PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL & TERRESTRIAL BIODIVERSITY STATEMENT
(Revision 1)

AUGRABIES SETLLEMENT WWTW

THE PROPOSED CONSTRUCTION OF A NEW WASTEWATER TREATMENT WORKS (WWTW) AT THE AUGRABIES SETLLEMENT, NEAR KAKAMAS KAI !GARIB MUNICIPALITY, NORTHERN CAPE PROVINCE.

PREPARED FOR:

ENVIROAFRICA.

PREPARED BY:

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EXECUTIVE SUMMARY

Currently, sewage wastewater generated in Kakamas, and its surrounding villages is treated at a series of oxidation ponds in Kakamas. Large portions of Kakamas, as well as all the villages and farms north and northwest of Kakamas up to Augrabies, use conservancy tanks along with VIP and UDS systems. Sewage from these areas is collected by municipal tankers and disposed of at the existing Kakamas oxidation ponds (at a significant transport cost), which had not been designed to handle the current volumes of sewage. The plant has a treatment capacity of 430m³ per day, while the effluent produced by the town, villages, and farms exceeds 3,400m³ per day. BVi Consulting Engineers (Upington) was appointed to investigate and propose long-term sustainable wastewater treatment facilities for the town of Kakamas and surrounding villages.

BVi proposed the construction of a 500 m^3/day Aerated Facultative Pond system for Augrabies Village.

VEGETATION TYPE & STATUS

According to the South African Vegetation map (Mucina & Rutherford, 2006), the development will only impact on one vegetation type, namely Bushmanland Arid Grassland (Figure 4) a vegetation type considered "Least Threatened".

WATER COURSES AND WETLANDS

A small very degraded seasonal stream runs just east of the property, with a small almost compromised section of this drainage line crossing through the study area, ending in a small pond (Figure 6). Although the DFFE Screening report (Appendix 2), gives the relative Aquatic biodiversity theme sensitivity as **Low sensitive**, (which is supported by the findings of this study), a freshwater specialist had been appointed to evaluate the potential impacts on water courses and wetlands.

SPECIAL HABITAT CONDITIONS

The landscape is homogenous and does not contain any significant biophysical feature that might have resulted in special habitats for fauna or flora, apart from the degraded watercourse and pond (which might be manmade).

LAND-USE

The study area is located within the urban edge of the Augrabies settlement. It is surrounded by housing developments and agri-industrial activities. The southern portion of the study area had been developed into a cemetery. Concrete water ponds had been constructed in the northwestern part of the site, while most of the remainder of the site is used for the dumping of spoil and even general waste (Figure 6). It is subject to constant human activity and had been severely degraded over time.

VEGETATION ENCOUNTERED

The study area is just under 10 ha, of which large portions have already been transformed by human activity (e.g., the cemetery in the southern part covers nearly 4 ha, while ponds to the north span about 0.75 ha). Most of the remainder of the site has been degraded by the dumping of spoil and even general waste and is subject to almost constant human activity (Photo 1 - Photo 4). The site features an uneven, rocky substrate mainly composed of granite rocks. The vegetation is sparse, fitting the Bushmanland Arid Grassland description, with occasional shrubs, weedy species, and white grasses. Plant species diversity is very low, even after the recent good summer rains. Only the middle part of the study (Photo 7) still supports some natural vegetation of any significance and even these areas are considered degraded.

In general, the vegetation in the study area is considered of **low botanical significance**, and it is only the presence of three mature camelthorn trees (*Vachellia erioloba*) (Photo 8) and one scruffy looking *Boscia albitrunca* individual that was of interest. The **impact on vegetation** is expected to be very **Low Negative**.

CONSERVATION PRIORITY AREAS

According to the 2016, Northern Cape critical biodiversity areas maps, the study area will impact on a critical biodiversity area (CBA2) (Figure 5). The reasons for the CBA status, is given under Heading 4.3.1, and evaluated and discussed, based on the findings of the site verification, under Heading 7.1.

It is considered unlikely that the proposed development will have any significant impact on any of the reasons listed for identifying the CBA. As a result, the impact on conservation priority areas is expected to be **Low Negative**.

CONNECTIVITY

The study area is located within the urban edge of Augrabies. Connectivity is already greatly compromised. It is unlikely that the proposed development will have any significant additional impact on connectivity.

As a result, the impact on connectivity is considered **Low Negative**.

THREATENED AND PROTECTED PLANT SPECIES

According to the **DFFE Screening** report (Appendix 2), the **plant species theme sensitivity is considered Medium Sensitive**, because of the potential for encountering one medium sensitive plant species namely *Sensitive species 144*.

- ***Sensitive species 144*** is one of the best know plants of the family Aspodelaceae in the Northern Cape. It has a red-list status of "Vulnerable" because of a projected overall population decline of at least 26% by 2102, while climate change species distribution models predict losses of suitable habitat of between 33% and 68% by 2070. This species was **not observed** within the study area.
- However, three (3) ***Vachellia erioloba*** trees (NFA protected species) were observed, but the impacts on these plants should be easy to mitigate.
- Three (3) NCNCA protected species were observed (Refer to Table 11), but none of them are red-listed species and all of them are common widespread species. The proposed project is not likely to result in significant species or habitat loss.

As a result, a plant **species sensitivity rating** of **Medium-Low Sensitive** is supported, but it could be easily reduced to **Low Sensitive** if the mature *Vachellia erioloba* trees are protected (Refer to the Mitigation Recommendations).

FAUNA & AVI-FAUNA

According to the **DFFE Screening Tool** report (Appendix 2), the relative Animal species theme sensitivity is considered **Medium sensitivity** because the footprint area overlaps the known distribution range of one bird species, namely *Neotis ludwigii* (Ludwig's Bustard). Ludwig's Bustard is a near endemic and classified as e**ndangered** because of a projected rapid population decline.

However, given the location of the study area (within the urban edge), the proximity to existing houses and the almost constant human presence, it is considered highly unlikely that the proposed development will result in any significant additional impact on the breeding or feeding patterns of this species

as a result the sensitivity rating for this project is considered **Low Sensitive.**

MAIN CONCLUSION

According to the **DFFE Screening** report the relative Terrestrial Biodiversity theme sensitivity is considered of **Very High Sensitivity** because it overlaps a CBA2 (Refer to Heading 4.3 & 7.1).

The aim of the Terrestrial biodiversity assessment (Table 12) is to identify areas of terrestrial sensitivity, based on the findings of this study. In this case, because of the location and least threatened status of the vegetation even the cumulative impact will be **Low**. According, this assessment, the main impacts associated with the proposed development will be:

- The potential impact on plant species of conservation concern (SoCC), specifically 3 mature *Vachellia erioloba* trees.

No fatal flaws or any other obstacles were found with respect to the flora, vegetation, fauna, and terrestrial biodiversity. **Even with minimum mitigation it is considered highly unlikely that the development will contribute significantly to any of the following:**

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g., migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened species.
- Loss of ecosystem connectivity.

The findings of this assessment suggests that the relative terrestrial biodiversity theme sensitivity should be **Low Sensitive** (not Very High Sensitive as suggested in the DFFE screening report).

WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT THE PROJECT BE APPROVED WITH THE MITIGATION ACTIONS AS DESCRIBED UNDER HEADING 8.

INDEPENDENCE & CONDITIONS

PB Consult is an independent entity with no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and the company have no interest in secondary or downstream development because of the authorization of this project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. The author reserves the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTR and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve).

In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits.

During 2010 he joined EnviroAfrica to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes NEMA EIA applications, environmental management plans for various industries, environmental compliance audits, environmental control work as well as more than 70 biodiversity & botanical specialist studies.

Towards the end of 2017, Mr Botes started his own small environmental consulting business focusing on biodiversity & botanical assessments, biodiversity management plans and environmental compliance audits.

DECLARATION OF INDEPENDENCE

THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I Petrus, Jacobus, Johannes Botes, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014, as amended, and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 13 of GN No. R. 326.

Note: The terms of reference must be attached.

Signature of the specialist:

PB Consult (Sole Proprietor)

Name of company:

29 April 2025

Date:

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ABBREVIATIONS

BAR	Basic Assessment Report
CBA	Critical biodiversity area (in terms of the 2017 City of Cape Town Biodiversity Network)
DENC	Department of Environment and Nature Conservation
EA	Environmental Authorization (Record of Decision)
EAP	Environmental assessment practitioner
ECO	Environmental Control Officer
EIA	Environmental impact assessment
EMP	Environmental Management Plan or Program
EMS	Environmental management system
EN	Endangered
ESA	Ecological support area (in terms of the 2017 City of Cape Town Biodiversity Network)
LT	Least Threatened
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NEMA	National Environmental Management Act, 1998 (Act no. 107 of 1998)
NFA	National Forest Act, Act 84 of 1998
VU	Vulnerable
WWTW	Wastewater Treatment Works

1. INTRODUCTION

Kakamas and its surrounding villages are situated in the rocky semi-desert landscape next to the Orange River, between Keimoes and Pofadder in the Kai !Grib Municipality of the Northern Cape Province. The Orange River is central to the local economy, supporting heavily irrigated farmland on both sides. Currently, wastewater generated by Kakamas and its surrounding villages is treated at a series of oxidation ponds in Kakamas. Many parts of Kakamas, as well as all the villages and farms north and northwest of Kakamas up to Augrabies, use conservancy tanks along with VIP and UDS systems. Sewage wastewater from these areas is managed by municipal suction tankers and disposed of at the existing Kakamas oxidation ponds, which incurs significant transport costs. The Kakamas Oxidation Ponds were not designed or upgraded to handle the current volumes of sewage. The plant has a treatment capacity of 430m³ per day, while the effluent produced by the town, villages, and farms exceeds 3,400m³ per day.

BVi Consulting Engineers (Upington) was appointed to investigate and propose a sustainable, technical, and socio-economic solution for the wastewater issues in Kakamas, aiming to provide long-term sustainable wastewater treatment facilities for the town of Kakamas and surrounding villages.

BVi proposed the construction of a 500 m^3/day Aerated Facultative Pond system for Augrabies Village. The pond system must be located on municipal land, which was one of the main constraints (getting large enough portions of available land) in terms of location alternatives. The proposed development will be about 1.6 – 2 ha in size and will be located on Erf 169, within the urban edge of the Augrabies Village (Figure 2).

The development will result in the transformation of less than 2 ha of land, but the proposed area still supports natural veld (albeit disturbed too very disturbed). According to the 2012 Vegetation map of South Africa, the proposed footprint will only impact on one vegetation type, namely Bushmanland Arid Grassland (Figure 4), a vegetation type that has which has been classified as "Least Threatened" (GN. No. 2747 of 18 November 2022). However, the proposed footprint falls within a critical biodiversity area (CBA2) as identified in the 2016 Northern Cape critical biodiversity areas maps (Holness & Oosthuysen, 2016) (Heading 4.3).

The DFFE screening report for the site (Appendix 1), identified areas of potential environmental sensitivity, of which the following will be discussed in this report:

- The relative Animal species theme sensitivity is considered of **High Sensitivity**;
- The relative Plant species theme sensitivity is considered of **Medium Sensitivity**;
- The relative Terrestrial Biodiversity theme sensitivity is considered of **Very High Sensitivity**.

The site visit confirmed that the vegetation is disturbed to very disturbed Bushmanland Arid Grassland. Large portions of the site had been used for dumping general waste as well as spoil from construction sites. Botanically speaking the site is of low significance, but two large *Vachellia erioloba* trees were observed (on the western boundary of the site), while one *Boscia albitrunca* shrub was observed within the site itself.

1.1. LEGISLATION GOVERNING THIS REPORT

EnviroAfrica was appointed to facilitate the NEMA EIA application for the project. PB Consult was appointed by EnviroAfrica to conduct a botanical and terrestrial biodiversity evaluation of the proposed footprint area.

This is a 'specialist report', compiled in terms of:

- The National Environmental Management Act, Act. 107 of 1998 (NEMA);
- The "Protocol for the Specialist Assessment and Minimum report content requirements for environmental impacts on terrestrial biodiversity" in terms of Sections 24(5)(a) and (h) and 44 of the NEMA (Government Notice No. 320 of 20 March 2020).

1.2. TERMS OF REFERENCE

The Terms of Reference for this study was to undertake a site visit and to compile a specialist report that assesses the potential impacts on *Botanical, Fauna and Terrestrial Biodiversity* features of the proposed development.

Study should address:

- Habitat sensitivity;
- Threatened ecosystems (including critical biodiversity areas and ecological support areas);
- Flora and fauna species of conservation concern;
- Any significant terrestrial biodiversity features that might be impacted as a result of the proposed development (including those identified in the DFFE Screening Report).
- Potential direct and cumulative impacts resulting from the proposed development on the receiving environment.

2. STUDY AREA

2.1. LOCATION & LAYOUT

Augrabies is a small town in the Kai !Garib Municipality of the Northern Cape Province of South Africa. It is situated near the Augrabies Falls National Park, just off the R359 (Augrabies road) on the south bank of the Orange River, about 22km west, north-west of Kakamas.

The name "Augrabies comes from the Khoi word "Aukoerebis", meaning "place of the great noise, referring to the roar of the waterfall. The area has a rich history, with evidence of human habitation dating back to the Stone Ages. The Khoi migrated to the area approximately 2,000 years ago, while the first European to record seeing the falls was Hendrik Wikar in 1778.

The proposed WWTW will be less than 2 ha in size and will be located within the urban edge of the Augrabies village (Erf 169) (Figure 1). The study area was just under 10 ha in size, but included areas already used as a cemetery as well as old concrete ponds (Figure 2). NB. BVi mentioned that these ponds can potentially be incorporated into the proposed WWTW design.

Figure 1: Google Image showing the location of the study area (purple) for the proposed Augrabies WWTW within the Augrabies urban edge (yellow).

Figure 2: Google Image showing a close-up of the study area (purple) within which the proposed WWTW will be located.

