13"E

6.2.6 In Situ Water Quality

In situ water quality analysis results from the April low flow and September high flow 2021 surveys are provided in Table 6-9.

Table 6-9: In situ water quality results for the September 2021 survey

Site	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
TWQR*	**-**	**-**	**>5.00**	**5-30**
		April 2021		
K1	6.9	2350	5.23	21.0
		September 2021		
K2	8.5	2730	8.73	19.6
***TWQR – Target Water Quality Range (DWS, 1996)**				

The water quality results 2021 surveys indicated elevated conductivity levels, however, these are considered largely natural due to the low surface water in the reach and geology within the region, contributing to elevated conductivity levels. However, it is noted that a waste water treatment works is located upstream of the site, and a dense urban settlement, which further contributes dissolved solids into the aquatic systems. Excessive algae was observed within the Gamka (Figure 6-14), indicating eutrophic conditions within the system, and likely attributed to the waste water treatment works located upstream. Further constituents fell within the water quality guidelines. The water quality results observed in this study should be used to monitor the potential impacts of the proposed development. The standing pool observed within the reach presented some degree of modification to water quality, and would limit the diversity of sensitive aquatic biota. Biota expected within the residual pools are expected to be adapted to the conditions observed onsite during the low and high flow season surveys.

Figure 6-14: Illustration of excessive algae growth within the Gamka reach

6.2.7 Catchment Level Habitat Assessment

The results of the Intermediate Habitat Integrity Assessment (IHIA) in the Gamka River reach within the study area is provided in Table 6-10.

Table 6-10: Results for the habitat assessment in the Gamka River (K1 and K2)

Instream	Average Score	Impact Score
Water abstraction	15	8,4
Flow modification	15	7,8
Bed modification	12	6,24
Channel modification	10	5,2
Water quality	12	6,72
Inundation	5	2
Exotic macrophytes	5	1,8
Exotic fauna	0	0
Solid waste disposal	12	2,88
Total Instream		**59**
Category		**D**
Riparian	**Average Score**	**Impact Score**
Indigenous vegetation removal	14	7,28
Exotic vegetation encroachment	5	2,4
Bank erosion	7	3,92
Channel modification	5	2,4
Water abstraction	15	7,8
Inundation	5	2,2
Flow modification	10	4,8
Water quality	5	2.6
Total Riparian		**66.6**
Category		**C**

The reach included portions of the Gamka River sampled (K1 and K2). The results of the IHIA for the Gamka River indicated largely modified instream habitat integrity. Modifications were attributed to abstraction in the upstream reaches (Beaufort West Dam) resulting in flow modifications. Solid waste disposal was observed on site (Figure 6-15). Numerous low water crossings within the reach have resulted in instream channel, bed and flow modifications. Agricultural and livestock activities contributed to erosion and instream sedimentation the assessed reach. Several instream impoundments occur within the sampled reach, reducing instream habitat integrity (Figure 6-17).

Figure 6-15: Illustration of the solid waste within the system (Site K1)

Figure 6-16: Illustration of agricultural activities adjacent to the Gamka River (Google Earth, 2021)

Figure 6-17: Illustration of instream impoundments within the Gamka River (Google Earth, 2021)

6.2.8 Aquatic Macroinvertebrates Assessment

6.2.8.1 Instream Habitat Assessment

The Integrated Habitat Assessment System (IHAS) index was developed by McMillan (1998) for use in conjunction with the SASS5 protocol and was applied at site K1 and K2. The IHAS results for the various surveys are presented in Table 6-11. Results indicate adequate habitat diversity at both site K1 and K2 to support a moderately diverse macroinvertebrate community.

Table 6-11: IHAS results recorded during the April 2021 survey

	K1	K2
Score	56	65
Suitability	**Adequate**	**Adequate**

A biotope rating of available habitat was conducted at each site assessed to determine the suitability of habitat to macroinvertebrate communities. The Gamka River within the area is classed as a upper foothills river reach or geoclass D (Rountree, 2013). The categories were calculated according to the biotope rating assessment as applied in Tate and Husted (2015). An indication of the available biotopes during the April 2021 survey are presented in Table 6-12. A rating system of 0 to 5 was applied, 5 being abundant and diverse, and 0 being not available/absent.

Table 6-12 Biotope availability at the sites K1 and K2

Biotope	Weighting (Upper foothills)	K1	K2
Stones in current (SIC)	20	0	2

Stones out of current (SOOC)	10	3	3
Bedrock	5	2	3
Aquatic vegetation	1	1	2.5
Marginal vegetation in current	2	0	1
Marginal vegetation out of current	2	2.5	3
Gravel	3	2	2.5
Sand	1	1	2
Mud	1	2.5	3
Biotope Score (X / 45)		14	22
Weighted Biotope Score (%)		25	49
Biotope Category (Tate and Husted, 2015)		**F**	**D**

Habitat availability within the K1 assessed reach was rated as class F (poor diversity). The poor biotope score was attributed to the absence of flow and subsequent absence of flow diversity, and limited aquatic and marginal vegetation in the reach. The habitat available was predominantly mud and bedrock substrate with scattered boulders, and submerged debris. The low biotope diversity was considered natural within the system due to the ephemeral natural of the river. The biotope assessment indicated that a largely tolerant macroinvertebrate community would be expected at the site. Site K2 presented a higher diversity of instream and marginal habitat. Despite the increase in biotope diversity, the habitat quality was considered poor due to the excessive algal growth observed, which smothers available habitat for aquatic macroinvertebrates.

6.2.8.2 Biotic Integrity Based on SASS5 Results

The aquatic macroinvertebrate (SASS5) results for the April 2021 survey period are presented in Table 6-13. The sampled aquatic systems fell within the Karoo ecoregion. Due to inadequate data from the ecoregion, no formal biological bands have been generated. Therefore, the ecological category cannot be determined for the site using the SASS5 index. The total sensitivity score for the site K1 was 66 and a total of 15 taxa collected, resulting in an Average Score Per Taxon (ASPT) or average sensitivity score of 4.4. A similar ASPT of 4.5 was scored at K2 during the high flow survey. The ASPT values during both studies indicated the aquatic macroinvertebrate community at the site comprised of mostly tolerant taxa (Intolerance Rating < 5). Three taxa were collected that are considered moderately tolerant, including Aeshnidae, Hydracarina and Hydraenidae (tolerance values of 8). A lower total sensitivity score was observed at site K2, with 2 fewer taxa being collected. The depauperate macroinvertebrate community observed at during both studies was expected for the reach due to the absence of flow at K1 and low habitat diversity at site K1. Site K2 presented excessive algal growth which limited habitat quality, contributing to a lower macroinvertebrate community.

Table 6-13: Macroinvertebrate Assessment Results (April 2021)

	K1 (April 2021)	K2 (September 2021)
SASS Score	66	**58**
No of taxa	15	13
ASPT*	4.4	4.5

	K1 (April 2021)	K2 (September 2021)
SASS Score	66	**58**
Ecological Category (Dallas, 2007)	**N/A**	**N/A**

The data collected from the SASS5 assessment was used in the MIRAI assessment (Thirion, 2007). The expected macroinvertebrate community for the ecoregion is presented in Table 6-14, with values ranging from 1-5, with 1 being unlikely to 5 being commonly collected. The reference frequency indicates a very low probability of most taxa to occur within the ecoregion, indicating most aquatic systems within the area are likely to host depauperate macroinvertebrate communities. A total of 50 taxa were expected, with 17 being collected. Results for the MIRAI assessment are provided in Table 6-15.

Table 6-14: Reference frequency of occurrence and presence/absence of macroinvertebrate assessment

Taxa	Reference Frequency	Presence/Absence
Turbellaria	1	
Oligochaeta	1	1
Hirudinea	1	
Potamonautidae	3	1
Hydracarina	1	1
Baetidae 1 sp	3	1
Baetidae 2 spp	3	
Baetidae >2 spp	3	
Caenidae	3	
Trichorythidae	1	
Coenagrionidae	3	1
Aeshnidae	3	1
Corduliidae	3	
Gomphidae	3	
Libellulidae	3	1
Belostomatidae	1	
Corixidae	3	1
Gerridae	3	1
Hydrometridae	1	
Naucoridae	3	
Nepidae	1	
Notonectidae	3	1
Pleidae	1	
Veliidae	3	1
Hydropsychidae 1 sp	1	
Hydropsychidae 2 spp	1	
Hydropsychidae >2 spp	1	

Philopotamidae	1	
Polycentropodidae	1	
Hydroptilidae	1	
Leptoceridae	1	
Dytiscidae	3	1
Elmidae	3	
Gyrinidae	3	
Hydraenidae	1	1
Hydrophilidae	1	1
Ceratopogonidae	3	
Chironomidae	3	1
Culicidae	3	
Dixidae	1	
Ephydridae	3	1
Muscidae	3	
Psychodidae	1	
Simuliidae	1	
Syrphidae	1	
Tabanidae	3	
Tipulidae	1	
Ancylidae	1	
Lymnaeidae	1	
Physidae		1
Unionidae	1	
No of taxa	**50 Expected**	**17 Collected**

Table 6-15: MIRAI results for the 2021 survey

Metric Group	Gamka River
Flow modification	79,0
Habitat	70,4
Water Quality	77,3
Ecological Score	**76**
Invertebrate Category	**C**

The results of the MIRAI derived an ecological category of class C (Moderately modified) for the Gamka River. The dominant factor in the reduced ecological score was habitat. As indicated in the biotope assessment, habitat diversity was limited. Water quality and flow modification further decreased ecological integrity, however to a lesser extent.

6.2.9 Present Ecological Status

The results for the reach-based PES assessment for the Gamka River are presented in Table 6-16. The overall results of the PES assessment derived a moderately modified ecological

category (class C). This modified status can be primarily attributed to habitat related drivers and modifications to the riparian areas. Flow and water quality modifications, and solid waste disposal further contributed to modifications in the reach. Urban and agricultural activities have resulted in sedimentation of instream areas, loss of indigenous vegetation and water quality perturbations in the Gamka River.

Table 6-16: The Present Ecological Status for the Gamka River

Aspect Assessed	Category
Riparian Ecological Category	C
Aquatic Invertebrate Ecological Category	C
Ecostatus	**class C**

6.2.10 Watercourse Characterisation

The vegetation types of the development area are predominantly Southern Karoo Riviere types. Riverine features include valley floors and drainage networks. Typical riparian thickets occur along the defined drainage lines of the study area (Strahler orders 3 and 4), which is illustrated in Figure 6-18. However, an extensive network of 1st and 2nd order watercourses occur throughout the study area which lack vegetative indicators. Drainage lines are recorded for the development area. Due to the sporadic nature of rainfall within the region, the systems are ephemeral in nature (bar the Gamka River). Riparian zones within the ecoregion present very high ecological importance and sensitivity, as the zones present an increase in vegetation diversity, provide longitudinal ecological connectivity, and an interface between the aquatic and terrestrial environments. These riparian areas are highly sensitive to changes in water level and flow, as they have adapted to short growing times during short spells of precipitation

Figure 6-18: Typical vegetation consisting of grassland and increase of riparian thicket within the lower Strahler drainage lines (taken September 2021) within the study area.

Figure 6-19: First order drainage line with few vegetation indicators (taken September 2021)

Riparian zone delineations associated with the Gamka River were conducted using aerial imagery where riparian thickets (including *Vachellia karoo* - Sweet thorn) were readily observable and associated with the watercourse. Numerous drainage lines and flats presented few riparian indicators as indicated in **Error! Reference source not found.**.

6.2.11 Resource Buffers

The "*Buffer zone guidelines for wetlands, rivers and estuaries*" (Macfarlane *et al.,* 2014) was used to determine the appropriate wetland buffer zone for the proposed development.

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. A buffer zone has been prescribed for this project to serve as a "barrier" between the proposed development and the water resources.

The buffer zone tool was used to calculate the appropriate buffer required for the proposed grid connection, which would be applicable to the drainage lines and Gamka River. The model shows that the largest risk posed by the project during the construction phase is that of "increased sediment inputs and turbidity". During the operational phase the flow patterns being altered (increase flood peaks), increased sediment inputs and altered water quality are high risks. These risks are based on what could threaten the systems and what buffer would be required at a desktop level. A buffer zone of 15 m and 30 m was determined (Table 6-17) for the drainage lines and Gamka River respectively, this buffer is calculated assuming mitigation measures are applied. According to the buffer guideline (Macfarlane, et al. 2014) a high-risk activity, such as mining, would require a buffer that is 95% effective to reduce the risk of the impact to a low level threat.

Table 6-17: Post-mitigation buffer requirement

Required Buffer after mitigation measures have been applied	
Drainage line	15 m
Gamka River	30 m

7 Habitat Assessment and Site Ecological Importance

7.1 Habitat Assessment

The habitat assessment identified two habitat type within the development area, with the Southern Karoo Riviere Plains type being dominant, with the delineation of these habitat types presented in Figure 7-6. Only the access route traverses the Southern Karoo Riviere Grassland habitat type.

Drainage Lines are characterised as low lying (valley bottom) channels where seasonal rain event water is channelled downstream of the powerline areas. Certain areas were found to contain standing water, but no flowing water was found. Characteristically these areas are well vegetated with woody species as well as grasses, where standing water was encountered reed species were prevalent. Sand and clay accumulate in these areas creating a microclimate of nutrient rich areas which accommodate a variety of plant species. Even though somewhat disturbed, the ecological integrity, importance and functioning of these areas play a crucial role as a water resource system and an important habitat for various fauna and flora, including possibly present SCC. The preservation of this system is the most important aspect to consider for the proposed development, even more so due to the high sensitivity of the area according to the various ecological datasets. This habitat needs to be protected and improved due to the role of this habitat as a water resource.

Rocky Ridges, are high lying areas characterised by a rocky landscape with very little sand or clay present in the substrate. These habitats are unsuitable for agriculture or grazing and therefore displays a landscape free of these impacts. Plant species encountered here were mostly succulents and grasses with spiny shrubs also recorded. No trees were encountered due to this limited substrate. Only the powerline is expected to cross these areas. These habitat types are regarded as sensitive due to the number of endemic plant species encountered here and preservation of it is essential.

Southern Karoo Riviere is a delta where the surface wash of the rain events flows in a generally south-western direction, following the main river channel through the rocky/stony substrate and deposits clay material on the alluvial plains. These rocky areas are characteristically darker areas where grasses and small/low shrubs dominate the species composition, these areas are called Southern Karoo Riviere Grassland. As part of these surface wash areas the Southern Karoo Riviere Sandy Plains are encountered to the east of the study area where a sandy substrate dominates. These areas are heavily disturbed from a grazing and trampling perspective but is still regarded as playing a crucial role in lateral water flow. The preservation of this system's ecological role will go hand in hand with the drainage lines preservation. This area is located in the Platdoring catchment area, and has been classified as a drainage flat. A desktop delineation of alluvial soils was conducted and is presented in Figure 7-6.

Gamka Shrubland are areas where short spiny shrubs dominated a mostly rocky substrate, grass species were present but if grazing took place, these were absent in many cases. These

areas were found to be important from a connectivity perspective and therefore pays an important role in the ecosystem.