Table 1: Midpoint co-ordinates of the study area (WGS 84 format)

DESCRIPTION	CO-ORDINATE
Augrabies WWTW (approximate location)	S 28°40'24.39" E 20°25'57.34"

2.2. PROJECT DESCRIPTION

BVi Consulting Engineers proposed the construction of a 500 m^3/day Aerated Facultative Pond system for Augrabies Village and surrounds, comprising the following:

- *Operational Building/Shelter*
- *Inlet Works (inclusive of Tanker Truck discharge facility)*
- *Screenings Removal*
- *Grit Channels*
- *Flow measurement*
- *Facultative Ponds x 2 (lined with HDPE membrane)*
- Wind powered Floating Aerator/Mixers
- *Medium Bubble Diffused Air aeration system Stainless Steel*
- *Low Pressure Centrifugal Fam c/w Motor*
- *Electrical Switchgear & DO Control System*
- *Aerobic Ponds x 2 (lined with HDPE membranes)*
- *Disinfection facility*
- Irrigation equipment for disposal of Effluent on sports fields
- *22kV x 1.5km overhead Electrical Power supply line + Transformer.*

2.3. TOPOGRAPHY, GEOLOGY AND SOILS

The study area is relatively small (<10 ha) and includes an existing cemetery as well as old concrete ponds (probably part of older water treatment works). The site is fairly uneven and quite rocky (but elevation difference is to slight to play any significant role in the vegetation encountered). It is currently used as a short-cut between various houses and a dumping site for general waste and excavated spoil (including building rubble). It almost seems as if there is a co-ordinated effort to level the site by filling it up. A small seasonal watercourse cross the northern part of the study area (west to east) ending in a man-made pond in the northeastern corner of the site.

The Bushmanland is part of the Nama-Karoo, which is underlaid by a thick succession of sedimentary rocks. This includes the Cape Supergroup (marine origin), followed by Dwyka tillites and then as southern Africa drifted away from the south pole, by other fossil-rich sediments of the Karoo Supergroup (including Ecca and Beaufort Groups) deposited in a great inland sea (300 – 180 million years ago). Igneous activity after this period resulted in voluminous outpourings of basaltic lava intrusions of dolerite sills and dykes into Karoo sediments. (Mucina *et al*., 2006).

2.4. CLIMATE

The climate of Nama-Karoo is essentially continental and is little affected by the ameliorating influences of the oceans. It is an arid biome where most of rivers are nonperennial (apart from the Orange River in this area). Shallow lakes (Bushmanland Vloere) may store water after heavy rainfall events, but this is unpredictable and will dry up during the dry season (Mucina *et. al.,* 2006).

Rainfall is unreliable and droughts are unpredictable and sometimes prolonged. In the southwest of the Nama-Karoo, rain comes in the form of unpredictable summer thunderstorms and occasional

inland intrusions of winter high-pressure systems from the west. Summers are hot (mean January maximum >30°C) and winters are cold (with the mean July minimum close to zero). Temperature extremes ranges from -5°C in winter to 43°C in summer and winter frost occurs in all areas except in the extreme southeast of the biome (Albany Broken Veld). Dust devils and small whirlwinds are common in summer, but dust storms are uncommon (Mucina *et. al.,* 2006).

In all the vegetation types of the Nama-Karoo, rainfall peaks in March, while the onset of winter frost is soon afterwards, which means a very short growth season for frost sensitive species. This is further exacerbated in some years when the rains are later than usual or frost earlier than usual, or more seriously, when both occur in the same year (Mucina *et. al.,* 2006).

Kakamas normally receives about 134 mm of rain per year, with rainfall largely in late summer/early autumn (major peak) and very variable from year to year. It receives the lowest rainfall (3 mm) in June and the highest (27 mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Kakamas range from 20°C in July to 35°C in January. The region is the coldest during July with temperatures as low as 3.7°C on average during the night (www.saexplorer.co.za). Table 1 gives a summary of temperatures and rainfall recorded at Kakamas (https://en.climate-data.org/location/911655/).

Table 2: Average rainfall and temperatures at Kakamas (https://en.climate-data.org/location/911655/)

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	27.3	26.4	24.4	21.1	16	13.1	12.2	14.5	17.3	20.9	23.5	26.3
Min. Temperature (°C)	18.9	18.3	16.7	12.8	7.8	4.6	3.7	5.4	8.1	11.6	14.3	17.2
Max. Temperature (°C)	35.7	34.5	32.2	29.5	24.3	21.7	20.8	23.6	26.5	30.3	32.8	35.4
Avg. Temperature (°F)	81.1	79.5	75.9	70.0	60.8	55.6	54.0	58.1	63.1	69.6	74.3	79.3
Min. Temperature (°F)	66.0	64.9	62.1	55.0	46.0	40.3	38.7	41.7	46.6	52.9	57.7	63.0
Max. Temperature (°F)	96.3	94.1	90.0	85.1	75.7	71.1	69.4	74.5	79.7	86.5	91.0	95.7
Precipitation / Rainfall (mm)	17	21	27	17	9	3	4	3	3	7	13	10

3. APPROACH & METHODOLOGY

The protocol for specialist assessment and minimum report content and requirements for environmental impacts on terrestrial biodiversity was published in GN. No. 320 of 20 March 2020. It includes the requirements for desktop analysis and site verification.

3.1. DESKTOP ANALYSIS

The first step of the study was to conduct a desktop analysis of the study area and its immediate surroundings. Using the DFFE screening tool report as basis, spatial information from online databases such as SANBI BGIS and Google Earth were used to evaluate the site in terms of vegetation, obvious differences in landscape (e.g., variations in soil type, rocky outcrops etc.) or vegetation densities ,

which might indicate differences in plant community or species composition, critical biodiversity areas and other terrestrial biodiversity features as identified in the screening tool.

This information was used to prepare a study area map, which is used as a reference during the physical site visit. Plant species lists were prepared, and species of special significance were flagged.

3.2. SITE SENSITIVITY VERIFICATION

The fieldwork for project was carried out over two days (8th & 10th of April 2025). The site survey was conducted over a 4-hour period, by walking the site and sampling the vegetation, using a modified approach, based on the Braun-Blanquet vegetation survey method (Werger, 1974) (Figure 3).