Figure 7-1: Drainage Lines

Figure 7-2: Rocky Outcrops

Figure 7-3: Southern Karoo Riviere Sandy Flats

Figure 7-4: Gamka Shrublands

Figure 7-5: Southern Karoo Riviere Grasslands

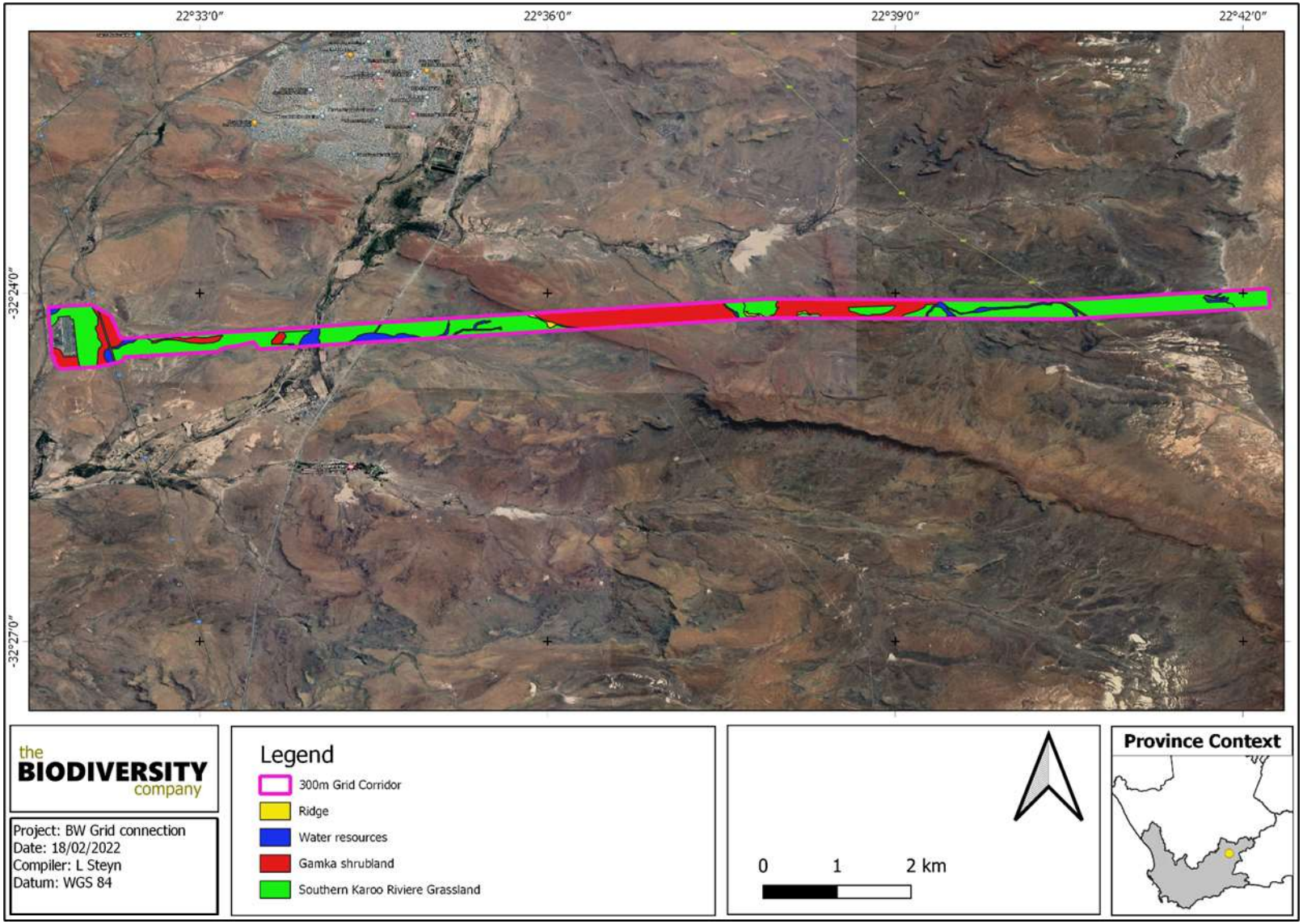


Figure 7-6: The delineated habitat units

7.2 Site Ecological Importance

The development area is situated wihin two habitat types that were delineated for the study area (Table 7-1). The SEI for the various vegetation types as they relate to the development areas are depicted in Figure 7-7. The guidelines for interpreting the SEI can be seen in Table 7-2. The grid connection development area traverses medium and high sensitivity areas. It is evident from the assessment that the area designated as a CBA1 is in a modified state, with medium functional integrity. The designated CBA areas are not in a natural nor near natural state

Table 7-1: Summary of habitat types delineated within the field assessment area of the development area

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Ridges	Medium Confirmed or highly likely occurrence of populations of NT species	Medium Medium (> 5 ha but < 20 ha) semi-intact area; Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity	Medium	Low Ridges provide habitat for a wide variety of avifauna species. Ridges are also necessary for sustainability of ecosystems such as recharging wetlands or rivers. The vegetation found on ridges are unique and highly susceptible to change and disturbance. Based on the lack of rain in the area the vegetation/habitat is unlikely to recover fully after > 15 years.	High
Drainage Lines	Medium Confirmed or highly likely occurrence of populations of NT species	High Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches.	Medium	Low species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.	High
Southern Karoo Riviere Grassland	Medium Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU); Presence of range-restricted species.	Medium Medium (> 5 ha but < 20 ha) semi-intact area; Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity	Medium	Low The average rainfall in the Beaufort West area is ~220mm, the assessment area itself based on the local farmers, prior to 2022, experienced a 6 year drought. As a result of the low rainfall in the area, shrubland species will likely not be able to recover. This is also true for the seed germination of these species. The change in the habitat will	Medium

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
				result in avifauna species being forced out of the area. The habitat is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore. Once the habitat has re-established, more resilient bird species will move into the area	
Southern Karoo Riviere Plains (incl dry plain)	Medium Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU); Presence of range-restricted species.	Medium Medium (> 5 ha but < 20 ha) semi-intact area; Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity	Medium	Low The average rainfall in the Beaufort West area is ~220mm, the assessment area itself based on the local farmers, prior to 2022, experienced a 6 year drought. As a result of the low rainfall in the area, shrubland species will likely not be able to recover. This is also true for the seed germination of these species. The habitat is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore. Once the habitat has re-established, more resilient bird species will move into the area	Medium
Gamka Shrubland	Medium Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU); Presence of range-restricted species.	Medium Medium (> 5 ha but < 20 ha) semi-intact area; Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity	Medium	Low The average rainfall in the Beaufort West area is ~220mm, the assessment area itself based on the local farmers, prior to 2022, experienced a 6 year drought. As a result of the low rainfall in the area, shrubland species will likely not be able to recover.	Medium

Table 7-2: Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities

Site Ecological Importance (SEI)	Interpretation in relation to proposed development activities
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.

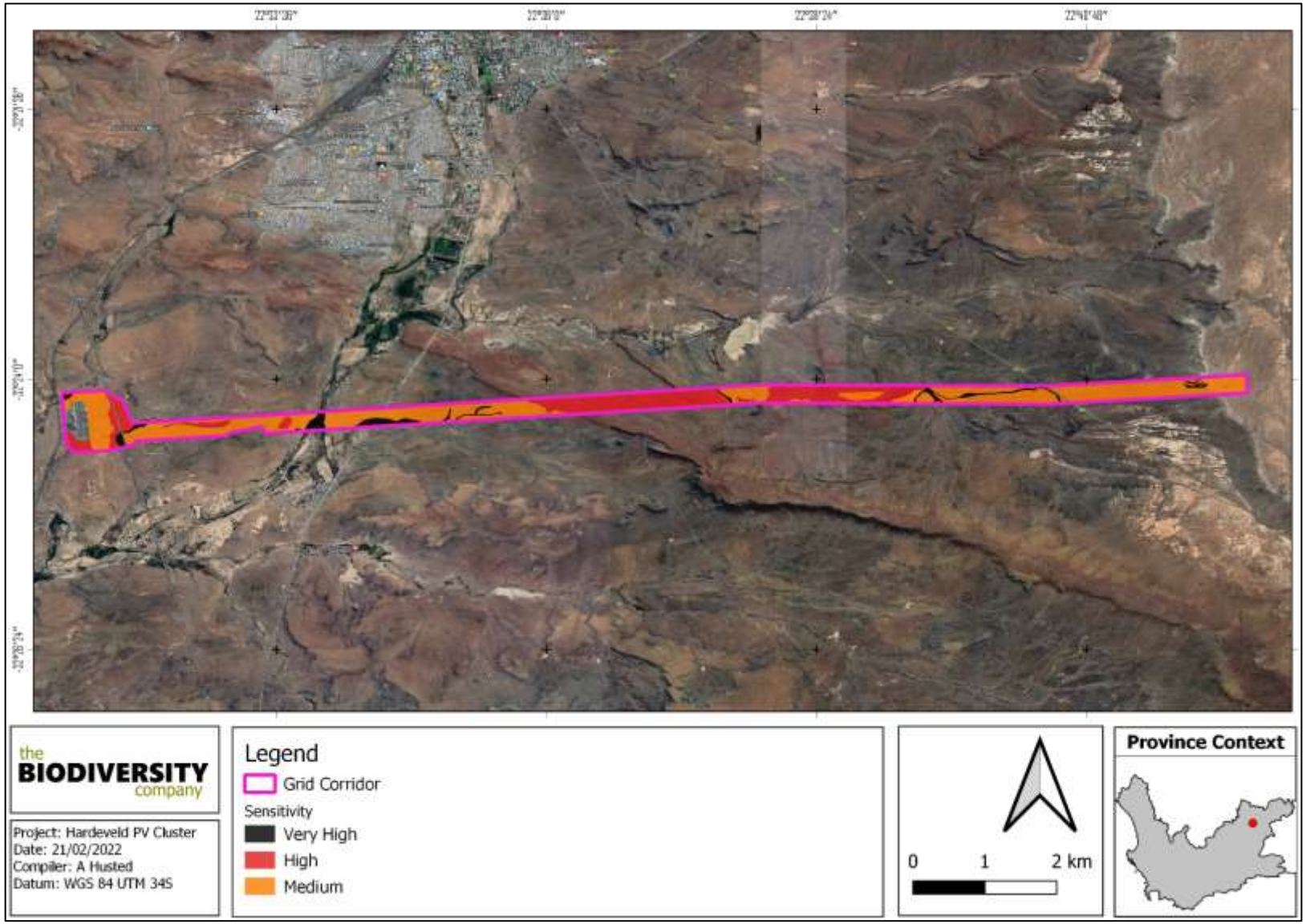


Figure 7-7: The development area and study area sensitivity

8 Impact Assessment

Potential impacts were evaluated against the data captured during the desktop-and field assessment to identify relevance to the development area. The relevant impacts associated with the proposed grid connection development were then subjected to a prescribed impact assessment methodology which is described below.

Mitigation measures were only applied to impacts deemed relevant based on the impact analysis. The likelihood and consequence descriptors are presented in Table 8-1 and Table 8-2. The significance rating matrix is presented in Table 8-3.

Table 8-1: Likelihood descriptors

Probability of impact	Rating
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**Rating**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

Table 8-2: Consequence Descriptors

Severity of impact	Rating
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**Rating**
Activity specific/ < 5 ha impacted / Linear features affected < 100m	1
Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Linear features affected > 3000m	5
Duration of impact	**Rating**
One day to one month: Temporary	1
One month to one year: Short Term	2
One year to five years: Medium Term	3
Life of operation or less than 20 years: Long Term	4

Permanent	5

Table 8-3: Significance Rating Matrix

	CONSEQUENCE (Severity + Spatial Scope + Duration)															
	0	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Absent
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	Low
	3	6	9	12	15	18	21	24	27	301	33	36	39	42	45	
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	Moderate
LIKELIHOOD (Probability + Sensitivity)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	Moderately High
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	High
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	Critical
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	

8.1 Alternatives Considered

No layout alternatives were considered.

8.2 Terrestrial Impact Assessment

8.2.1 Current impacts

The current impacts observed during surveys are listed below, these are informed by the 2019 SEA, where the key potential impacts and their mitigation is listed.

- Multiple high voltage powerlines;
- Grazing and trampling of natural vegetation by livestock;
- Farm roads and main roads (and associated traffic and wildlife road mortalities);
- Hunting;
- Dumping of litter and building rubble; and
- Alien and/or Invasive Plants (AIP).

8.2.1.1 No Go Option

The current impacts to the fauna and flora as well as landscapes will continue unabated, these are rated in Table 8-5.

The development area is associated with two vegetation types, both of which are classified as Least Threatened. The plains are prone to extensive lateral surface flow during periodic rainfall events. The overall sensitivity for these areas is determined to be medium. The no-go option is likely to result in the continued grazing of the development area. The loss in vegetation cover could also contributed to erosion of the area, albeit limited due to the relatively flat topography.

8.2.2 Anticipated Impacts

The development area overlaps in a CBA1, ESA1 and ESA2 area. CBA1 areas must maintain a natural or near natural state and only low impact biodiversity sensitive land uses are appropriate. ESA1 areas must be maintained in a functional near natural state, with some loss of habitat is acceptable provided that the underlying biodiversity objectives and ecological functioning are not compromised.

Karoo soils are susceptible to erosion and take decades to recover if allowed to rehabilitate. In undisturbed natural veld there are two natural features that protect the soil and enrich them, namely the biogenic crust and plant litter mulch (Jacobs & Jangle 2008). These protect the soil against erosion and provide the ideal conditions for seeds to germinate. Disturbance and reduction of vegetation cover lead to destruction of the biogenic crust and subsequent erosion (Jacobs & Jangle 2008). Plant litter also slows the water flow and allows for infiltration. Therefore, by minimising the footprint areas and access roads for the study area and powerline, disturbance of soil will be minimised. Road maintenance and erosion control for the access road will be important in the long term.

Table 8-4 presents the aspects anticipated for the proposed infrastructure considered to predict and quantify these impacts and assess & evaluate the magnitude on the identified terrestrial biodiversity.

Table 8-4: Anticipated impacts for the proposed development on terrestrial biodiversity

Main Impact	Project activities that can cause loss/impacts to habitat (especially with regard to the proposed infrastructure areas):	Secondary impacts anticipated
1. Destruction, fragmentation and degradation of habitats and ecosystems	Physical removal of vegetation, possibly protected species.	Displacement/loss of flora & fauna (including possible SCC) Increased potential for soil erosion Habitat fragmentation Erosion Increased potential for establishment of alien & invasive vegetation
	Access roads and servitudes	
	Soil dust precipitation	
	Dumping of waste products	
	Random events such as fire (cooking fires or cigarettes)	
	Water leakages	
Main Impact	**Project activities that can cause the spread and/or establishment of alien and/or invasive species**	**Secondary impacts anticipated**
2. Spread and/or establishment of alien and/or invasive species	Vegetation removal	Habitat loss for native flora & fauna (including SCC) Spreading of potentially dangerous diseases due to invasive and pest species Alteration of fauna assemblages due to habitat modification
	Vehicles potentially spreading seed	
	Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents	
	Creation of infrastructure suitable for breeding activities of alien and/or invasive birds	
Main Impact	**Project activities that can cause direct mortality of fauna**	**Secondary impacts anticipated**
3. Direct mortality of fauna	Clearing of vegetation	Loss of habitat Loss of ecosystem services Increase in rodent populations and associated disease risk
	Roadkill due to vehicle collision	
	Pollution of water resources due to dust effects, chemical spills, etc.	
	Intentional killing of fauna for food (hunting)	

Main Impact	Project activities that can cause reduced dispersal/migration of fauna	Secondary impacts anticipated
4. Reduced dispersal/migration of fauna	Loss of landscape used as corridor	Reduced dispersal/migration of fauna Loss of ecosystem services Reduced plant seed dispersal
	Compacted roads	
	Removal of vegetation	
Main Impact	**Project activities that can cause pollution in watercourses and the surrounding environment**	**Secondary impacts anticipated**
5. Environmental pollution due to water runoff, spills from vehicles and erosion	Chemical (organic/inorganic) spills	Pollution in watercourses and the surrounding environment Faunal mortality (direct and indirectly) Groundwater pollution Loss of ecosystem services
	Erosion	
Main Impact	**Project activities that can cause disruption/alteration of ecological life cycles due to sensory disturbance.**	**Secondary impacts anticipated**
6.Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and light pollution.	Operation of machinery (Large earth moving machinery, vehicles)	Disruption/alteration of ecological life cycles due to noise Loss of ecosystem services Secondary impacts associated with disruption/alteration of ecological life cycles due to dust Loss of ecosystem services
	Project activities that can cause disruption/alteration of ecological life cycles due to dust	
	Vehicles	
Main Impact	**Project activities that can cause staff to interact directly with potentially dangerous fauna**	**Secondary impacts anticipated**
7. Staff and others interacting directly with fauna (potentially dangerous) or poaching of animals	All unregulated/supervised activities outdoors	Loss of possibly present SCCs

8.2.2.1 Construction Phase

During this phase the infrastructure will be constructed, this includes:

- Laydown area;
- Access and Internal road network;
- Auxiliary buildings (33 kV switch room, gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Facility substation transformers and internal electrical reticulation;
- Inverters and cabling;
- Battery Energy Storage System (BESS);
- Rainwater tanks; and
- Perimeter fencing and security infrastructure.