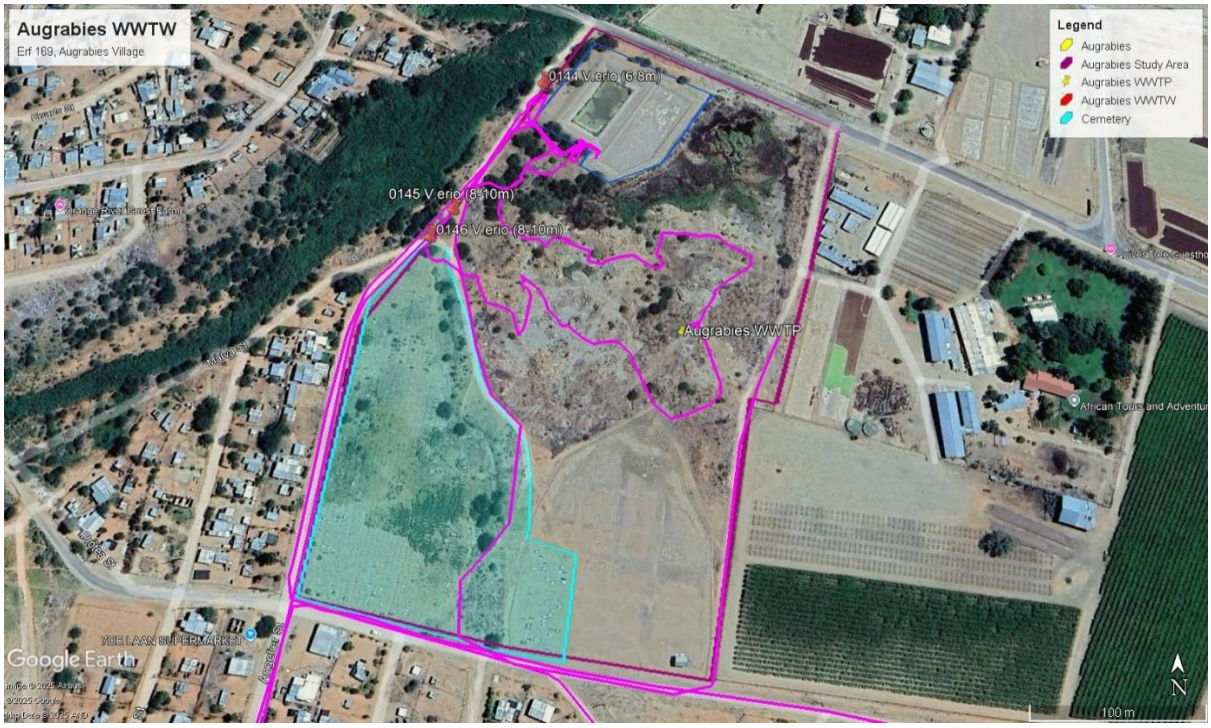

Figure 3: Google image, showing the study area (purple) and the routes walked during the site visit (pink).

Protected or other special plants and any terrestrial feature of significance was, marked by waypoints and/or on the study map, and photographed. A hand-held Garmin GPSMAP 67 was used to track the sampling route and for recording waypoints. During the survey notes, and photographic records were collected. All efforts were made to ensure that any variation in vegetation or soil condition, which might indicate special botanical features (e.g., rocky outcrops, watercourses or heuweltjies), were visited. Efforts was also made to ensure that the plant species list was as complete as possible.

3.3. LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

The findings are based on a two-day site visit (not long-term repetitive sampling), which means that it is likely that some plant species might have been out of season. However, at the time of the visit, the site had already experienced significant summer rains and the vegetation in the whole area was generally in good condition. The timing of the site visit was good in that it overlaps the summer rain period. The study area itself was quite disturbed and in poor condition (used as a dumping site and grazed by domestic animals). Essentially all perennial plants were identifiable and a good

understanding of the status of the vegetation and plant species in the study areas were obtained. Confidence in the findings is high. There should be no limiting factors which could significantly alter the outcome of this study. It is unlikely that a full botanical assessment will result in any additional findings that would have a significant impact on the outcome.

3.4. IMPACT ASSESSMENT METHOD

The concept of environmental impact assessment in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA) and the Environmental Impact Assessment (EIA) was developed to identify and evaluate the nature of potential impact to determine whether an activity is likely to cause significant environmental impact on the environment. The concept of significance is at the core of impact identification, evaluation and decision making, but despite this the concept of significance and the method used for determining significance remains largely undefined and open to interpretation (DEAT, 2002).

The objective of this study was to evaluate the status of the veld within the study area to identify special or significant environmental features which might be impacted by the proposed development.

The Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), were used to evaluate the botanical significance of the property with emphasis on:

- Significant ecosystems
    - Threatened or protected ecosystems
    - Special habitats
    - Corridors and or conservancy networks
- Significant species
    - Threatened or endangered species
    - Protected species.

3.4.1. DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria.

Significance = Conservation Value x (Likelihood + Duration + Extent + Severity) (Edwards 2011)

3.4.2. CRITERIA USED

***Conservation value*:** Conservation value refers to the intrinsic value of an attribute (e.g., an ecosystem, a vegetation type, a natural feature or a species) or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species (Refer to Table 3 for categories used).

Likelihood refers to the probability of the specific impact occurring because of the proposed activity (Refer to Table 4, for categories used).

Duration refers to the length in time during which the activity is expected to impact on the

environment (Refer to Table 5).

Extent refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur (Refer to Table 6).

Severity refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur (Refer to Table 7).

Table 3: Categories used for evaluating conservation status.

CONSERVATION VALUE	
Low (1)	The attribute is transformed, degraded not sensitive (e.g., Least threatened), with unlikely possibility of species loss.
Medium/low (2)	The attribute is in good condition but not sensitive (e.g., Least threatened), with unlikely possibility of species loss.
Medium (3)	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
Medium/high (4)	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
High (5)	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.

Table 4: Categories used for evaluating likelihood.

LIKELHOOD	
Highly Unlikely (1)	Under normal circumstances it is almost certain that the impact will not occur.
Unlikely (2)	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.
Possible (3)	The likelihood of the impact occurring, under normal circumstances is 50/50, it may, or it may not occur.
Probable (4)	It is very likely that the impact will occur under normal circumstances.
Certain (5)	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.

Table 5: Categories used for evaluating duration.

DURATION	
Short (1)	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).
Medium/short (2)	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).
Medium (3)	Impact is medium-term and reversible with mitigation but will last for some time after construction and may require ongoing mitigation. Rehabilitation time is expected to be longer (5-15 years).
Long (4)	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require ongoing mitigation. Rehabilitation time is expected to be longer (15-50 years).
Permanent (5)	The impact is expected to be permanent.

Table 6: Categories used for evaluating extent.

EXTENT	
Site (1)	Under normal circumstances the impact will be contained within the construction footprint.
Property (2)	Under normal circumstances the impact might extent outside of the construction site (e.g., within a 2 km radius), but will not affect surrounding properties.
Surrounding properties (3)	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding landowners or –users, but still within the local area (e.g., within a 50 km radius).
Regional (4)	Under normal circumstances the impact might extent to the surrounding region (e.g., within a 200 km radius), and will impact on landowners in the larger region (not only surrounding the site).
Provincial (5)	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).

Table 7: Categories used for evaluating severity.

SEVERITY	
Low (1)	It is expected that the impact will have little or no effect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.
Medium/low (2)	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium (3)	It is expected that the impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium/high (4)	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.
High (5)	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

3.4.3. SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. To do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact, and evaluate the significance of that impact should it occur.

Potential signific ant impacts are evaluated, using the method described above, to determine its potential significance. The potential significance is then described in terms of the categories given in Table 8. Mitigation options are evaluated, and comparison is then made (using the same method) of potential significance before mitigation and potential significance after mitigation (to advise the EAP).