The main anticipated impact includes the clearing and disturbance of vegetation, which will ultimately lead to trampling and compaction drilling as well as habitat destruction and the proliferation of alien plant species along the roads and cleared areas. From a faunal perspective the severing of movement corridors for fauna, loss of fauna and flora SCCs (if present) and the fragmentation of habitat is expected. Soil disturbance is expected to be minimal and concentrated in small areas. The following potential impacts were considered:

- Destruction, fragmentation and degradation of habitats and ecosystems;
- Spread and/or establishment of alien and/or invasive species;
- Displacement of faunal community (Including several SCC) due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration); and
- Mortalities and displacements of fauna and flora SCCs;
- Chemical pollution associated with dust suppressants for roads and laydown areas.

8.2.2.2 Operational Phase

The operational phase of the impact of daily activities is anticipated to further spread the alien invasive plants, as well as the deterioration of the habitats due to the increase of dust and edge effect impacts. Dust reduces the ability of plants to photosynthesize and thus leads to degradation/retrogression of the veld. The following potential impacts were considered:

- Continued fragmentation and degradation of habitats, ecosystems and ESA areas;
- Spread of alien and/or invasive species; and
- Displacement, direct mortalities and reduced dispersal/migration of faunal community (including SCC) due to disturbance (road collisions, collisions with solar panels and substation/powerlines, noise, light, dust, vibration).

8.2.2.3 Decommissioning Phase

This phase is when the scaling down of activities ahead of temporary or permanent closure is initiated. During this phase, the operational phase impacts will persist until of the activity reduces and the rehabilitation measures are implemented. The following potential impacts were considered:

- Continued fragmentation and degradation of habitats and ecosystems; and
- Spread of alien and/or invasive species.

8.2.2.4 Assessment of Significance

The assessment of impact significance considers pre-mitigation as well as implemented of post-mitigation scenarios. The mitigation actions required to lower the risk of the impact are provided in Section 8.2.3 of this report.

8.2.2.4.1 Construction Phase

Table 8-6 summarises the significance of potential impacts associated with the grid connection on fauna and flora before and after implementation of mitigation measures.

The loss of habitat and the degradation of habitat were rated as “Moderate” significance prior to mitigation measurers, this is partly attributed to the degraded extent of the designated CBA area. Through the implementation of mitigation measures such as the restriction and demarcation of the development area this can be reduced to ‘Low’, it can however not be mitigated completely as habitat will still be lost as well as plant species.

The risk of the spread of alien invasive species was rated “High” prior to the implementation of an alien management plan. Should the alien spread be successfully mitigated the risk can be reduced to “Low”.

Displacement of faunal community (Including several SCC) due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration) was rated as “Moderately” and after considered mitigation measures was adjusted to “Low”.

Mortalities and displacements of fauna and flora SCCs was rated as “Moderate” but mitigation measureas allowed for the adjust ment to “Low” significance.

8.2.2.4.2 Operational Phase

Table 8-7 summarises the significance of the operational phase impacts on biodiversity before and after implementation of mitigation measures. The impact significance of displacement and direct mortalities of fauna were rated as “Moderate” prior to mitigation. Implementation of mitigation measures reduced the significance of the impact to a ‘Low’ level. The continued fragmentation and degradation of habitats, ecosystem areas was rated as “Low” and after mitigation measures, adjusted to “Absent”. Unchecked the spread of alien and/or invasive species was rated as ‘Moderate’ but after mitigation adjusted to “Low”.

8.2.2.4.3 Decommissioning Phase

The fauna and flora would have become accustomed to the changed habitat and the disturbance of this habitat would now result in a further fragmentation. The significance of this impact prior to mitigations were rated as “Moderate” and was reduced to “Low” post mitigation (Table 8-8). Alien invasive species will flourish in the now newly disturbed areas, and this will need to be monitored quarterly for two years post decommissioning.

Table 8-5: No-Go Option

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Destruction, fragmentation and degradation of habitats and ecosystems due to grazing and trampling by livestock	5	3	3	2	4		5	3	3	2	4	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology with limited sensitivity/importance	Highly likely	**Moderate**	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology with limited sensitivity/importance	Highly likely	**Moderate**
Spread and/or establishment of alien and/or invasive species	5	3	3	2	3		5	3	3	2	3	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology with limited sensitivity/importance	Likely	**Moderate**	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology with limited sensitivity/importance	Likely	**Moderate**
Displacement of faunal community (Including several SCC) due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, hunting, dust, vibration)	5	3	3	3	3		5	3	3	3	3	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**

								/ Linear features affected < 1000m				

Table 8-6: Assessment of significance of potential impacts on the terrestrial fauna and flora associated with the construction phase of the project

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Habitat Loss (Destroy, fragment and degrade habitat)	4	3	3	3	4		3	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Highly likely	**Moderate**	One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	**Low**
Spread and/or establishment of alien and/or invasive species	4	3	3	4	3		3	3	3	3	2	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	**Moderate**	One year to five years: Medium Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Possible	**Low**
Displacement of faunal community (Including possible SCC) due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration)	3	4	3	4	3		2	3	2	4	3	
	One year to five years: Medium Term	Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	**Moderate**	One month to one year: Short Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Small / ecosystem structure and function largely unchanged	Ecology highly sensitive /important	Likely	**Low**
Mortalities and displacements of fauna and flora SCCs.	3	3	3	4	4		2	2	2	4	3	
	One year to five years:	Local area/ within 1 km of the site boundary / <	Significant / ecosystem structure	Ecology highly	Highly likely	**Moderate**	One month to one	Development specific/ within the site boundary / <	Small / ecosystem structure and	Ecology highly sensitive /important	Likely	**Low**

	Medium Term	5000ha impacted / Linear features affected < 1000m	and function moderately altered	sensitive /important			year: Short Term	100 ha impacted / Linear features affected < 100m	function largely unchanged			

Table 8-7: Assessment of significance of potential impacts on terrestrial fauna and flora associated with the operational phase of the project

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Continued Habitat Loss (Destroy, fragment and degrade habitat)	4	3	2	2	3		4	2	2	1	1	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	**Low**	Life of operation or less than 20 years: Long Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology not sensitive/important	Highly unlikely	**Absent**
Spread and/or establishment of alien and/or invasive species	4	3	3	3	3		4	3	3	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology with limited sensitivity/importance	Likely	**Low**
Displacement of faunal community (Including possible SCC) due to habitat loss, direct mortalities and	4	3	3	3	3		4	2	2	3	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear	Significant / ecosystem structure and function	Ecology moderately sensitive/ /important	Likely	**Moderate**	Life of operation or less than 20	Development specific/ within the site	Small / ecosystem structure and	Ecology moderately sensitive/ /important	Likely	**Low**

disturbance (road collisions, noise, light, dust, vibration)		features affected < 1000m	moderately altered				years: Long Term	boundary / < 100 ha impacted / Linear features affected < 100m	function largely unchanged			

Table 8-8: Assessment of significance of potential impacts on terrestrial fauna and flora associated with the decommissioning phase of the project

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Continued fragmentation and degradation of habitats and ecosystems	5	3	3	3	3		2	2	2	3	2	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology moderately sensitive/ /important	Possible	**Low**
Spread and/or establishment of alien and/or invasive species	5	3	3	3	3		2	2	2	3	3	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology moderately sensitive/ /important	Likely	**Low**

8.2.3 Specialist Management Plan

The aim of this section is present mitigation actions which may be incorporated into the Environmental Management Programme (EMPr) which will allow for the successful implementation and auditing of mitigation and monitoring actions. The proposed summarised mitigation actions are presented in Table 8-9.

Table 8-9: Mitigation measures including requirements for timeframes, roles and responsibilities for this report

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Management outcome: Vegetation and Habitats				
Areas rated as High should be avoided where feasible, and all efforts must be made to prevent access to these areas from construction workers, machinery and any construction. Disturbances to High sensitive area must also be minimised. The infrastructure should be realigned to prioritise development within Low/Moderate sensitivity areas. In the case where High sensitivity areas cannot be avoided, mitigation measures must be strictly adhered resulting in the impact to these areas to be Low.	Life of operation	Project manager, Environmental Officer	Development footprint	Ongoing
Avoid the delineated ridge areas where feasible. Avoid the need for rock blasting. Access by personell and vehicles must be restricted to the ridge areas.	Life of operation	Project manager, Environmental Officer	Development footprint	Ongoing
Clearing of vegetation should be minimized and avoided where possible. A pre-construction walk-through must be completed in order for any SCC to be marked.	Life of operation	Project manager, Environmental Officer	Development footprint	Ongoing
Where possible, existing access routes and walking paths must be made use of.	Construction/Operational Phase	Environmental Officer & Design Engineer	Roads and paths used	Ongoing
All laydown, chemical toilets etc. should be restricted to medium sensitivity areas. Any construction materials may not be stored for extended periods of time and must be removed from the development area once the construction/closure phase has been concluded. No storage of vehicles or equipment will be allowed outside of the designated development areas.	Construction/Operational Phase	Environmental Officer & Design Engineer	Laydown areas	Ongoing
Areas that are cleared during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood and wind events. This will also reduce the likelihood of encroachment by alien invasive plant species.	Operational phase	Environmental Officer & Contractor	Assess the state of rehabilitation and encroachment of alien vegetation	Quarterly for up to two years after the closure
Any woody material removed can be shredded and used in conjunction with the topsoil to augment soil moisture and prevent further erosion.	Operational and Decommissioning phase	Environmental Officer & Contractor	Woody material around footprint	During Phase
A spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. No servicing of equipment on site unless necessary. All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons	Life of operation	Environmental Officer & Contractor	Spill events, Vehicles dripping.	Ongoing

oils, diesel etc.) in such a way as to prevent them leaking and entering the environment.				
It should be made an offence for any staff to take/ bring any plant species into/out of any portion of the development area. No plant species whether indigenous or exotic should be brought into/taken from the development area, to prevent the spread of exotic or invasive species or the illegal collection of plants.	Life of operation	Project manager, Environmental Officer	Any instances	Ongoing
A fire management plan needs to be complied and implemented to restrict the impact fire might have on the surrounding areas.	Life of operation	Environmental Officer & Contractor	Fire Management	During Phase
Rocks removed in the construction phased may not be dumped, but can be used in areas where erosion control needs to be performed	Operational phase	Environmental Officer & Contractor	Rock piles	During Phase
Any nationally protected trees or protected plants that was observed needs a relocation or destruction permit in order for any individual that may be removed or destroyed due to the development. Preferably, the trees/plants can be relocated within the property without a permit or otherwise left unharmed. High visibility flags must be placed near any protected plants in order to avoid any damage or destruction of the species. If left undisturbed the sensitivity and importance of these species needs to be part of the environmental awareness program.	Life of operation	Project manager, Environmental Officer Lodge Manager	Protected Tree/Plant species	Ongoing
Management outcome: Fauna				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments, Signs must be put up to enforce this. A pre-construction walkthrough must be completed to identify any SCC that may be present in the development area, with specific reference to trapdoor, Baboon spiders and Tortoises. If encountered a specialist management plan must be designed for each species, as per provincial and national guidelines.	Construction/Operational Phase	Project manager, Environmental Officer	Infringement into these areas	Ongoing
Noise must be kept to an absolute minimum during the evenings and at night to minimize all possible disturbances to amphibian species and nocturnal mammals	Construction/Operational Phase	Environmental Officer	Noise levels	Ongoing
No trapping, killing, or poisoning of any wildlife is to be allowed • Signs must be put up to enforce this;	Life of operation	Environmental Officer	Evidence of trapping etc	Ongoing
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife, with specific reference to Tortoises.	Life of operation	Health and Safety Officer	Compliance to the training.	Ongoing

Schedule activities and operations during least sensitive periods, to avoid migration, nesting and breeding seasons.	Life of operation	Project manager, Environmental Officer & Design Engineer	Activities should take place during the day in the case.	Ongoing
All areas to be developed must be walked through prior to any activity to ensure no nests or fauna species are found in the area. Should any Species of Conservation Concern not move out of the area or their nest be found in the area a suitably qualified specialist must be consulted to advise on the correct actions to be taken.	Construction and Operational phase	Project manager, Environmental Officer	Presence of Nests and faunal species	Planning, Construction and Decommissioning
Any holes/deep excavations must be dug and planted in a progressive manner; Should the holes overnight they must be covered temporarily to ensure no small fauna species fall in.	Planning and construction	Environmental Officer & Contractor, Engineer	Presence of trapped animals and open holes	Ongoing

Management outcome: Alien Species				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas.	Construction/Operational Phase	Project manager, Environmental Officer & Contractor	Footprint Area	Life of operation
An alien management plan must be implemented quarterly for 2 years after the construction phase	Construction phase and Decommissioning phase	Project manager, Environmental Officer & Contractor	Assess presence and encroachment of alien vegetation	Quarterly for 2 years after phase

Management outcome: Dust				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes wetting of exposed soft soil surfaces. • No non environmentally friendly suppressants may be used as this could result in pollution of water sources	Life of operation	Contractor	Dustfall	Dust monitoring program.

Management outcome: Waste Management				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Waste management must be a priority and all waste must be collected and stored effectively.	Life of operation	Environmental Officer & Contractor	Waste Removal	Weekly
Litter, spills, fuels, chemicals and human waste in and around the development area.	Construction/Closure Phase	Environmental Officer & Health and Safety Officer	Presence of Waste	Daily

A minimum of one toilet must be provided per 10 persons. Portable toilets must be pumped dry to ensure the system does not degrade over time and spill into the surrounding area.	Life of operation	Environmental Officer & Health and Safety Officer	Number of toilets per staff member. Waste levels	Daily
The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility	Life of operation	Environmental Officer & Health and Safety Officer	Availability of bins and the collection of the waste.	Ongoing
Where a registered disposal facility is not available close to the development area, the Contractor shall provide a method statement with regard to waste management. Under no circumstances may domestic waste be burned on site	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Collection/handling of the waste.	Ongoing
Refuse bins will be emptied and secured Temporary storage of domestic waste shall be in covered waste skips. Maximum domestic waste storage period will be 10 days.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Management of bins and collection of waste	Ongoing, every 10 days

Management outcome: Environmental awareness training				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the development area to inform contractors and site staff of the presence of Red data species, their identification, conservation status and importance, biology, habitat requirements and management requirements the Environmental Authorisation and within the EMPr. The avoidance and protection of the riparian areas must be included into a site induction. Contractors and employees must all undergo the induction and made aware of the "no-go" to be avoided.	Life of operation	Health and Safety Officer	Compliance to the training.	Ongoing

Management outcome: Erosion				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Speed limits must be put in place to reduce erosion. • Reducing the dust generated by the listed activities above, especially the earth moving machinery, through wetting the soil surface and putting up signs to enforce speed limit as well as speed bumps built to force slow speeds; • Signs must be put up to enforce this.	Life of operation	Project manager, Environmental Officer	Water Runoff from road surfaces	Ongoing
Where possible, existing access routes and walking paths must be made use of.	Life of operation	Project manager, Environmental Officer	Routes used within the area	Ongoing

Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events and strong winds.	Life of operation	Project manager, Environmental Officer	Re-establishment of indigenous vegetation	Progressively

8.3 Aquatic Impact Assessment

8.3.1 Current impacts

Impacts along the powerline route are limited to the pylon footprint area and considered low should they be located outside of the delineated water resource. Impacts include erosion, low water crossings along servitude lines which resulted in significant erosion of banks and channels in drainage lines and impacts to water resource areas.

8.3.2 Anticipated Impacts

8.3.2.1 Construction Phase

The proposed powerline construction is regarded as low risk to the water resources should construction occur outside of the delineated areas as the footprint area is limited to the pylon base. However, the increase in traffic along the servitude is likely to increase erosion of channels and banks along drainage lines, larger riverine systems. Existing powerlines are currently in place on the proposed route and span across water courses. Upon observation of the bases of the pylons, minimal disturbances were observed. It is recommended that new pylon structures be situated in-line with existing pylons where these fall outside of delineated water resources. Should pylon placement be within the main water resources impacts would be considered moderate.

8.3.2.2 Operational Phase

During the operational phase, physical disturbances within the development area would be considered minimal should adequate management mitigation measures be implemented during the construction phase, and rehabilitation of disturbed areas undertaken. The powerlines pose low risks to the water resources during the operational phase should the pylons be constructed outside of the delineated water resources.

8.3.2.3 Decommissioning Phase

This phase is when the scaling down of activities ahead of temporary or permanent closure is initiated. During this phase, similar impacts are expected as during the construction phase.

8.3.3 Risk Assessment

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 509 by the Department of Water and Sanitation (DWS). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM). This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

Findings from the DWS aspect and impact register / risk assessment for the development area are provided in Section 8.3.3.1.

8.3.3.1 Development Area

For the proposed powerline crossing points, mitigation measures are largely associated with avoiding the delineated watercourse areas and implementing recommended buffer zones. Impacts are associated with the installation of pylons. The impact table for the powerline construction are presented in Table 8-10 and DWS risk assessment presented in Table 8-11 and Table 8-12. Risks associated with the proposed project range from moderate to low without mitigation measures, and with the implementation of adequate mitigation measures, all risks to the watercourses are rated as Low.

Table 8-10: Impacts assessed for the proposed powerline crossings

Aspect	Activity	Impacts to Watercourses
Construction		
Habitat integrity	Clearing associated with construction of pylons	Loss and degradation of hydromorphic, marginal, emergent and aquatic vegetation
		Smothering and subsequent loss of instream habitat due to sediment inputs
	Operation of equipment and machinery in watercourses	Disturbance and poaching of riverine soils and vegetation
Sediment balance	Excavation and vegetation clearing	Increase in sediment inputs & turbidity and associated smothering of instream/marginal vegetation and substrates
		Alteration of soil profile
		Loss of soil and organic matter from a water resource
	Soil and building material stockpile management	Increase in sediment inputs & turbidity and associated smothering and loss of instream habitat
		Input of toxicants
Water quality	Contamination due to improper storage of chemicals, construction materials, fuel and machinery leaks	Physical changes (e.g. turbidity)
		Chemical changes (e.g. pH, salinity toxicants and heavy metals)
		Loss of aquatic habitat and biota
Rehabilitation	Final landscaping and post-construction rehabilitation	Excess rubble and construction material in watercourse and riparian areas
		Improper re-establishment of original flow path and embankment slopes
		Increased sedimentation
		Increased erosion from exposed surfaces
Operation		
Stormwater	Increased hardened surfaces (pylon base) and appropriate stormwater management	Increased runoff and flow velocities entering the watercourse
		Increased flow concentration
		Increased erosion and scouring of bed and banks, especially in discharge areas
		Increased sedimentation and turbidity
Compiled by	**Christian Fry (Pr. Sci. Nat. 119082)**	

Table 8-11: DWS Risk Impact Matrix for the proposed project

Activity	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Construction of Pylon	2	3	3	3	2,75	2	3	7,75
Clearing areas	2	4	3	3	3	2	2	7
Operation of machinery & equipment	3	3	3	3	3	2	2	7
Staff ablutions	3	3	3	3	3	2	2	7
Stormwater Management	2	1	2	2	1,75	1	2	4,75
Erosion and sedimentation control	1	2	2	2	1,75	2	2	5,75
Operational Phase								
Site Management	2	1	2	1	1,5	3	4	8,5
Storm water management	2	1	1	1	1,25	3	4	8,25
Decommissioning Phase								
Construction of Pylon	2	3	3	3	2,75	2	3	7,75
Clearing areas	2	4	3	3	3	2	2	7
Operation of machinery & equipment	3	3	3	3	3	2	2	7
Staff ablutions	3	3	3	3	3	2	2	7

Table 8-12: DWS Risk Assessment Continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Construction of Pylon	1	4	1	2	8	62	**Moderate**	**Low**

Clearing areas	1	4	1	2	8	56	**Moderate**	**Low**
Operation of machinery & equipment	1	3	5	1	10	70	**Moderate**	**Low**
Staff ablutions	1	4	1	2	8	56	**Moderate**	**Low**
Stormwater Management	1	2	5	2	10	47,5	**Low**	**Low**
Erosion and sedimentation control	1	1	1	1	4	23	**Low**	**Low**
Operational Phase								
Site Management	1	2	1	1	5	42,5	**Low**	**Low**
Storm water management	1	1	1	1	4	33	**Low**	**Low**
Decommissioning Phase								
Construction of Pylon	1	4	1	2	8	62	**Moderate**	**Low**
Clearing areas	1	4	1	2	8	56	**Moderate**	**Low**
Operation of machinery & equipment	1	3	5	1	10	70	**Moderate**	**Low**
Staff ablutions	1	4	1	2	8	56	**Moderate**	**Low**

* In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below

8.3.4 Mitigation Measures

The following is prescribed in support of the aquatic ecology assessment:

- An adaptive rehabilitation plan needs to be implemented from the onset of the project. This must be compiled with input from independent ecological specialists; and
- A competent Environmental Control Officer (ECO) must oversee the construction and rehabilitation phase of the project, with watercourse areas as a priority.

8.3.4.1 General Mitigation Measures

The following general mitigation measures are provided:

- Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent them leaking and entering the environment;
- Mixing of concrete must under no circumstances take place within the drainage lines. No batching may be allowed on the bare ground, it must be readymix or batched on batching plates;
- The water resources outside of the specific development area must be avoided;
- Laydown yards, camps and storage areas must be beyond the watercourse areas. Where possible, the construction of the crossings must take place from the existing road and not from within the drainage line;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Prevent uncontrolled access of vehicles through the watercourse that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals and toxicants to be used for the construction must be stored outside the watercourses and in a bunded area within the site camp. Mobile refueling must be done over a drip tray beyond of all watercourse and buffer areas;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the development area. These should not be placed near any water course or in buffer zones. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the watercourses;

- All removed soil and material must not be stockpiled within the watercourses. Stockpiling should take place outside of watercourses. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Erosion and sedimentation into the drainage lines must be minimised through the effective stabilisation in compliance with the stormwater and erosion management plan (e.g. gabions and Reno mattresses) and the re-vegetation of any disturbed areas;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses that are drought tolerant) to protect the exposed soil;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported;
- Make sure all excess consumables and building materials / rubble are removed from site and deposited at an appropriate waste facility; and
- Landscape and re-vegetate all cleared areas as soon as possible to limit erosion potential.

8.4 Unplanned Events

The planned activities will have anticipated impacts as discussed; however, unplanned events may occur on any project and may have potential impacts which will need management.

Table 8-13 is a summary of the findings of an unplanned event assessment from a terrestrial ecology perspective. Note, not all potential unplanned events may be captured herein, and this must therefore be managed throughout all phases according to recorded events.

Table 8-13: Summary of unplanned events for terrestrial biodiversity

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spills into the surrounding environment	Contamination of habitat as well as water resources associated with the spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Fire	Uncontrolled/unmanaged fire that spreads to the surrounding natural grassland and ridges	Appropriate/Adequate fire management plan need to be implemented.
Wind erosion	Reduce habitat and remove topsoil layer	Rehabilitation and erosion monitoring plan

8.5 Cumulative Impact

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the

concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for terrestrial fauna and flora.

Localised cumulative impacts include the cumulative effects from operations that are close enough to potentially cause additive effects on the environment or sensitive receivers. These include dust deposition, noise and vibration, disruption of wildlife corridors or habitat, groundwater drawdown, groundwater and surface water quality, and transport.

There are numerous powerline in the area which have been considered for this assessment. The overall cumulative impact is expected to be moderate (Table 8-14).

Table 8-14: Cumulative impact assessment for the development

Impact Nature: Loss / Degradation to Local Ecology		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Low	Moderate
Duration	Long term	Long term
Magnitude	Moderate	Moderate
Probability	Probable	Highly probable
Significance	**Moderate**	**Moderate**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

9 Conclusion

9.1 Terrestrial Ecology

The land within proposed study area has been altered both currently and historically. The inhabitants of the farm and people from the general area have had an impact on both the fauna and the flora of the study area. It is apparent that at least some of the powerline corridor is situated on municipal land, therefore the access to these areas as well as impacts cannot be controlled at this stage. However, the Drainage lines, Rocky Ridges, Southern Karoo Riviere and Gamka Shrubland vegetation types, present across the entire study area can be regarded as important, not only within the local landscape, but also regionally; as they are used for habitat, foraging and movement corridors for fauna within a fragmented landscape. All the vegetation types encountered are well represented on a regional scale and the impact to them from this development is not regarded as a serious negative impact. No protected plant or animal species were encountered.

The grid connection development area traverses medium and high sensitivity areas. Development activities within the medium sensitivity areas can be considered favourably for development, only when all mitigation measures are implemented. Efforts must be taked to limit (where feasible) direct impacts to the high sensitivity areas (water resources), and minimise the extext of impacts to the high sensitivity areas (ridges).

9.2 Freshwater Ecology

The watercourses considered in this assessment were largely derived to be ephemeral drainage lines located within moderately modified to largely natural catchments. A network of drainage lines and the Gamka River are located within the development area.

The results of the habitat assessment for the Gamka River indicated largely modified instream habitat integrity. Modifications were attributed to abstraction in the upstream reaches (Beaufort West Dam) resulting in flow modifications. Solid waste disposal was observed on site. Numerous low water crossings within the reach have resulted in instream channel, bed and flow modifications. Agricultural and livestock activities contributed to erosion and instream sedimentation the assessed reach. Several instream impoundments occur within the sampled reach, reducing instream habitat integrity.

9.3 Impact Statement

An impact statement is required as per the NEMA regulations with regards to the proposed development.

9.3.1 Terrestrial

Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project, may be favourably considered, on condition all prescribed mitigation measures are implemented. A summary of impacts pre and post mitigation is displayed below in Table 9-1 to Table 9-4.

Table 9-1: No Go Option

Impact	Prior mitigation Significance	Post mitigation

Destruction, fragmentation and degradation of habitats and ecosystems due to grazing and trampling by livestock	**Moderate**	**Moderate**
Spread and/or establishment of alien and/or invasive species	**Moderate**	**Moderate**
Displacement of faunal community (Including several SCC) due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, hunting, dust, vibration)	**Moderate**	**Moderate**

Table 9-2: Construction Phase

Impact	Prior mitigation Significance	Post mitigation
Habitat Loss (Destroy, fragment and degrade habitat)	**Moderate**	**Low**
Spread and/or establishment of alien and/or invasive species	**Moderate**	**Low**
Displacement of faunal community (Including possible SCC) due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration)	**Moderate**	**Low**
Mortalities and displacements of fauna and flora SCCs	**Moderate**	**Low**

Table 9-3: Operational Phase

Impact	Prior mitigation Significance	Post mitigation
Continued Habitat Loss (Destroy, fragment and degrade habitat)	**Low**	**Absent**
Spread and/or establishment of alien and/or invasive species	**Moderate**	**Low**
Displacement and direct mortalities of faunal community (including SCC) due to disturbance (road collisions, collisions with substation, noise, light, dust, vibration)	**Moderate**	**Low**

Table 9-4: Decomisioning phase

Impact	Prior mitigation Significance	Post mitigation
Continued fragmentation and degradation of habitats and ecosystems	**Moderate**	**Low**
Spread and/or establishment of alien and/or invasive species	**Moderate**	**Low**

9.3.2 Aquatic

For the proposed powerline crossing points, mitigation measures are largely associated with avoiding the delineated watercourse areas and implementing recommended buffer zones. Impacts are associated with the installation of pylons. Risks associated with the proposed project range from moderate to low without mitigation measures, and with the implementation of adequate mitigation measures, all risks to the watercourses are rated as Low. Due to the expected low post-mitigation risks, a General Authorisation in terms on the National Water Act, 1998 is permissible for the development.

Aspect	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase				
Construction of Pylon	8	62	**Moderate**	**Low**
Clearing areas	8	56	**Moderate**	**Low**
Operation of machinery & equipment	10	70	**Moderate**	**Low**
Staff ablutions	8	56	**Moderate**	**Low**
Stormwater Management	10	47,5	**Low**	**Low**

Erosion and sedimentation control	4	23	**Low**	**Low**
Operational Phase				
Site Management	5	42,5	**Low**	**Low**
Storm water management	4	33	**Low**	**Low**
Decommissioning Phase				
Removal of Pylon	8	62	**Moderate**	**Low**
Clearing areas	8	56	**Moderate**	**Low**
Operation of machinery & equipment	10	70	**Moderate**	**Low**
Staff ablutions	8	56	**Moderate**	**Low**

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11 Appendices

Specialist declarations

DECLARATION

I, Rudolph Greffrath, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Rudolph Greffrath

Terrestrial Ecologist

The Biodiversity Company

September 2021

RUDOLPH GREFFRATH

Terrestrial Ecology Specialist

SACNASP Pr Sci Nat

Experience

Rudolph's current role is that of a senior terrestrial ecologist, with specific reference to fauna and flora biodiversity management. In this capacity he is responsible for the execution management of terrestrial ecological studies and the management of numerous specialists who perform this function under his leadership.

He has completed numerous independent reports where the sole focus was terrestrial ecology as well as integrated projects such as EIA reports and ESIA reports. With regards to the latter he has extensive experience in the interrelationship of the various biotic and abiotic specialist components and the concepts that can have an impact and must be discussed across the board. These reports are used for environmental authorisations or are focused specialist studies which meet local and international standards.

He is well versed in the demands of inter disciplinary cooperation, and has executed projects where a combination of highly academically qualified specialists have reported to him. He has experience in stakeholder engagement where the relationships with NGO's and other interested and affected parties must be established for the completion of projects to an acceptable international standard.

Rudolph has extensive experience in the application of the International Finance Corporation Performance standards, specifically performance standard 6. In this field he has worked within the extractive and energy sectors across Africa to ensure their compliance to IFC PS6. In applying international best practice he has gained experience in applying the No Net Loss and Net Positive Impact approaches for Biodiversity in a business context. He has experience in applying leading practice according to the Equator Principles, Business and Biodiversity Ofset Program, the Cross Sectoral Biodiversity Initiative, the Energy and Biodiversity Initiative, Fauna and Flora International, the International Petroleum Industry Environmental Conservation Association's guidance documents, the Economics of Ecosystems and Biodiversity and World Bank criteria, specifically Criteria 7.

Rudolph is responsible for off set design after a mitigation hierarchy is applied, in this regard he compiles Biodiversity Land Management Programs/Biodiversity Action Plans, where various specialist studies are collated into a working document for clients in order to aid in pre or post mining management and achieving the No Net Loss and Net Positive Impacts.

Further to this he is also involved in rehabilitation design studies which entail the planning, implementation and monitoring of vegetative rehabilitation. He is responsible for the planning of post mine land use and the various methods utilised to achieve this. Rudolph also fulfils the role of project manager. Here he manages national and international projects across Africa, specifically west, central and southern Africa, managing a multidisciplinary team of specialists. Rudolph is also involved in the acquisition of regulatory permits for clients, this includes the planning of relocation strategies for protected and endangered plant species in areas where mines are to be established. This involves the planning and execution of data gathering surveys. Thereafter he manages the process involving relevant provincial and National authorities in order to obtain the specific permit that allows for a development to continue.

Information pertaining to the technical expertise of Rudolph includes knowledge and working experience in the following:

- Environmental Impact Assessments (EIAs), Basic Assessments and Environmental Management Plans (EMPs) for environmental authorisations in terms of the South African National Environmental Management Act (NEMA), 1998 (Act 107 of 1998);
- Implementation of Government Notice 320 (dated 20 March 2020) and Government Notice 1150 (dated 30 October 2020) in terms of NEMA: "Procedures for the Assessment and

Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation;

- Environmental pre-feasibility studies for gold tailings reclamation and iron ore and coal mining projects;
- Convention on Biological Diversity, Strategic Planning for Biodiversity, Mechanisms for implementation, Cooperation and Partnerships;
- Business and Biodiversity Off Sets program, standards on biodiversity off sets;
- International Finance Corporation (IFC) related projects across central and west Africa, applying performance standards and Equator Principles on the Environmental Health and Safety Guidelines set down by the IFC;
- International Council for Mining and Metals, Conservation of Biodiversity and Integrated approaches to land use planning;
- European Investment Bank; application of sustainability principles, such as those of the International Finance Corporation (part of the World Bank Group), in particular on biodiversity. Standard 3 on Biodiversity and Ecosystems, as part of the EIB Environmental and Social Standards;
- Environmental and Social Impact Assessments (ESIA) for Environmental Authorisation;
- Environmental off-Set studies, determining off-set liability, applying the Mitigation hierarchy and best practice in the form of IFC performance standard 6.
- Large Mammal Monitoring Projects;
- Biodiversity Assessments including Mammalia, Avifauna, Herpetofauna and Arthropoda;
- Environmental Impact Assessments (EIA) based Impacts to the terrestrial Ecological environment;
- Geographic Information Systems (GIS), frequent use of ArcGIS, QGIS.
- Biodiversity Action Plan, design and Implementation;
- Biodiversity and Land Management Programs;
- Protected plant species management strategies planning and implementation;
- Monitoring of rehabilitation success by means of vegetation establishment;
- Rehabilitation planning;
- Environmental auditing of rehabilitated areas;
- Project management of ecological specialist studies; and
- Planning and design of Rehabilitation off-set strategies.