Table 8: Categories used to describe significance rating (adjusted from DEAT, 2002)

SIGNIFICANCE	DESCRIPTION
Insignificant or Positive (4-22)	There is no impact, or the impact is insignificant in scale or magnitude because of low sensitivity to change or low intrinsic value of the site, or the impact may be positive.
Low (23-36)	An impact barely noticeable in scale or magnitude because of low sensitivity to change or low intrinsic value of the site or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium Low (37-45)	Impact is of a low order and therefore likely to have little real effect. Mitigation is easily achieved. Social, cultural, and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and easily possible but may require modification of the project design or layout. Social, cultural, and economic activities of communities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long term effect on the social and/or natural environment, within site boundary.
Medium high (56-63)	Impact is real, substantial, and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. Social, cultural, and economic activities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long-term effect on the social and/or natural environment, beyond site boundary within local area.
High (64-79)	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. Social, cultural, and economic activities of communities are disrupted and may come to a halt. These impacts will usually result in long-term change to the social and/or natural environment, beyond site boundaries, regional or widespread.
Unacceptable (80-100)	An impact of the highest order possible. There is no possible mitigation that could offset the impact. Social, cultural, and economic activities of communities are disrupted to such an extent that these come to a halt. The impact will result in permanent change. Very often these impacts are un-mitigatable and usually result in very severe effects, beyond site boundaries, national or international.

4. DESKTOP ASSESSMENT

The results of the desktop analysis are discussed in this chapter.

4.1. BROAD- SCALE VEGETATION EXPECTED

According to the 2012 South African Vegetation map (Mucina & Rutherford, 2006), the study area will only impact on one vegetation type, namely Bushmanland Arid Grassland (Figure 4), a vegetation type considered "Least Threatened", in terms of the "*Revised National list of ecosystems that are threatened and in need of protection*" (GN. No. 2747 of 18 November 2022).

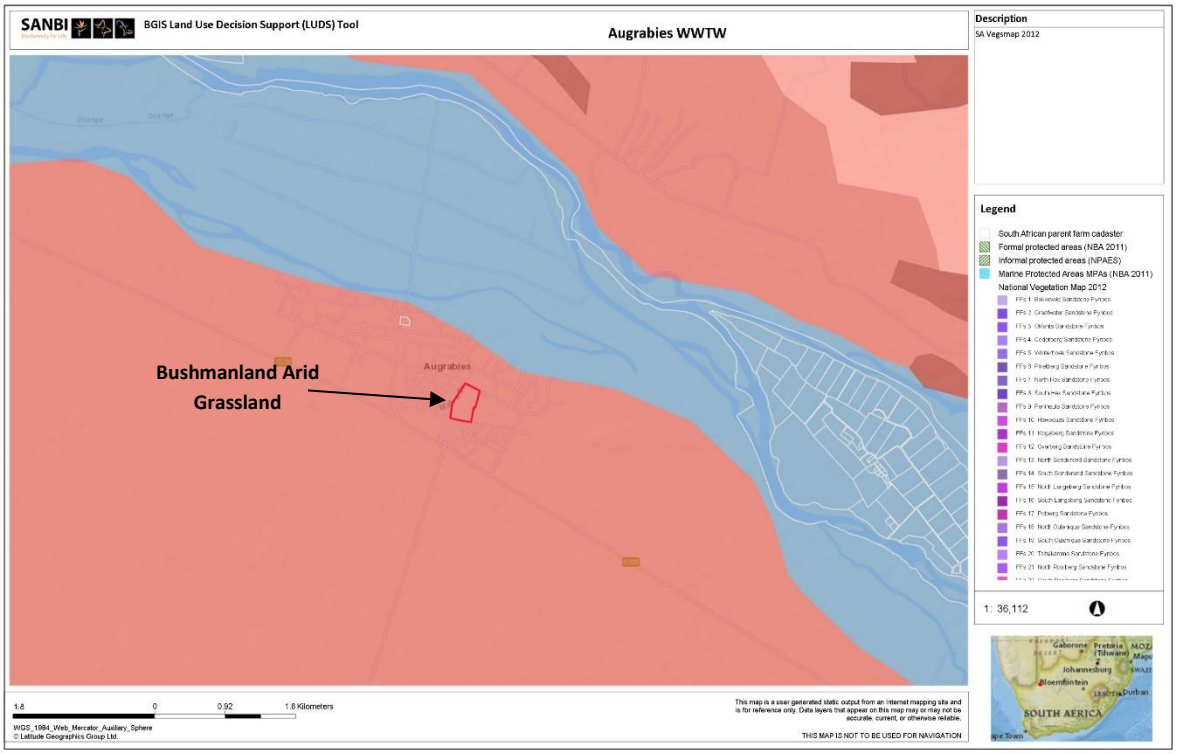

Figure 4: Vegetation map of South Africa (2012), showing the expected vegetation type (SANB BGIS)

Bushmanland Arid Grassland is found in the Northern Cape Province from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the north-west this vegetation unit borders on desert vegetation (north-west of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies from 600 – 1 200 m. The vegetation is described as occurring on extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland, which is dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semi-desert "steppe". In years of abundant rainfall rich displays of annual herbs can be expected (Mucina *et. al.,* 2006).

4.2. ECOLOGICAL DRIVERS & FUNCTIONING

Bushmanland Arid Grassland is part of the Nama-Karoo Biome, which is a large arid landlocked region on the central plateau of the western half of South Africa, extending into Namibia. It is flanked by the Succulent Karoo to the west and south, desert to the northwest, arid Kalahari Savanna to the north, Grassland to the northeast, Albany Thicket to the southeast and small parts of Fynbos to the south. In South Africa, only the Desert Biome has a higher variability in annual rainfall and only the Kalahari Savanna greater extremes in temperature. The Nama-Karoo receives most of its rainfall in summer, especially in late summer (Mucina *et. al*., 2006).

Climate is essentially continental and with almost no effect of the ameliorating influences of the oceans. Rainfall is low and unreliable, peaking in March. Droughts are unpredictable and often prolonged. Summers are hot and winters cold with temperature extremes ranging from -5°C in winter to 43°C in summer. However, rainfall intensity can be high (e.g., episodic thunderstorm and hailstorm events). This coupled with the generally low vegetation cover associated with aridity and grazing pressure by domestic stock over the last two centuries, raises the potential for soil erosion. In semi-arid environments such as the Nama-Karoo, nutrients are generally located near the soil surface, making it vulnerable to sheet erosion (Mucina *et. al*., 2006).

In contrast with the Succulent Karoo, the Nama-Karoo is not particularly rich in plant species and does not contain any centre of endemism (in contrast with Van Wyk & Smith 2001). Local endemism is very low, which might indicate a relative youthful biome linked to the remarkable geological and environmental homogeneity of the Nama-Karoo. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulent dominance (as in the Succulent Karoo). It is also too dry in summer for dominance by perennial grasses alone and the soils generally to shallow and rainfall too low for dominance by trees. But soil type, soil depth and local differences in moisture availability can cause abrupt changes in vegetation structure and composition (e.g., small drainage lines support more plant species than surrounding plains) (Mucina *et. al*., 2006).