Tertiary Education

- 2005-2006: B-tech Degree in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).
- 2001- 2004: National Diploma in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

DECLARATION

I Christian Fry, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Christian Fry

Freshwater Ecologist

The Biodiversity Company

September 2021

Christian Fry

M.Sc. Aquatic Health

Cell: : +276 234 7001

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Identity Number: 8510025260084

Date of birth: 2nd October 1985

Pr. Sci. Nat. 119082

Profile Summary

- Experience within the mining and civil engineering sectors, locally and internationally.
- Providing aquatic ecological expertise for the assessment and management of freshwater systems.
- The implementation of aquatic biomonitoring programmes in accordance with licensing.

Areas of Interest

- Aquatic Ecology and Water Resource Management.
- Experimental design and project implementation.
- Fish Health
- Freshwater Macroinvertebrates
- Resource Sector and Renewable Energy & Infrastructure Development
- Aquatic Ecology and Water Resource Management.

Key Experience

- Familiar with World Bank, Equator Principles and the International Finance Corporation requirements
- Environmental, Social and Health Impact Assessments (ESHIA)
- Environmental Management Programmes (EMP)
- River Ecostatus Monitoring Programme methodologies
- Aquatic Ecological Assessments
- Aquaculture
- Biomonitoring Programmes
- Toxicity
- Fish community Assessments
- Ecological Flow Requirements

Countries worked in

South Africa, Mali, Mozambique, Liberia, Guinea
Tanzania

Nationality

South African

Languages

English,
siSwati,
Afrikaans.

Qualifications and Awards

- MSc (University of Johannesburg) – Aquatic Health (Cum laude).
- Schoonbee Medal Award: best postgraduate dissertation 2014
- Golden Key Award 2014
- BSc Honours (University of Johannesburg) – Aquatic Health
- BSc Zoology and Human Physiology
- SASS 5 Accredited – Department of Water Affairs and Sanitation for the River Health Programme
- Professional Natural Scientist: Aquatic Health (Reg. No: 119082)

SELECTED PROJECT EXPERIENCE

Project Name: Baseline Aquatic and Impact Study for the Proposed Mokolo and Crocodile River (West) Water Augmentation Project (Phase 2A) (MCWAP-2A): Water Transfer Infrastructure & Borrow Pits

Client: NEMAI Consulting

Personal position / role on project: Lead Aquatic Specialist.

Location: Limpopo, South Africa (2018).

Main project features: Baseline aquatic and impact assessment.

Project Name: A baseline and Impact Assessment for the Proposed Siguiri Gold Mine, Guinea.

Client: SRK

Personal position / role on project: Lead Aquatic Specialist.

Location: Siguiri Province, Guinea (2017- 2018).

Main project features: To conduct a dry and wet season (Winter) ecological baseline assessment of the watercourses for the proposed Siguiri Block 2 project

Project Name: A baseline and Impact Assessment for the Proposed Pavua Hydropower Station, Mozambique.

Client: Mott McDonald

Personal position / role on project: Lead Aquatic Specialist.

Location: Beira, Mozambique (2016- 2017).

Main project features: To conduct a dry and wet season (Winter) ecological baseline and impact assessment of the watercourses for the proposed Pavua Hydropower Station.

Project Name: An Aquatic Specialist Baseline and Impact Assessment for the Proposed Ndablama Gold Mine.

Client: Aureus Mining.

Personal position / role on project: Aquatic Specialist.

Location: Lofu Province, Liberia (2015- 2016).

Main project features: To conduct a dry and wet season (Winter) ecological baseline and impact assessment of the watercourses for the proposed Ndablama project. Establish aquatic monitoring protocol for aquatic systems.

Project Name: The Environmental and Social Impact Assessment (ESIA) the proposed solar photovoltaic facility and transmission in Cuamba

Personal position / role on project: Lead Aquatic Specialist.

Location: Mozambique

Main project features: To conduct a single season terrestrial and aquatic ecological baseline and impact assessment for the proposed development. The study was required to meet national and IFC requirements, including a Critical Habitat assessment.

Project Name: An Aquatic Baseline and Impact Assessment for the Proposed Italthai Railway Line.

Client: Italthai.

Personal position / role on project: Aquatic Specialist.

Location: Caia, Mozambique (2015).

Main project features: To conduct a dry season aquatic baseline and impact assessment for the proposed Italthai railway line from Tete to Quelimane

Project Name: A Joint Basin Survey of the Upper Orange, Lower Orange and Vaal catchments to determine the current status of the systems: Specialist Consultants to conduct Ecological Studies (Fish, Macroinvertebrate, Diatoms, Water Quality and Habitat) and report on the current status (defining system trends).

Client: ORASECOM.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (including Namibia, Botswana & Lesotho) (2015).

Main project features: To determine the current status of the catchments and to discuss the temporal and spatial trends of the monitoring reaches.

Project Name: Sabie River Fish Community Analyses

Client: Kruger National Park/ University of KwaZulu-Natal

Personal position / role on project: Aquatic Specialist.

Location: Kruger Park, South Africa (2016).

Main project features: Assess fish community structures in the Sabie River for the proposed raising of the Corumana Dam wall.

Project Name: Aquatic Biomonitoring of the Aquatic Systems for the Ilima Coal Mine, in Mpumalanga Province.

Client: GSW.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Carolina) – 2016 to present

Main project features: To conduct annual aquatic biomonitoring of the aquatic systems to assess the impacts of the mine on the river systems and aquatic biota.

Additional Project Experience

Project	Role	Resource	Client	Location
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Coal	Anglo Coal (Goedehoop)	South Africa (Mpumalanga)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Platinum	Sibanye Platinum	South Africa (Limpopo)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Gold	Sibanye Gold	South Africa (Limpopo)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Coal	Northern Coal (Jagtlust)	South Africa (Mpumalanga)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Coal	HCI Khusela Coal (Palesa)	South Africa
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Coal	Delta, Penumbra Ferreira	South Africa (Mpumalanga)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Vanadium	VanChem Vanadium	South Africa (Mpumalanga)
Aquatic Biomonitoring	Technical specialist	Coal	Msobo Coal (Spitzkop and Tselentis)	South Africa (Mpumalanga)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Coal	HCI Khusela Coal (Mbali)	South Africa (Mpumalanga)
WULA Requirements - Aquatic Biomonitoring	Technical specialist	Coal	DRD gold (Ergo)	South Africa (Gauteng)
Loulo Gold Mine	Technical specialist	Gold	Randgold Resources	Mali

Kriel Power Station Ash Dump Extention IWULA Application	Technical assistant	IWULA Application	Eskom (Kriel Power Station)	South Africa (Mpumalanga)
Aquatic Assessment (Braamfontein Spruit) Pro-bono	Technical specialist	Spruit Day Clean-up	Local Residence Association	South Africa (Gauteng)

ACADEMIC QUALIFICATIONS

University of Johannesburg/Danish Technical University, Aarhus, Denmark (2014):

MAGISTER SCIENTIAE CUM HONORIBUS (MSc) - Aquatic Health:

Title: *Experimental infection models and diagnosis of epizootic ulcerative syndrome in three-spot gourami (Trichogaster trichopterus) and rainbow trout (Oncorhynchus mykiss)*

University of Johannesburg, South Africa (2009): Bachelor of Science (Honours): Zoology (Aquatic Health)

Honours mini-dissertation: Effects of clove oil anaesthesia and euthanasia on the gill histology of the Sharptooth catfish (*Clarias gariepinus*)

University of Johannesburg, South Africa (2006-2008): Bachelor of Science Zoology (Aquatic Health) and Human Physiology.

PUBLICATIONS

Desai, M., Husted, A., Fry, C., Downs, C. T., & O'Brien, G. C. (2019). Spatial shifts and habitat partitioning of ichthyofauna within the middle–lower region of the Pungwe Basin, Mozambique. *Journal of Freshwater Ecology*, 34(1), 685–702. doi: 10.1080/02705060.2019.1673221

Fry C. 2021. A Field Guide Freshwater Macroinvertebrates of Southern Africa. In Press.

Appendix B Flora species expected in the study area and surrounds

Family	Genus	Sp1	IUCN	Ecology
Asteraceae	*Helichrysum*	*rosum*	LC	Indigenous; Endemic
Pteridaceae	*Pellaea*	*calomelanos*	LC	Indigenous
Ranunculaceae	*Clematis*	*brachiata*	LC	Indigenous
Rubiaceae	*Anthospermum*	*spathulatum*	LC	Indigenous
Poaceae	*Festuca*	*scabra*	LC	Indigenous
Cactaceae	*Cylindropuntia*	*imbricata*		Not indigenous; Naturalised; Invasive
Asphodelaceae	*Trachyandra*	*jacquiniana*	LC	Indigenous; Endemic
Aizoaceae	*Mesembryanthemum*	*granulicaule*		Indigenous
Euphorbiaceae	*Euphorbia*	*hypogaea*	LC	Indigenous; Endemic
Ranunculaceae	*Ranunculus*	*trichophyllus*	LC	Indigenous
Anacampserotaceae	*Anacampseros*	*arachnoides*	LC	Indigenous; Endemic
Crassulaceae	*Cotyledon*	*orbiculata*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*mauritanica*	LC	Indigenous
Campanulaceae	*Wahlenbergia*	*nodosa*	LC	Indigenous; Endemic
Asteraceae	*Gerbera*	*piloselloides*	LC	Indigenous
Hyacinthaceae	*Albuca*	*unifolia*	LC	Indigenous
Apocynaceae	*Xysmalobium*	*gomphocarpoides*	LC	Indigenous; Endemic
Rhamnaceae	*Rhamnus*	*prinoides*	LC	Indigenous
Aizoaceae	*Trichodiadema*	*barbatum*	LC	Indigenous; Endemic
Geraniaceae	*Pelargonium*	*malacoides*		Indigenous
Zygophyllaceae	*Tetraena*	*microcarpa*		Indigenous
Asteraceae	*Felicia*	*hirsuta*	LC	Indigenous
Melianthaceae	*Melianthus*	*comosus*	LC	Indigenous
Malvaceae	*Hermannia*	*vestita*	LC	Indigenous
Colchicaceae	*Ornithoglossum*	*sp.*		
Brassicaceae	*Lepidium*	*africanum*	LC	Indigenous
Oxalidaceae	*Oxalis*	*lanata*	LC	Indigenous; Endemic
Asphodelaceae	*Haworthia*	*semiviva*	LC	Indigenous; Endemic
Asteraceae	*Geigeria*	*ornativa*	LC	Indigenous
Asteraceae	*Dimorphotheca*	*cuneata*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*emarcidum*		Indigenous; Endemic
Asteraceae	*Senecio*	*striatifolius*	LC	Indigenous

Cucurbitaceae	*Kedrostis*	*africana*	LC	Indigenous
Apiaceae	*Conium*	*chaerophylloides*	LC	Indigenous
Santalaceae	*Thesium*	*gnidiaceum*	LC	Indigenous; Endemic
Asteraceae	*Pteronia*	*hutchinsoniana*	LC	Indigenous; Endemic
Santalaceae	*Viscum*	*continuum*	LC	Indigenous; Endemic
Asteraceae	*Pteronia*	*glauca*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon*	*deserticola*	LC	Indigenous; Endemic
Amaranthaceae	*Gamka*	*seminuda*	LC	Indigenous
Iridaceae	*Syringodea*	*concolor*	LC	Indigenous; Endemic
Verbenaceae	*Lantana*	*rugosa*	LC	Indigenous
Asteraceae	*Eriocephalus*	*africanus*	LC	Indigenous; Endemic
Iridaceae	*Ixia*	*marginifolia*	LC	Indigenous; Endemic
Santalaceae	*Lacomucinaea*	*lineata*		Indigenous
Gisekiaceae	*Gisekia*	*pharnaceoides*	LC	Indigenous
Anacardiaceae	*Searsia*	*undulata*	LC	Indigenous
Asteraceae	*Lasiopogon*	*glomerulatus*	LC	Indigenous
Asteraceae	*Cuspidia*	*cernua*	LC	Indigenous; Endemic
Amaranthaceae	*Atriplex*	*nummularia*		Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Hebenstretia*	*robusta*	LC	Indigenous; Endemic
Amaranthaceae	*Gamka*	*adisca*	LC	Indigenous; Endemic
Fabaceae	*Psoralea*	*aphylla*	LC	Indigenous; Endemic
Geraniaceae	*Monsonia*	*crassicaulis*	LC	Indigenous
Amaranthaceae	*Gamka*	*dealata*	LC	Indigenous; Endemic
Asteraceae	*Oedera*	*humilis*		Indigenous
Ebenaceae	*Diospyros*	*lycioides*	LC	Indigenous
Caryophyllaceae	*Scleranthus*	*sp.*		
Scrophulariaceae	*Aptosimum*	*procumbens*	LC	Indigenous
Asteraceae	*Osteospermum*	*sinuatum*	LC	Indigenous
Rubiaceae	*Kohautia*	*cynanchica*	LC	Indigenous
Asteraceae	*Felicia*	*fascicularis*	LC	Indigenous
Hyacinthaceae	*Drimia*	*toxicaria*		Indigenous
Geraniaceae	*Pelargonium*	*tetragonum*	LC	Indigenous; Endemic
Asteraceae	*Pentzia*	*incana*	LC	Indigenous
Acanthaceae	*Blepharis*	*mitrata*	LC	Indigenous

Asphodelaceae	*Gasteria*	*disticha*		Indigenous
Asteraceae	*Garuleum*	*bipinnatum*	LC	Indigenous; Endemic
Asteraceae	*Curio*	*radicans*	LC	Indigenous
Hyacinthaceae	*Lachenalia*	*aurioliae*	LC	Indigenous; Endemic
Poaceae	*Bromus*	*pectinatus*	LC	Indigenous
Brassicaceae	*Sisymbrium*	*capense*	LC	Indigenous
Acanthaceae	*Justicia*	*incana*		Indigenous
Malvaceae	*Hermannia*	*cuneifolia*	LC	Indigenous
Poaceae	*Enneapogon*	*scaber*	LC	Indigenous
Asteraceae	*Helichrysum*	*hamulosum*	LC	Indigenous; Endemic
Apocynaceae	*Asclepias*	*sp.*		
Brassicaceae	*Heliophila*	*minima*	LC	Indigenous
Zygophyllaceae	*Roepera*	*sessilifolia*		Indigenous
Poaceae	*Stipagrostis*	*obtusa*	LC	Indigenous
Malvaceae	*Hermannia*	*desertorum*	LC	Indigenous
Poaceae	*Oropetium*	*capense*	LC	Indigenous
Poaceae	*Digitaria*	*argyrograpta*	LC	Indigenous
Urticaceae	*Urtica*	*lobulata*	LC	Indigenous
Aizoaceae	*Tetragonia*	*microptera*	LC	Indigenous
Aizoaceae	*Galenia*	*acutifolia*	LC	Indigenous; Endemic
Hyacinthaceae	*Albuca*	*setosa*	LC	Indigenous
Scrophulariaceae	*Peliostomum*	*leucorrhizum*	LC	Indigenous
Asteraceae	*Eriocephalus*	*spinescens*	LC	Indigenous; Endemic
Euphorbiaceae	*Euphorbia*	*rhombifolia*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon*	*sp.*		
Poaceae	*Tenaxia*	*disticha*		Indigenous
Poaceae	*Enneapogon*	*scoparius*	LC	Indigenous
Santalaceae	*Thesium*	*lacinulatum*	LC	Indigenous
Lamiaceae	*Salvia*	*verbenaca*	LC	Not indigenous; Naturalised; Invasive
Malvaceae	*Radyera*	*urens*	LC	Indigenous
Aizoaceae	*Tetragonia*	*sp.*		
Euphorbiaceae	*Euphorbia*	*stolonifera*	LC	Indigenous; Endemic
Asteraceae	*Eriocephalus*	*tenuifolius*	LC	Indigenous
Scrophulariaceae	*Diascia*	*capsularis*	LC	Indigenous

Frankeniaceae	*Frankenia*	*pulverulenta*	LC	Indigenous
Capparaceae	*Cadaba*	*aphylla*	LC	Indigenous
Asphodelaceae	*Bulbine*	*sp.*		
Polygalaceae	*Polygala*	*asbestina*	LC	Indigenous; Endemic
Poaceae	*Stipagrostis*	*uniplumis*	LC	Indigenous
Aizoaceae	*Drosanthemum*	*sp.*		
Asphodelaceae	*Haworthiopsis*	*nigra*		Indigenous; Endemic
Aizoaceae	*Delosperma*	*sp.*		
Colchicaceae	*Ornithoglossum*	*vulgare*	LC	Indigenous
Aizoaceae	*Trichodiadema*	*attonsum*	LC	Indigenous; Endemic
Poaceae	*Panicum*	*maximum*	LC	Indigenous
Poaceae	*Hyparrhenia*	*hirta*	LC	Indigenous
Poaceae	*Eragrostis*	*homomalla*	LC	Indigenous
Cactaceae	*Opuntia*	*ficus-indica*	NE	Not indigenous; Cultivated; Naturalised; Invasive
Malvaceae	*Hermannia*	*spinosa*	LC	Indigenous
Asteraceae	*Helichrysum*	*caespititium*	LC	Indigenous
Cyperaceae	*Cyperus*	*bellus*	LC	Indigenous
Poaceae	*Themeda*	*triandra*	LC	Indigenous
Fabaceae	*Indigofera*	*sessilifolia*	LC	Indigenous
Lamiaceae	*Ballota*	*africana*	LC	Indigenous
Asteraceae	*Dicoma*	*picta*	LC	Indigenous; Endemic
Peraceae	*Clutia*	*thunbergii*	LC	Indigenous
Araliaceae	*Cussonia*	*paniculata*	LC	Indigenous; Endemic
Lamiaceae	*Stachys*	*rugosa*	LC	Indigenous
Bignoniaceae	*Rhigozum*	*trichotomum*	LC	Indigenous
Fabaceae	*Prosopis*	*velutina*	NE	Not indigenous; Naturalised; Invasive
Aizoaceae	*Malephora*	*thunbergii*	LC	Indigenous; Endemic
Fabaceae	*Melolobium*	*candicans*	LC	Indigenous
Fabaceae	*Melolobium*	*sp.*		
Asteraceae	*Relhania*	*sp.*		
Poaceae	*Schismus*	*barbatus*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia*	*atropurpurea*	LC	Indigenous
Iridaceae	*Moraea*	*cookii*	LC	Indigenous
Poaceae	*Eragrostis*	*bicolor*	LC	Indigenous

Aizoaceae	*Stomatium*	*sp.*		
Asteraceae	*Troglophyton*	*capillaceum*	LC	Indigenous
Anacardiaceae	*Searsia*	*pallens*	LC	Indigenous
Asparagaceae	*Asparagus*	*capensis*	LC	Indigenous
Asteraceae	*Arctotis*	*dregei*	LC	Indigenous; Endemic
Pteridaceae	*Pellaea*	*rufa*	LC	Indigenous; Endemic
Apocynaceae	*Stapelia*	*engleriana*	DD	Indigenous; Endemic
Asteraceae	*Leysera*	*tenella*	LC	Indigenous
Scrophulariaceae	*Nemesia*	*fruticans*	LC	Indigenous
Asteraceae	*Pentzia*	*calcarea*	LC	Indigenous
Scrophulariaceae	*Limosella*	*vesiculosa*	LC	Indigenous
Geraniaceae	*Erodium*	*cicutarium*		Not indigenous; Naturalised; Invasive
Poaceae	*Eragrostis*	*cylindriflora*	LC	Indigenous
Poaceae	*Melica*	*decumbens*	LC	Indigenous
Cactaceae	*Tephrocactus*	*articulatus*		Not indigenous; Naturalised; Invasive
Solanaceae	*Lycium*	*horridum*	LC	Indigenous
Scrophulariaceae	*Zaluzianskya*	*venusta*	LC	Indigenous; Endemic
Verbenaceae	*Chascanum*	*pumilum*	LC	Indigenous
Poaceae	*Pennisetum*	*setaceum*	NE	Not indigenous; Naturalised; Invasive
Anacardiaceae	*Searsia*	*lancea*	LC	Indigenous
Aizoaceae	*Schlechteranthus*	*spinescens*		Indigenous; Endemic
Pteridaceae	*Cheilanthes*	*hirta*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon*	*polycephalus*	LC	Indigenous
Asteraceae	*Senecio*	*inaequidens*	LC	Indigenous
Cyperaceae	*Cyperus*	*squarrosus*	LC	Indigenous
Scrophulariaceae	*Selago*	*sp.*		
Asteraceae	*Pentzia*	*punctata*	LC	Indigenous
Fabaceae	*Indigofera*	*alternans*	LC	Indigenous
Cyperaceae	*Schoenoplectus*	*decipiens*	LC	Indigenous
Apocynaceae	*Piaranthus*	*comptus*	LC	Indigenous; Endemic
Solanaceae	*Lycium*	*pumilum*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*noctiflorum*		Indigenous
Asteraceae	*Helichrysum*	*scitulum*	LC	Indigenous; Endemic
Asteraceae	*Eriocephalus*	*ericoides*	LC	Indigenous

Asteraceae	*Cotula*	*australis*	LC	Indigenous
Apocynaceae	*Piaranthus*	*sp.*		
Asparagaceae	*Asparagus*	*mucronatus*	LC	Indigenous; Endemic
Crassulaceae	*Crassula*	*barbata*	LC	Indigenous; Endemic
Poaceae	*Eragrostis*	*lehmanniana*	LC	Indigenous
Zygophyllaceae	*Tetraena*	*chrysopteron*		Indigenous
Asphodelaceae	*Haworthiopsis*	*tessellata*		Indigenous
Aizoaceae	*Galenia*	*papulosa*	LC	Indigenous
Poaceae	*Leptochloa*	*fusca*	LC	Indigenous
Asteraceae	*Othonna*	*sp.*		
Fabaceae	*Indigofera*	*dillwynioides*	LC	Indigenous; Endemic
Scrophulariaceae	*Nemesia*	*sp.*		
Asteraceae	*Berkheya*	*pinnatifida*	LC	Indigenous; Endemic
Geraniaceae	*Pelargonium*	*carnosum*	LC	Indigenous
Apocynaceae	*Brachystelma*	*circinatum*	LC	Indigenous
Caryophyllaceae	*Dianthus*	*micropetalus*	LC	Indigenous
Cactaceae	*Cylindropuntia*	*fulgida*		Not indigenous; Naturalised
Crassulaceae	*Crassula*	*socialis*	LC	Indigenous; Endemic
Aizoaceae	*Drosanthemum*	*vespertinum*	LC	Indigenous; Endemic
Scrophulariaceae	*Cromidon*	*decumbens*	LC	Indigenous; Endemic
Aizoaceae	*Tetragonia*	*arbuscula*	LC	Indigenous
Poaceae	*Eragrostis*	*rotifer*	LC	Indigenous
Fabaceae	*Prosopis*	*glandulosa*	NE	Not indigenous; Naturalised
Asteraceae	*Pentzia*	*lanata*	LC	Indigenous
Malvaceae	*Malva*	*pusilla*		Not indigenous; Naturalised
Scrophulariaceae	*Zaluzianskya*	*karrooica*	LC	Indigenous; Endemic
Asphodelaceae	*Bulbine*	*abyssinica*	LC	Indigenous
Apocynaceae	*Stapelia*	*grandiflora*	LC	Indigenous
Poaceae	*Capeochloa*	*arundinacea*	LC	Indigenous
Asteraceae	*Gazania*	*krebsiana*	LC	Indigenous
Asphodelaceae	*Aloe*	*claviflora*	LC	Indigenous
Scrophulariaceae	*Nemesia*	*floribunda*	LC	Indigenous
Apiaceae	*Deverra*	*denudata*	LC	Indigenous
Asteraceae	*Felicia*	*ovata*	LC	Indigenous; Endemic

Scrophulariaceae	*Buddleja*	*glomerata*	LC	Indigenous; Endemic
Poaceae	*Tragus*	*berteronianus*	LC	Indigenous
Celastraceae	*Gymnosporia*	*buxifolia*	LC	Indigenous
Asteraceae	*Euryops*	*trifidus*	LC	Indigenous; Endemic
Asteraceae	*Cineraria*	*aspera*	LC	Indigenous
Acanthaceae	*Blepharis*	*capensis*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*cuneifolia*	LC	Indigenous
Poaceae	*Cynodon*	*dactylon*	LC	Indigenous
Amaranthaceae	*Sericocoma*	*sp.*		
Asteraceae	*Pegolettia*	*retrofracta*	LC	Indigenous
Limeaceae	*Limeum*	*sp.*		
Fabaceae	*Lotononis*	*caerulescens*	LC	Indigenous; Endemic
Crassulaceae	*Cotyledon*	*cuneata*	LC	Indigenous; Endemic
Lamiaceae	*Mentha*	*longifolia*	LC	Indigenous
Poaceae	*Tragus*	*koelerioides*	LC	Indigenous
Hyacinthaceae	*Ornithogalum*	*sp.*		
Aizoaceae	*Tetragonia*	*robusta*	LC	Indigenous; Endemic
Aizoaceae	*Galenia*	*secunda*	LC	Indigenous
Fabaceae	*Lessertia*	*frutescens*	LC	Indigenous
Asteraceae	*Felicia*	*muricata*	LC	Indigenous
Rubiaceae	*Anthospermum*	*sp.*		
Aizoaceae	*Mesembryanthemum*	*nodiflorum*	LC	Indigenous
Poaceae	*Aristida*	*sp.*		
Malvaceae	*Hermannia*	*cernua*	LC	Indigenous
Asteraceae	*Gazania*	*ciliaris*	LC	Indigenous; Endemic
Solanaceae	*Lycium*	*hirsutum*	LC	Indigenous
Asteraceae	*Pentzia*	*quinquefida*	LC	Indigenous; Endemic
Loranthaceae	*Moquiniella*	*rubra*	LC	Indigenous
Fabaceae	*Melolobium*	*microphyllum*	LC	Indigenous
Amaranthaceae	*Atriplex*	*suberecta*	LC	Not indigenous; Naturalised; Invasive
Ophioglossaceae	*Ophioglossum*	*polyphyllum*	LC	Indigenous
Lamiaceae	*Salvia*	*disermas*	LC	Indigenous
Iridaceae	*Moraea*	*crispa*	LC	Indigenous
Asteraceae	*Cotula*	*microglossa*	LC	Indigenous; Endemic

Aizoaceae	*Galenia*	*glandulifera*	LC	Indigenous; Endemic
Anacampserotaceae	*Anacampseros*	*albidiflora*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*althaeifolia*	LC	Indigenous; Endemic
Hypoxidaceae	*Empodium*	*elongatum*	LC	Indigenous
Crassulaceae	*Tylecodon*	*wallichii*	LC	Indigenous; Endemic
Dipsacaceae	*Scabiosa*	*columbaria*	LC	Indigenous
Scrophulariaceae	*Chaenostoma*	*macrosiphon*	LC	Indigenous; Endemic
Poaceae	*Melinis*	*repens*	LC	Indigenous
Scrophulariaceae	*Hebenstretia*	*parviflora*	LC	Indigenous
Scrophulariaceae	*Selago*	*magnakarooica*	LC	Indigenous; Endemic
Iridaceae	*Gladiolus*	*permeabilis*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*stricta*	LC	Indigenous
Malvaceae	*Anisodontea*	*triloba*	LC	Indigenous; Endemic
Poaceae	*Cymbopogon*	*pospischilii*	NE	Indigenous
Asparagaceae	*Asparagus*	*sp.*		
Aizoaceae	*Ruschia*	*beaufortensis*	LC	Indigenous; Endemic
Fabaceae	*Lotononis*	*azureoides*	LC	Indigenous; Endemic
Crassulaceae	*Cotyledon*	*orbiculata*	LC	Indigenous
Cucurbitaceae	*Cucumis*	*africanus*	LC	Indigenous
Solanaceae	*Solanum*	*retroflexum*	LC	Indigenous
Poaceae	*Stipagrostis*	*ciliata*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*excavatum*	LC	Indigenous; Endemic
Solanaceae	*Lycium*	*cinereum*	LC	Indigenous
Asteraceae	*Helichrysum*	*trilineatum*	LC	Indigenous
Apocynaceae	*Pachypodium*	*succulentum*	LC	Indigenous; Endemic
Asteraceae	*Gazania*	*lichtensteinii*	LC	Indigenous
Rhamnaceae	*Phylica*	*purpurea*		Indigenous
Apocynaceae	*Piaranthus*	*geminatus*	LC	Indigenous; Endemic
Hyacinthaceae	*Ornithogalum*	*comptonii*	LC	Indigenous; Endemic
Aizoaceae	*Galenia*	*sarcophylla*	LC	Indigenous
Hyacinthaceae	*Albuca*	*namaquensis*	LC	Indigenous
Poaceae	*Aristida*	*congesta*	LC	Indigenous
Aizoaceae	*Galenia*	*sp.*		
Scrophulariaceae	*Manulea*	*sp.*		

Polygalaceae	*Polygala*	*sp.*		
Zygophyllaceae	*Roepera*	*lichtensteiniana*		Indigenous
Lamiaceae	*Stachys*	*linearis*	LC	Indigenous
Poaceae	*Setaria*	*verticillata*	LC	Indigenous
Scrophulariaceae	*Nemesia*	*cynanchifolia*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*articulatum*		Indigenous
Asphodelaceae	*Trachyandra*	*karrooica*	LC	Indigenous
Malvaceae	*Hermannia*	*pulchella*	LC	Indigenous
Scrophulariaceae	*Aptosimum*	*indivisum*	LC	Indigenous
Bignoniaceae	*Rhigozum*	*obovatum*	LC	Indigenous
Rubiaceae	*Galium*	*capense*	LC	Indigenous
Asphodelaceae	*Haworthia*	*marumiana*	NE	Indigenous; Endemic
Colchicaceae	*Colchicum*	*melanthioides*	LC	Indigenous
Ranunculaceae	*Ranunculus*	*multifidus*	LC	Indigenous
Amaranthaceae	*Atriplex*	*lindleyi*		Not indigenous; Naturalised; Invasive
Poaceae	*Eragrostis*	*curvula*	LC	Indigenous
Limeaceae	*Limeum*	*aethiopicum*	NE	Indigenous; Endemic
Poaceae	*Stipagrostis*	*namaquensis*	LC	Indigenous
Poaceae	*Eragrostis*	*procumbens*	LC	Indigenous
Asteraceae	*Macledium*	*spinosum*	LC	Indigenous; Endemic
Asteraceae	*Ursinia*	*nana*	LC	Indigenous
Asteraceae	*Senecio*	*burchellii*	LC	Indigenous; Endemic
Boraginaceae	*Lobostemon*	*stachydeus*	LC	Indigenous
Amaranthaceae	*Chenopodium*	*mucronatum*	LC	Indigenous
Fabaceae	*Lessertia*	*frutescens*	LC	Indigenous
Asteraceae	*Pteronia*	*bolusii*	LC	Indigenous; Endemic
Asteraceae	*Arctotis*	*subacaulis*	LC	Indigenous
Amaranthaceae	*Gamka*	*atrata*	LC	Indigenous; Endemic
Juncaceae	*Juncus*	*inflexus*	LC	Indigenous
Fabaceae	*Argyrolobium*	*argenteum*	LC	Indigenous; Endemic
Poaceae	*Sporobolus*	*ioclados*	LC	Indigenous
Poaceae	*Fingerhuthia*	*sesleriiformis*	LC	Indigenous
Aizoaceae	*Trichodiadema*	*densum*	LC	Indigenous; Endemic
Scrophulariaceae	*Selago*	*geniculata*	LC	Indigenous; Endemic