In terms of status, very little of the Nama-Karoo has been transformed and the dominant land use is farming with small stock, cattle, and game. Farms are fenced, but generally large (because of the low carrying capacity). The biggest threat to this vegetation remains domestic livestock grazing pressure. Grazing by livestock, particularly during the summer growing season, reduces the perennial grass component, while prolonged droughts kill a high proportion of perennial plants, rapidly changing vegetation composition in favour of short-lived species with soil stored seed banks. Overgrazing after drought periods can delay vegetation recovery, which will worsen the effect of subsequent droughts.

4.3. CBA & ESA CORRIDORS

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape (Holness & Oosthuysen, 2016). It updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial

ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning to promote sustainable development and protection of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans.

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.
- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds, but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

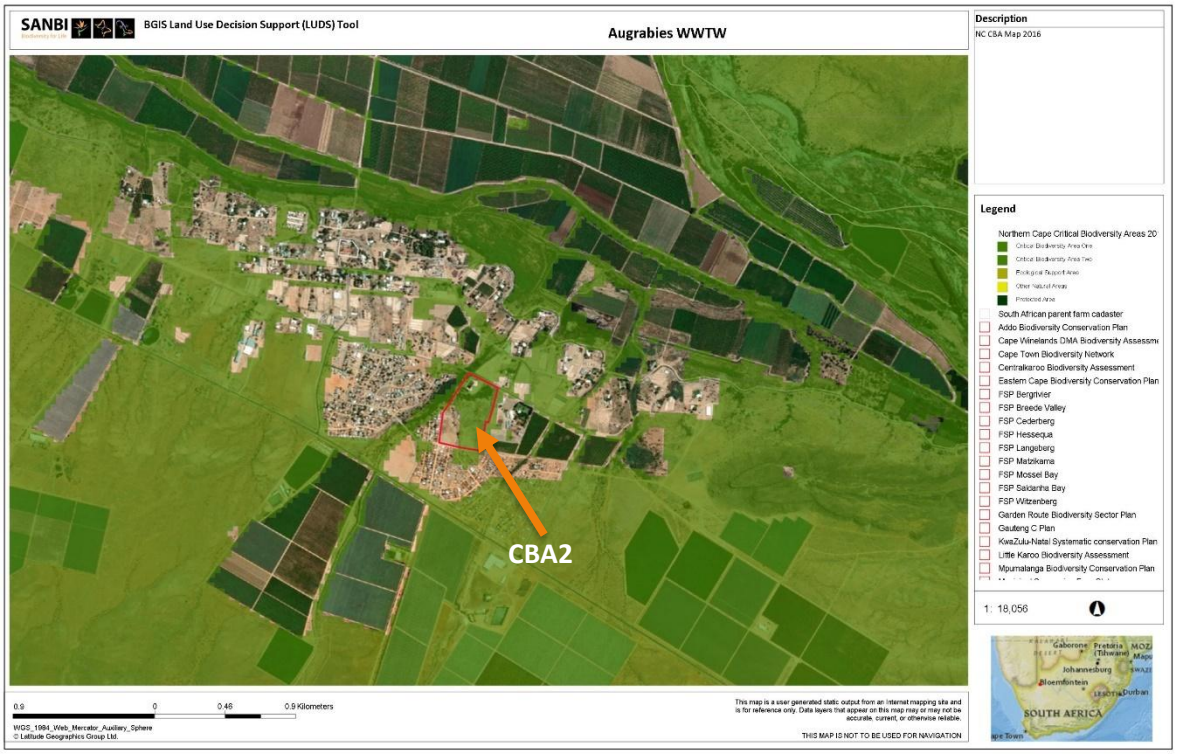

Figure 5: Northern Cape CBA map (2016) showing the study area (red), in terms of identified critical biodiversity areas.

4.3.1. CBA REASONS

According to the 2016 Northern Cape critical biodiversity areas maps, the study area is located within a critical biodiversity area (CBA2) (Figure 5). The NCCBA reasons layer lists the following reasons for the CBA:

- **Bushmanland Arid Grassland:** Referring to the SA Vegsmap (Figure 4) and the potential impact on this vegetation type. This is the only vegetation type expected to be impacted.
- **Lower Gariep Alluvial Vegetation:** Referring to the SA Vegsmap (Figure 4) and the potential impact on this vegetation type. Not expected to be impacted.
- **Namakwa CBA2 and Associated**: Referring to the Northern Cape Critical Biodiversity Areas maps discussed in this section. The study area partially overlaps a CBA2 area (Figure 5).
- **All Natural Wetlands**: Refers to the potential impact on natural wetlands. In this case it refers to the potential impact on wetlands associated with the Orange River and its tributaries. A small degraded seasonal stream runs just east of the property, with a small almost compromised section of this drainage line running into the study area. The DFFE Screening report (Appendix 2), gives the relative Aquatic biodiversity theme sensitivity as **Low sensitive**, which is supported by the findings of this study. A freshwater specialist had been appointed to evaluate the potential impacts on water courses and wetlands.
- **All Rivers**: Referring to the potential impact on watercourses and its associated corridors. Please refer above.
- **All Wetland FEPAS**: Refers to the potential impact on wetlands and freshwater ecosystem priority areas (FEPAS). Please refer above.
- **PA Distance buffers 5km & 10km**: Referring to impact within 5 km or 10 km from protected areas (PA). The urban edge of the Augrabies settlement is just over 5 km southeast of the Augrabies National Park. The study area itself is located within the urban edge of the settlement and is surrounded by urban development or agri-industrial enterprises.
- **NPAES PA + Focus**: Refers to protected areas (PA) and large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large, protected areas.
- **Landscape Structural Elements**: Refers to mountainous ecological corridors that can create or maintain ecological linkages in a fragmented landscape.

Refer to Heading 7.1 for a discussion of the findings of this study.

4.4. WATERCOURSES AND WETLANDS

A small very degraded seasonal stream runs just east of the property, with a small almost compromised section of this drainage line crossing through the study area, ending in a small pond. The pond might be manmade - the result of historical excavations when constructing the concrete water treatment ponds immediately to its west (Figure 6).

The DFFE Screening report (Appendix 2), gives the relative Aquatic biodiversity theme sensitivity as **Low sensitive**, which is supported by the findings of this study. A freshwater specialist had been appointed to evaluate the potential impacts on water courses and wetlands.