Malvaceae	*Hermannia*	*burkei*	LC	Indigenous
Boraginaceae	*Anchusa*	*riparia*	LC	Indigenous
Aizoaceae	*Drosanthemum*	*lique*	LC	Indigenous; Endemic
Crassulaceae	*Cotyledon*	*papillaris*	LC	Indigenous
Crassulaceae	*Cotyledon*	*sp.*		
Scrophulariaceae	*Selago*	*centralis*	LC	Indigenous
Apiaceae	*Heteromorpha*	*arborescens*	LC	Indigenous; Endemic
Ebenaceae	*Diospyros*	*austroafricana*	LC	Indigenous
Acanthaceae	*Barleria*	*stimulans*	LC	Indigenous; Endemic
Fabaceae	*Medicago*	*laciniata*	NE	Not indigenous; Naturalised
Asteraceae	*Pteronia*	*viscosa*	LC	Indigenous
Asteraceae	*Gnaphalium*	*capense*	LC	Indigenous; Endemic
Asteraceae	*Euryops*	*subcarnosus*	LC	Indigenous
Fabaceae	*Lessertia*	*inflata*	LC	Indigenous; Endemic
Poaceae	*Aristida*	*diffusa*	LC	Indigenous
Malvaceae	*Malva*	*parviflora*		Not indigenous; Naturalised
Aizoaceae	*Malephora*	*lutea*	LC	Indigenous; Endemic
Brassicaceae	*Heliophila*	*carnosa*	LC	Indigenous
Geraniaceae	*Pelargonium*	*sidoides*	LC	Indigenous
Boraginaceae	*Heliotropium*	*ciliatum*	LC	Indigenous
Aizoaceae	*Aizoon*	*rigidum*	LC	Indigenous; Endemic
Poaceae	*Melinis*	*repens*	LC	Indigenous
Bryaceae	*Bryum*	*argenteum*		Indigenous
Fabaceae	*Lotononis*	*pungens*	LC	Indigenous; Endemic
Lobeliaceae	*Lobelia*	*dregeana*	LC	Indigenous
Hyacinthaceae	*Albuca*	*sp.*		
Asparagaceae	*Asparagus*	*suaveolens*	LC	Indigenous
Oleaceae	*Menodora*	*juncea*	LC	Indigenous; Endemic
Pteridaceae	*Cheilanthes*	*induta*	LC	Indigenous; Endemic
Aizoaceae	*Delosperma*	*aberdeenense*	LC	Indigenous; Endemic
Apocynaceae	*Carissa*	*bispinosa*	LC	Indigenous
Pteridaceae	*Cheilanthes*	*eckloniana*	LC	Indigenous
Poaceae	*Cenchrus*	*ciliaris*	LC	Indigenous
Malvaceae	*Anisodontea*	*sp.*		

Asteraceae	*Felicia*	*sp.*		
Aizoaceae	*Ruschia*	*intricata*	LC	Indigenous; Endemic
Orchidaceae	*Holothrix*	*villosa*	LC	Indigenous; Endemic
Asparagaceae	*Asparagus*	*lignosus*	LC	Indigenous; Endemic
Asteraceae	*Arctotis*	*venusta*	LC	Indigenous
Anacampserotaceae	*Anacampseros*	*filamentosa*		Indigenous; Endemic
Aizoaceae	*Ruschia*	*sp.*		
Amaranthaceae	*Atriplex*	*semibaccata*		Not indigenous; Naturalised; Invasive
Bruniaceae	*Audouinia*	*esterhuyseniae*	VU	Indigenous; Endemic
Asteraceae	*Helichrysum*	*asperum*	LC	Indigenous; Endemic
Asteraceae	*Pteronia*	*staehelinoides*	LC	Indigenous; Endemic
Amaryllidaceae	*Gethyllis*	*longistyla*	LC	Indigenous; Endemic
Asteraceae	*Sonchus*	*dregeanus*	LC	Indigenous
Asteraceae	*Senecio*	*achilleifolius*	LC	Indigenous
Asteraceae	*Senecio*	*cotyledonis*	LC	Indigenous
Geraniaceae	*Pelargonium*	*sessiliflorum*		Indigenous; Endemic
Asteraceae	*Berkheya*	*sp.*		
Malvaceae	*Abutilon*	*sonneratianum*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia*	*atropurpurea*		Indigenous
Asphodelaceae	*Gasteria*	*sp.*		
Poaceae	*Sporobolus*	*fimbriatus*	LC	Indigenous
Rubiaceae	*Anthospermum*	*rigidum*	LC	Indigenous
Hyacinthaceae	*Dipcadi*	*viride*	LC	Indigenous
Aizoaceae	*Drosanthemum*	*calycinum*	NT	Indigenous; Endemic
Asparagaceae	*Asparagus*	*exuvialis*	NE	Indigenous
Asphodelaceae	*Bulbine*	*triebneri*	LC	Indigenous
Apocynaceae	*Gomphocarpus*	*tomentosus*	LC	Indigenous
Apocynaceae	*Tridentea*	*jucunda*	LC	Indigenous
Hyacinthaceae	*Ornithogalum*	*hispidum*	LC	Indigenous
Poaceae	*Eragrostis*	*bergiana*	LC	Indigenous
Poaceae	*Pentameris*	*airoides*	LC	Indigenous
Asteraceae	*Arctotis*	*leiocarpa*	LC	Indigenous
Geraniaceae	*Pelargonium*	*griseum*	LC	Indigenous; Endemic
Aspleniaceae	*Asplenium*	*adiantum-nigrum*	LC	Indigenous

Asteraceae	*Helichrysum*	*lineare*	LC	Indigenous
Boraginaceae	*Trichodesma*	*africanum*	LC	Indigenous
Asteraceae	*Felicia*	*namaquana*	LC	Indigenous
Asparagaceae	*Asparagus*	*aethiopicus*	LC	Indigenous
Geraniaceae	*Pelargonium*	*ribifolium*	LC	Indigenous; Endemic
Asteraceae	*Senecio*	*muirii*	LC	Indigenous; Endemic
Asteraceae	*Senecio*	*asperulus*	LC	Indigenous
Asteraceae	*Osteospermum*	*calendulaceum*	LC	Indigenous; Endemic
Asteraceae	*Felicia*	*hyssopifolia*	LC	Indigenous
Cyperaceae	*Afroscirpoides*	*dioeca*		Indigenous
Asteraceae	*Helichrysum*	*pumilio*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*filifolia*	NE	Indigenous; Endemic
Crassulaceae	*Crassula*	*montana*	LC	Indigenous; Endemic
Iridaceae	*Tritonia*	*florentiae*	LC	Indigenous; Endemic
Fabaceae	*Indigofera*	*meyeriana*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*coccocarpa*	LC	Indigenous
Hyacinthaceae	*Drimia*	*physodes*	LC	Indigenous
Hyacinthaceae	*Drimia*	*intricata*	LC	Indigenous
Geraniaceae	*Monsonia*	*salmoniflora*	LC	Indigenous
Scrophulariaceae	*Selago*	*saxatilis*	LC	Indigenous
Aizoaceae	*Drosanthemum*	*hispidum*	LC	Indigenous
Lamiaceae	*Salvia*	*stenophylla*		Indigenous
Bryaceae	*Bryum*	*radiculosum*		Indigenous
Campanulaceae	*Wahlenbergia*	*cernua*	LC	Indigenous; Endemic
Orchidaceae	*Eulophia*	*hians*	LC	Indigenous
Scrophulariaceae	*Chaenostoma*	*sp.*		
Euphorbiaceae	*Euphorbia*	*stellispina*	LC	Indigenous; Endemic
Malvaceae	*Anisodontea*	*anomala*	LC	Indigenous; Endemic
Asteraceae	*Gazania*	*krebsiana*	LC	Indigenous
Aizoaceae	*Malephora*	*crocea*	LC	Indigenous; Endemic
Asteraceae	*Chrysocoma*	*ciliata*	LC	Indigenous
Asteraceae	*Crassothonna*	*protecta*	LC	Indigenous
Asteraceae	*Osteospermum*	*scariosum*	NE	Indigenous
Scrophulariaceae	*Aptosimum*	*spinescens*	LC	Indigenous

Convolvulaceae	*Cuscuta*	*campestris*		Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Limosella*	*africana*	LC	Indigenous
Santalaceae	*Thesium*	*hystricoides*	LC	Indigenous
Fabaceae	*Lessertia*	*annularis*	LC	Indigenous
Apocynaceae	*Gomphocarpus*	*filiformis*	LC	Indigenous
Campanulaceae	*Wahlenbergia*	*undulata*	LC	Indigenous
Asteraceae	*Oncosiphon*	*piluliferus*	LC	Indigenous
Zygophyllaceae	*Zygophyllum*	*sp.*		
Asphodelaceae	*Bulbine*	*frutescens*	LC	Indigenous
Poaceae	*Sporobolus*	*tenellus*	LC	Indigenous
Asteraceae	*Senecio*	*pinnulatus*	LC	Indigenous; Endemic
Malvaceae	*Grewia*	*robusta*	LC	Indigenous; Endemic
Fabaceae	*Indigofera*	*exigua*	LC	Indigenous; Endemic
Asteraceae	*Leysera*	*gnaphalodes*	LC	Indigenous
Asteraceae	*Arctotis*	*microcephala*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*guerichianum*	LC	Indigenous
Boraginaceae	*Cynoglossum*	*obtusicalyx*	LC	Indigenous; Endemic
Anacardiaceae	*Searsia*	*pyroides*	LC	Indigenous
Scrophulariaceae	*Limosella*	*grandiflora*	LC	Indigenous
Marsileaceae	*Marsilea*	*burchellii*	LC	Indigenous
Santalaceae	*Viscum*	*rotundifolium*	LC	Indigenous
Scrophulariaceae	*Selago*	*acocksii*	LC	Indigenous; Endemic
Brassicaceae	*Brassica*	*tournefortii*		Not indigenous; Naturalised; Invasive
Asteraceae	*Pentzia*	*globosa*	LC	Indigenous
Gentianaceae	*Sebaea*	*sp.*		
Asphodelaceae	*Astroloba*	*sp.*		
Asteraceae	*Dimorphotheca*	*sp.*		
Poaceae	*Polypogon*	*sp.*		
Asparagaceae	*Asparagus*	*striatus*	LC	Indigenous; Endemic
Poaceae	*Tribolium*	*purpureum*	LC	Indigenous
Asparagaceae	*Asparagus*	*burchellii*	LC	Indigenous; Endemic
Poaceae	*Fingerhuthia*	*africana*	LC	Indigenous
Asphodelaceae	*Aloe*	*affinis*	LC	Indigenous; Endemic
Rubiaceae	*Galium*	*capense*	LC	Indigenous

Amaryllidaceae	*Haemanthus*	*humilis*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*lacera*	LC	Indigenous; Endemic
Rubiaceae	*Nenax*	*microphylla*	LC	Indigenous
Fabaceae	*Indigofera*	*hantamensis*	LC	Indigenous; Endemic
Pteridaceae	*Cheilanthes*	*hirta*		Indigenous
Crassulaceae	*Crassula*	*capitella*	LC	Indigenous
Geraniaceae	*Pelargonium*	*laxum*	LC	Indigenous; Endemic
Crassulaceae	*Crassula*	*dependens*	LC	Indigenous
Geraniaceae	*Pelargonium*	*aridum*	LC	Indigenous
Polygalaceae	*Polygala*	*leptophylla*	LC	Indigenous
Scrophulariaceae	*Manulea*	*chrysantha*	LC	Indigenous; Endemic
Aizoaceae	*Malephora*	*latipetala*	LC	Indigenous; Endemic
Asteraceae	*Phymaspermum*	*parvifolium*	LC	Indigenous; Endemic
Plantaginaceae	*Veronica*	*anagallis-aquatica*	LC	Indigenous
Poaceae	*Heteropogon*	*contortus*	LC	Indigenous
Fabaceae	*Vachellia*	*karroo*	LC	Indigenous
Asteraceae	*Lactuca*	*inermis*	LC	Indigenous
Asphodelaceae	*Haworthiopsis*	*nigra*		Indigenous; Endemic
Scrophulariaceae	*Chaenostoma*	*halimifolium*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*spartaria*	LC	Indigenous
Lamiaceae	*Stachys*	*dregeana*	LC	Indigenous
Ricciaceae	*Riccia*	*angolensis*		Indigenous
Asteraceae	*Eumorphia*	*corymbosa*	LC	Indigenous; Endemic
Asteraceae	*Euryops*	*oligoglossus*	LC	Indigenous
Cactaceae	*Opuntia*	*elata*		Not indigenous; Cultivated; Naturalised; Invasive
Aspleniaceae	*Asplenium*	*trichomanes*	LC	Indigenous
Geraniaceae	*Geranium*	*harveyi*	LC	Indigenous; Endemic
Scrophulariaceae	*Selago*	*albida*	LC	Indigenous
Brassicaceae	*Heliophila*	*cornuta*	NE	Indigenous
Fabaceae	*Lotononis*	*fruticoides*	LC	Indigenous; Endemic
Asteraceae	*Athanasia*	*microcephala*	LC	Indigenous; Endemic
Poaceae	*Eragrostis*	*chloromelas*	LC	Indigenous
Asparagaceae	*Asparagus*	*retrofractus*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*sp.*		

Hyacinthaceae	*Albuca*	*secunda*	LC	Indigenous; Endemic
Apocynaceae	*Ceropegia*	*stapeliiformis*	LC	Indigenous; Endemic
Scrophulariaceae	*Buddleja*	*salviifolia*	LC	Indigenous
Asteraceae	*Felicia*	*filifolia*	LC	Indigenous
Hyacinthaceae	*Albuca*	*virens*	LC	Indigenous
Alliaceae	*Tulbaghia*	*leucantha*	LC	Indigenous
Poaceae	*Cymbopogon*	*prolixus*	LC	Indigenous
Asteraceae	*Helichrysum*	*zeyheri*	LC	Indigenous
Asteraceae	*Senecio*	*sp.*		
Hyacinthaceae	*Massonia*	*echinata*	LC	Indigenous; Endemic
Aizoaceae	*Mesembryanthemum*	*tetragonum*		Indigenous
Iridaceae	*Moraea*	*unguiculata*	LC	Indigenous; Endemic
Aizoaceae	*Ruschia*	*spinosa*	LC	Indigenous
Kewaceae	*Kewa*	*bowkeriana*	LC	Indigenous
Zygophyllaceae	*Roepera*	*incrustata*		Indigenous
Poaceae	*Bromus*	*catharticus*	NE	Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Hebenstretia*	*sp.*		
Brassicaceae	*Sisymbrium*	*orientale*		Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia*	*braunsii*	LC	Indigenous
Asphodelaceae	*Trachyandra*	*acocksii*	LC	Indigenous; Endemic
Aizoaceae	*Trichodiadema*	*sp.*		
Iridaceae	*Moraea*	*polystachya*	LC	Indigenous
Asteraceae	*Osteospermum*	*leptolobum*	LC	Indigenous; Endemic
Asteraceae	*Gorteria*	*alienata*		Indigenous; Endemic
Typhaceae	*Typha*	*capensis*	LC	Indigenous
Asphodelaceae	*Bulbine*	*narcissifolia*	LC	Indigenous
Poaceae	*Phragmites*	*australis*	LC	Indigenous
Caryophyllaceae	*Cerastium*	*capense*	LC	Indigenous
Fabaceae	*Melolobium*	*canescens*	LC	Indigenous
Asteraceae	*Hertia*	*ciliata*	LC	Indigenous
Asteraceae	*Helichrysum*	*sp.*		
Aizoaceae	*Mesembryanthemum*	*noctiflorum*		Indigenous
Hyacinthaceae	*Dipcadi*	*ciliare*	LC	Indigenous; Endemic
Solanaceae	*Lycium*	*schizocalyx*	LC	Indigenous