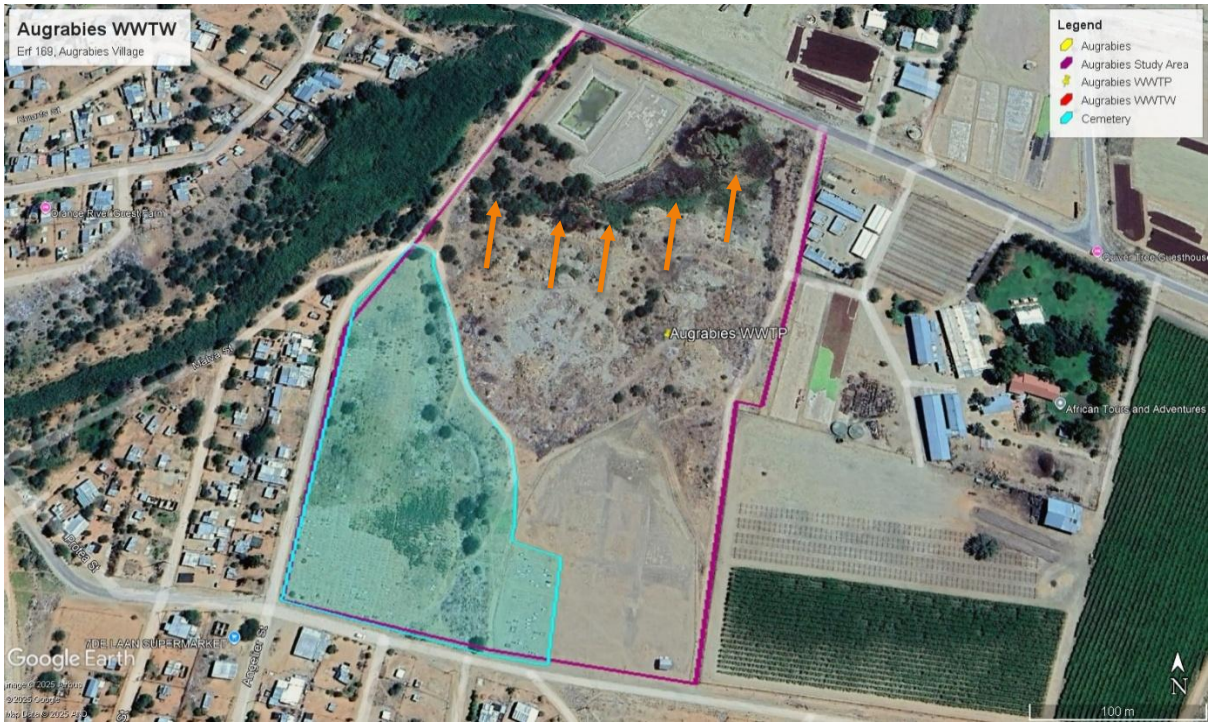

Figure 6: Google Imagery showing the study area (purple), the small seasonal drainage line to the west of the site and the (potentially manmade) wetland area within the site (orange arrows). Almost all of the large trees within the site were *Prosopis* trees (recently removed).

4.5. POTENTIAL IMPACT ON CENTERS OF ENDEMISM

"Gariep" is the Khoekhoe name for the Orange River, which means the "Great River". The lower Orange River cuts right through the core of the Gariep Centre of endemism (GC) and also forms the international border between South Africa and Namibia (Figure 7). The GC, with **the Richtersveld as its core** is part of the Succulent Karoo Region and is considered a region of high floristic endemism. It is located in the north-western corner of the Northern Cape and the adjacent south-western corner of Namibia (Van Wyk & Smith, 2001). Van Wyk & Smith (2001) describes the GC as more or less L-shaped and within South Africa it is bounded by Port Nolloth (and north to include the Richtersveld), Steinkopf, Pofadder and on the Augrabies Falls to the south and east and by the Orange River in the north (note that it also extends into Namibia).

The GC, as described by Van Wyk & Smith (2001) includes several local foci of endemism, some of which comprise distinct sub-centres. The topography of the GC can vary significantly and includes sandy plains and dunes (along the coast and inland), rugged inselbergs, gravel plains, dry river beds, steep rock-strewn mountains and deep gorges. The Orange River is the only permanent watercourse within this region. The climate is harsh, the weather unpredictable and with very little rainfall (predominantly in winter, but to the east it moves into the summer rainfall zone). Geologically the GC is very complex and exceeds by far the other centres of endemism in South Africa (Van Wyk & Smith, 2001). Soils are usually alkaline, sandy, shallow and stony, but clayey soils can occur, and large areas are covered by aeolian sands.

Vegetation within the GC is mainly xerophytic semi-desert shrubland with a predominance of

succulents. However, succulents are less prominent towards the east (as it moves out of the winter rainfall zone into the summer rainfall zone). Vegetation is intimately related to the geomorphology, geology and climate of the region. Trees and shrubs are very rare and mostly confined to rocky mountainous areas, dry watercourses, springs and banks of the Orange River. Within the Richtersveld and Port Nolloth area, most the rare and endangered plant species are concentrated on the higher mountain ranges and other high lying areas.

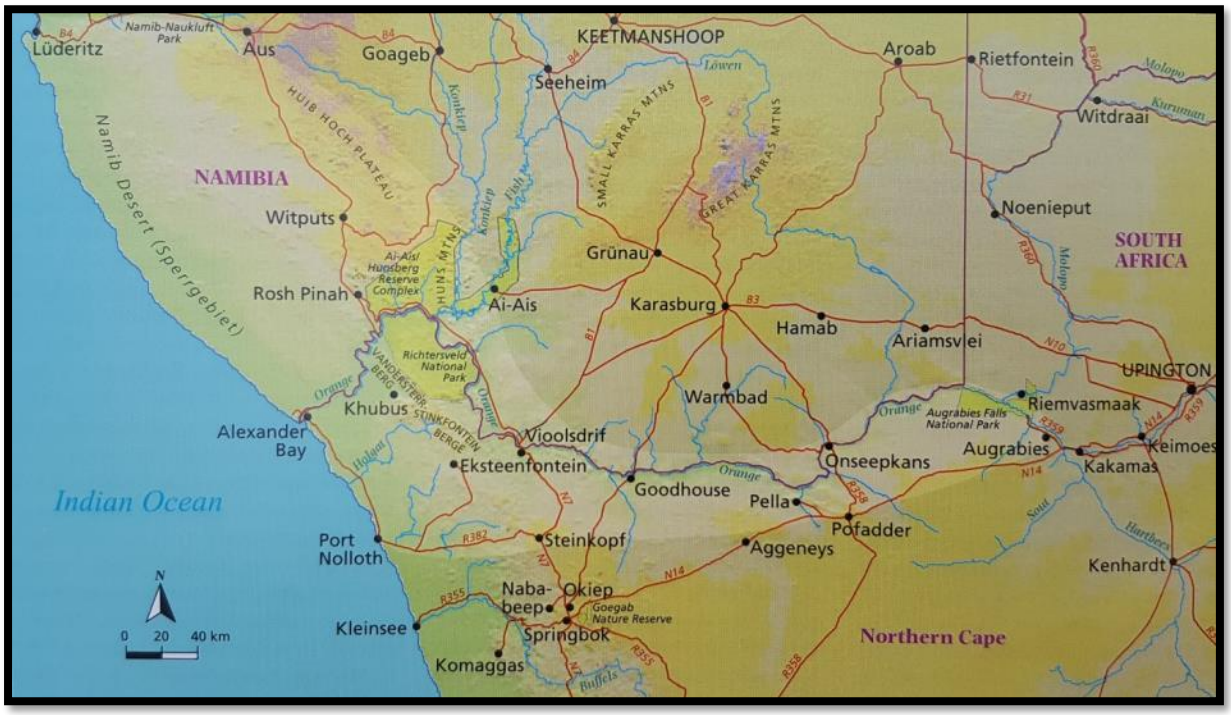

Figure 7: The Gariep Centre (highlighted) with the Richtersveld as its core (taken from Van Wyk & Smith, 2001)