Cyperaceae	*Pseudoschoenus*	*inanis*	LC	Indigenous
Asteraceae	*Berkheya*	*glabrata*	LC	Indigenous; Endemic
Euphorbiaceae	*Euphorbia*	*patula*		Indigenous; Endemic
Aizoaceae	*Trichodiadema*	*pomeridianum*	LC	Indigenous
Aizoaceae	*Galenia*	*procumbens*	LC	Indigenous; Endemic
Acanthaceae	*Justicia*	*guerkeana*	LC	Indigenous
Malvaceae	*Hermannia*	*grandiflora*	LC	Indigenous
Crassulaceae	*Crassula*	*expansa*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*coriarium*		Indigenous
Lobeliaceae	*Lobelia*	*thermalis*	LC	Indigenous
Geraniaceae	*Pelargonium*	*grossularioides*	LC	Indigenous; Endemic
Aizoaceae	*Trichodiadema*	*intonsum*	LC	Indigenous; Endemic
Aizoaceae	*Tetragonia*	*haworthii*	LC	Indigenous; Endemic
Convolvulaceae	*Convolvulus*	*sagittatus*	LC	Indigenous
Asteraceae	*Euryops*	*cuneatus*	LC	Indigenous; Endemic
Poaceae	*Polypogon*	*monspeliensis*	NE	Not indigenous; Naturalised
Iridaceae	*Moraea*	*speciosa*	LC	Indigenous; Endemic
Poaceae	*Cynodon*	*incompletus*	LC	Indigenous; Endemic
Boraginaceae	*Lithospermum*	*scabrum*	LC	Indigenous; Endemic
Asteraceae	*Pseudognaphalium*	*luteoalbum*	LC	Not indigenous; Cryptogenic
Asteraceae	*Dicerothamnus*	*rhinocerotis*		Indigenous; Endemic
Poaceae	*Chloris*	*virgata*	LC	Indigenous
Geraniaceae	*Pelargonium*	*multicaule*	LC	Indigenous
Boraginaceae	*Myosotis*	*arvensis*		Not indigenous; Naturalised; Invasive
Asphodelaceae	*Astroloba*	*foliolosa*	LC	Indigenous; Endemic
Asphodelaceae	*Gasteria*	*disticha*		Indigenous
Thymelaeaceae	*Lasiosiphon*	*microphyllus*	LC	Indigenous; Endemic
Amaranthaceae	*Gamka*	*kali*		Not indigenous; Naturalised; Invasive
Asteraceae	*Berkheya*	*spinosa*	LC	Indigenous; Endemic
Poaceae	*Eragrostis*	*obtusa*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*crystallinum*	LC	Indigenous
Crassulaceae	*Crassula*	*pubescens*	LC	Indigenous; Endemic
Thymelaeaceae	*Passerina*	*obtusifolia*	LC	Indigenous; Endemic
Poaceae	*Digitaria*	*eriantha*	LC	Indigenous

Asphodelaceae	*Haworthiopsis*	*tessellata*		Indigenous
Asteraceae	*Ifloga*	*glomerata*	LC	Indigenous
Aizoaceae	*Mesembryanthemum*	*inachabense*	LC	Indigenous
Asteraceae	*Gazania*	*heterochaeta*	LC	Indigenous
Geraniaceae	*Pelargonium*	*gracillimum*	LC	Indigenous; Endemic
Aizoaceae	*Mesembryanthemum*	*stenandrum*	LC	Indigenous; Endemic
Polygalaceae	*Polygala*	*ephedroides*	LC	Indigenous
Amaranthaceae	*Gamka*	*minutifolia*	LC	Indigenous; Endemic
Malvaceae	*Hermannia*	*sp.*		
Amaranthaceae	*Sericocoma*	*avolans*	LC	Indigenous
Cactaceae	*Cylindropuntia*	*pallida*		Not indigenous; Cultivated; Naturalised; Invasive
Crassulaceae	*Crassula*	*tomentosa*	LC	Indigenous
Asteraceae	*Cotula*	*sororia*	LC	Indigenous; Endemic
Asteraceae	*Amellus*	*strigosus*	LC	Indigenous; Endemic
Asteraceae	*Euryops*	*imbricatus*	LC	Indigenous; Endemic
Aizoaceae	*Aloinopsis*	*rosulata*	LC	Indigenous; Endemic
Brassicaceae	*Heliophila*	*crithmifolia*	LC	Indigenous
Asteraceae	*Geigeria*	*filifolia*	LC	Indigenous
Brassicaceae	*Lepidium*	*englerianum*		Indigenous
Juncaceae	*Juncus*	*rigidus*	LC	Indigenous
Cactaceae	*Opuntia*	*microdasys*	NE	Not indigenous; Cultivated; Naturalised; Invasive
Poaceae	*Ehrharta*	*calycina*	LC	Indigenous
Asteraceae	*Conyza*	*scabrida*		Indigenous
Campanulaceae	*Wahlenbergia*	*tenella*	LC	Indigenous; Endemic
Urticaceae	*Forsskaolea*	*candida*	LC	Indigenous
Zygophyllaceae	*Tribulus*	*terrestris*	LC	Indigenous
Crassulaceae	*Tylecodon*	*reticulatus*	LC	Indigenous
Asteraceae	*Felicia*	*filifolia*	LC	Indigenous; Endemic
Fabaceae	*Prosopis*	*chilensis*	NE	Not indigenous; Naturalised
Geraniaceae	*Pelargonium*	*abrotanifolium*	LC	Indigenous; Endemic
Poaceae	*Enneapogon*	*desvauxii*	LC	Indigenous
Aizoaceae	*Galenia*	*fruticosa*	LC	Indigenous
Brassicaceae	*Lepidium*	*desertorum*	LC	Indigenous
Aizoaceae	*Antimima*	*sp.*		

Hypoxidaceae	*Empodium*	*flexile*	LC	Indigenous; Endemic
Achariaceae	*Kiggelaria*	*africana*	LC	Indigenous
Hyacinthaceae	*Drimia*	*anomala*	LC	Indigenous; Endemic
Crassulaceae	*Crassula*	*corallina*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia*	*tysonii*	LC	Indigenous; Endemic
Aizoaceae	*Mesembryanthemum*	*geniculiflorum*		Indigenous
Asteraceae	*Tarchonanthus*	*minor*	LC	Indigenous
Caryophyllaceae	*Pollichia*	*campestris*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*decepta*	LC	Indigenous; Endemic
Boraginaceae	*Ehretia*	*rigida*	LC	Indigenous; Endemic
Scrophulariaceae	*Lyperia*	*tristis*	LC	Indigenous
Pottiaceae	*Tortula*	*atrovirens*		Indigenous
Asteraceae	*Pteronia*	*aspalatha*	LC	Indigenous; Endemic
Geraniaceae	*Pelargonium*	*tragacanthoides*	LC	Indigenous
Asteraceae	*Pteronia*	*membranacea*	LC	Indigenous; Endemic
Hyacinthaceae	*Albuca*	*exuviata*	LC	Indigenous; Endemic
Ricciaceae	*Riccia*	*albovestita*		Indigenous
Asteraceae	*Euryops*	*lateriflorus*	LC	Indigenous
Crassulaceae	*Adromischus*	*triflorus*	LC	Indigenous; Endemic
Aspleniaceae	*Asplenium*	*cordatum*	LC	Indigenous
Aizoaceae	*Trianthema*	*parvifolia*	LC	Indigenous
Apocynaceae	*Microloma*	*armatum*	LC	Indigenous
Campanulaceae	*Wahlenbergia*	*sp.*		
Asteraceae	*Oedera*	*oppositifolia*		Indigenous; Endemic
Hyacinthaceae	*Ledebouria*	*ensifolia*	LC	Indigenous
Poaceae	*Hordeum*	*murinum*	NE	Not indigenous; Naturalised

Appendix C Mammals expected in the study area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Aethomys granti	Grant's rock mouse	Unlisted	LC
Aethomys namaquensis	Namaqua rock rat	LC	LC
Antidorcas marsupialis	Springbok	LC	LC
Aonyx capensis	Cape Clawless Otter	NT	NT
Bunolagus monticularis	Riverine Rabbit	EN	CR
Canis mesomelas	Black-backed Jackal	LC	LC
Caracal caracal	Caracal	LC	LC
Chlorotalpa sclateri	Sclater's Golden Mole	LC	LC
Crocidura cyanea	Reddish-grey Musk Shrew	LC	LC
Cryptomys hottentotus	Common Mole-rat	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Dendromus melanotis	Grey Climbing Mouse	LC	LC
Desmodillus auricularis	Short-tailed Gerbil	LC	LC
Elephantulus edwardii	Cape elephant shrew	Unlisted	LC
Elephantulus rupestris	Western rock sengi	LC	LC
Eptesicus hottentotus	Long-tailed Serotine Bat	LC	LC
Felis nigripes	Black-footed Cat	VU	VU
Felis silvestris	African Wildcat	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Gerbillurus paeba	Hairy-footed Gerbil	LC	LC
Graphiurus ocularis	Spectacular Dormouse	NT	LC
Herpestes pulverulentus	Cape Grey Mongoose	LC	LC
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ictonyx striatus	Striped Polecat	LC	LC
Leptailurus serval	Serval	NT	LC
Lepus capensis	Cape Hare	LC	LC
Lepus saxatilis	Scrub Hare	LC	LC
Macroscelides proboscideus	Karoo Round-eared Sengi	LC	LC
Malacothrix typica	Gerbil Mouse	LC	LC
Mastomys coucha	Multimammate Mouse	LC	LC
Mellivora capensis	Honey Badger	LC	LC
Mus musculus	House Mouse	Unlisted	LC
Neoromicia capensis	Cape Serotine Bat	LC	LC
Nycteris thebaica	Egyptian Slit-faced Bat	LC	LC
Oreotragus oreotragus	Klipspringer	LC	LC
Orycteropus afer	Aardvark	LC	LC
Otocyon megalotis	Bat-eared Fox	LC	LC

Otomys saundersiae	Saunder's vlei rat	LC	LC
Otomys unisulcatus	Karoo Bush Rat	LC	LC
Panthera pardus	Leopard	VU	VU
Papio ursinus	Chacma Baboon	LC	LC
Parahyaena brunnea	Brown Hyaena	NT	NT
Parotomys brantsii	Brants' Whistling Rat	LC	LC
Parotomys littledalei	Littledale's Whistling Rat	NT	LC
Pelea capreolus	Grey Rhebok	NT	NT
Petromyscus collinus	Pygmy Rock Mouse	LC	LC
Poecilogale albinucha	African Striped Weasel	NT	LC
Procavia capensis	Rock Hyrax	LC	LC
Pronolagus saundersiae	Natal Red Rock Rabbit	LC	LC
Proteles cristata	Aardwolf	LC	LC
Raphicerus campestris	Steenbok	LC	LC
Rhabdomys pumilio	Xeric Four-striped Mouse	LC	LC
Rousettus aegyptiacus	Egyptian Fruit Bat	LC	LC
Suncus varilla	Lesser Dwarf Shrew	LC	LC
Suricata suricatta	Suricate	LC	LC
Sylvicapra grimmia	Common Duiker	LC	LC
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	LC
Tragelaphus strepsiceros	Greater Kudu	LC	LC
Vulpes chama	Cape Fox	LC	LC

Appendix D Reptiles species expected in the study area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Acontias meleagris	Cape Legless Skink	LC	LC
Agama aculeata aculeata	Western Ground Agama	LC	Unlisted
Agama atra	Southern Rock Agama	LC	LC
Aspidelaps lubricus lubricus	Cape coral snake	LC	LC
Bitis arietans arietans	Puff Adder	LC	Unlisted
Boaedon capensis	Brown House Snake	LC	LC
Bradypodion ventrale	Eastern Cape Dwarf Chameleon	LC	LC
Chamaeleo namaquensis	Namaqua Chameleon	LC	LC
Chersina angulata	Angulate Tortoise	LC	LC
Chersobius boulengeri	Karoo padloper	LC	Unlisted
Chondrodactylus angulifer	Common Giant Gecko	LC	LC
Chondrodactylus bibronii	Bibron's Gecko	LC	Unlisted
Cordylosaurus subtessellatus	Dwarf Plated Lizard	LC	LC
Cordylus cordylus	Cape Girdles Lizard	LC	LC
Crotaphopeltis hotamboeia	Red-lipped Snake	LC	Unlisted
Dasypeltis scabra	Rhombic Egg-eater	LC	LC
Dipsina multimaculata	Dwarf Beaked Snake	LC	Unlisted
Duberria lutrix	Common Slug-eater	LC	LC
Gerrhosaurus typicus	Karoo plated lizard	Unlisted	Unlisted
Goggia braacki	Braack's Pygmy Gecko	LC	LC
Goggia incognita	Striped Pygmy Gecko	LC	LC
Hemachatus haemachatus	Rinkhals	LC	LC
Homopus femoralis	Greater Dwarf Tortoise	LC	LC
Homoroselaps lacteus	Spotted Harlequin Snake	LC	LC
Karusasaurus polyzonus	Southern Karusa Lizard	LC	LC
Lamprophis aurora	Aurora House Snake	LC	LC
Lamprophis guttatus	Spotted Rock Snake	LC	LC
Meroles suborbitalis	Spotted Desert Lizard	LC	Unlisted
Naja nivea	Cape Cobra	LC	Unlisted
Nucras livida	Karoo Sandveld Lizard	LC	LC
Pachydactylus capensis	Cape Gecko	LC	Unlisted
Pachydactylus geitje	Ocellated Gecko	LC	LC
Pachydactylus kladaroderma	Thin-skinned Gecko	LC	LC
Pachydactylus latirostris	Quartz Gecko	LC	Unlisted
Pachydactylus maculatus	Spotted Gecko	LC	LC
Pachydactylus mariquensis	Common Banded Gecko	LC	LC
Pachydactylus oculatus	Golden Spotted Gecko	LC	LC
Pachydactylus purcelli	Purcell's Gecko	LC	Unlisted
Pedioplanis burchelli	Burchell's Sand Lizard	LC	LC
Pedioplanis laticeps	Karoo Sand Lizard	LC	LC
Pedioplanis lineoocellata pulchella	Common sand lizard	LC	LC
Pedioplanis namaquensis	Namaqua Sand Lizard	LC	Unlisted
Pelomedusa galeata	South African Marsh Terrapin	Not evaluated	Unlisted

Prosymna sundevallii	Sundevall's Shovel-snout	LC	LC
Psammobates tentorius verroxii	Tent Tortoise	NT	NT
Psammophis crucifer	Cross-marked Grass Snake	LC	LC
Psammophis notostictus	Karoo Sand Snake	LC	Unlisted
Psammophylax rhombeatus	Spotted Grass Snake	LC	Unlisted
Pseudaspis cana	Mole Snake	LC	Unlisted
Pseudocordylus microlepidotus microlepidotus	Cape Crag Lizard	LC	LC
Pseudocordylus microlepidotus namaquensis	Nuweveldberg Crag Lizard	LC	LC
Ptenopus garrulus maculatus	Spotted Barking Gecko	LC	Unlisted
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	LC	Unlisted
Stigmochelys pardalis	Leopard Tortoise	LC	LC
Tetradactylus tetradactylus	Cape Long-tailed Seps	LC	LC
Trachylepis capensis	Cape Skink	LC	Unlisted
Trachylepis homalocephala	Red-sided Skink	LC	LC
Trachylepis occidentalis	Western Three-striped Skink	LC	Unlisted
Trachylepis sulcata sulcata	Westren Rock Skink	LC	Unlisted
Trachylepis variegata	Variegated Skink	LC	Unlisted
Varanus albigularis albigularis	Southern Rock Monitor	LC	Unlisted

Appendix E Amphibians expected in the study area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Amietia fuscigula	Common River Frog	LC	LC
Amietia poyntoni	Poynton's River Frog	LC	LC
Cacosternum boettgeri	Common Caco	LC	LC
Cacosternum karooicum	Karoo Caco	DD	LC
Kassina senegalensis	Bubbling Kassina	LC	LC
Poyntonophrynus vertebralis	Southern Pygmy Toad	LC	LC
Pyxicephalus adspersus	Giant Bullfrog	LC	LC
Sclerophrys capensis	Raucous Toad	LC	LC
Strongylopus grayii	Clicking Stream Frog	LC	LC
Tomopterna delalandii	Cape Sand Frog	LC	LC
Tomopterna tandyi	Tandy's Sand Frog	LC	LC
Vandijkophrynus gariepensis	Karoo toad	LC	LC
Xenopus laevis	Common Platanna	LC	LC