The GC has the richest variety of succulents on earth with a very high level of endemism associated with these species. However, there is also a number of non-succulents endemic species within the GC (Van Wyk & Smith, 2001). According to Van Wyk & Smith (2001), this remarkable succulent endemism can be attributed to:

- The diverse geology (especially the quartzitic Gariep Supergroup, which is exposed only in the GC) especially in connection with the exposed mountains which provide diverse habitats and facilitate interception of moisture from clouds and fog (coupled with a unique climate). In the Richtersveld diversity is clearly associated with areas with high fog condensation and rainfall, while quartzitic substrates also show a propensity for harbouring endemics.
- The Orange River and its precursor have a significant influence on the geomorphological evolution of this region, being the principal conduit transporting sediments from the interior. The deep valleys associated with the river also create important passages for moist air to penetrate eastwards (from the sea) and also providing a frost-free refuge during colder periods.
- The cold Benguela Current and the South Atlantic Anticyclone initiated an increasing aridification of the region. The Benguela Current ensures a narrow zone of high humidity and low temperatures along the coast which is responsible for the fog which in turn is an extremely important additional source of moisture within the GC.

- Cyclonic rains in winter and close proximity to the summer-rainfall region would have favoured the development of the leaf succulents, while the interface between the rainfall systems would have allowed for the capture of some tropical floristic elements in the GC. Variability in annual rainfall within winter rainfall deserts is also much lower (again favouring the development of succulents).
- The right taxa, at the right place, at the right time (especially concerning the Mesembryanthemaceae).
- The rapid population turn-over associated with perennial shrubs (mainly Mesembryanthemaceae) within the GC would have minimised competitive interaction and would have been conducive to rapid speciation and diversification of especially perennial taxa.

Threats to the GC includes strip mining along the coast, extensive overgrazing in many of the inland mountainous areas, invasion by alien plants and illegal collecting of succulents.

In summary: The **Gariep Centre has the richest variety of succulents on earth** of which a **high percentage are endemic or near endemic.** A soft, but regular and therefore effective rainfall is mainly responsible for this abundance of plant life. Many of the endemic plants are limited to small areas, mostly on mountains where the rainfall is higher and habitat diversity is greatest.

The proposed development is on the eastern edge of the Gariep Centre of endemism. However, the site itself is expected to be degraded (within the Augrabies urban edge, and subject to constant anthropogenic activity).

4.6. LANDUSE AND COVER

The study area is located within the urban edge of the Augrabies settlement. It is surrounded by housing developments and agri-industrial activities. The southern portion of the study area had been developed into a cemetery. Concrete water ponds had been constructed in the northwestern part of the site, while most of the remainder of the site is used for the dumping of spoil and even general waste (Figure 6).

It is subject to constant human activity and had been severely degraded over time.

5. THE VEGETATION & FLORA

The study area is just under 10 ha, of which large portions have already been transformed by human activity (e.g., the cemetery in the southern part covers nearly 4 ha, while ponds to the north span about 0.75 ha). Most of the remainder of the site has been degraded by the dumping of spoil and even general waste and is subject to almost constant human activity (Photo 1 - Photo 4). The site features an uneven, rocky substrate mainly composed of granite rocks. The vegetation is sparse, fitting the Bushmanland Arid Grassland description, with occasional shrubs, weedy species, and white grasses. Plant species diversity is very low, even after the recent good summer rains.

Photo 1: A view over the cemetery to the south.

Photo 2: Evidence of illegal dumping in the southern part of the study area (next to the cemetery).

Photo 3: A photo showing some of the spoil heaps dumped in the eastern part of the site.

Photo 4: A photo showing the pond/wetland area to the northeast of the site.

Photo 5: Looking from north to south over the eastern part of the study area. Note the spoil heaps dumped over most of the area.

Photo 6: One of two concrete dams in the northern section of the study area. BVi will consider incorporating these dams into the proposed layout plans.

5.1. THE VEGETATION ENCOUNTERED

Only the middle part of the study (Photo 7) still supports some natural vegetation of any significance and even these areas are considered degraded. In general, the vegetation in the study area is considered of low botanical significance, and it is only the presence of three mature camelthorn trees (*Vachellia erioloba*) (Photo 8) and one scruffy looking *Boscia albitrunca* individual that was of interest. Fortunately, the *Vachellia erioloba* trees (6 – 10m in height) are located on the edge of the study area

and there is no reason why they should be impacted.

The vegetation can be described as a sparse to very sparse shrubland 0.75 – 1 m tall, with a sparse weedy annual herb and grassy layer in between. The shrub layer included species such as: *Senegalia mellifera* (swarthaak), *Phaeoptilum spinosum*, *Aptosimum spinescens*, *Codon royenii, Lacomucinaea lineata* and *Mesembryanthemum subnodosum* (disturbed areas). Apart from the grasses a number of weedy species such as *Atriplex semibaccata*, *Tribulus cristatus, Rogenia longiflora* and S*esamum capense* were common.

Photo 7: The middle area of the study area. *Senegalia mellifera* to the left of picture.

Photo 8: Two of the three Vachellia erioloba trees observed. Note that they are located next to the entrance road and should be easy to protect.

Photo 9: The western part of the watercourse. This area used to be dominated by larger *Prosopis* trees (they were recently removed – cut down).

The watercourse was characterized by dense stands of *Phragmites australis*, and *Typha capensis*. Along is edges, *Stoeberia arborea* patches were sometimes observed, while *Ficinia* cf. *indica* and

Stipagrostis namaquensis (river bushman grass) and even one each of the small trees, *Tamarisk usneoides* and *Dodonaea viscosa* were observed. The western part of the watercourse (within the study area), used to be dominated by *Prosopis* stands (which had since been cut) (Photo 9).

Photo 10: The middle part of the watercourse, marked by dense reeds.

In general, the **vegetation** is considered disturbed and **not of high botanical value**, BUT the *Vachellia erioloba* trees must be protected (Table 9).

5.2. FLORA ENCOUNTERED

Table 9 gives a list of the plant species encountered during this study. It is important to note that the species list is only based on a one-day site visit. It is likely that some species (especially annuals and geophytes) might have been missed, but the site was not pristine, and species diversity was low. The author is confident that a good understanding of the vegetation was achieved and confidence in the findings is high.

Table 9: List of plant species observed within the study area.

NO.	SPECIES NAME	FAMILY	STATUS	NOTES
1.	*Aptosimum spinescens*	SCROPHULARIACEAE	LC	Low shrub. Relatively common throughout the site.
2.	*Atriplex semibaccata*	AMARANTHACEAE	LC	Relatively common in disturbed areas near the watercourse.
3.	*Boscia albitrunca*	BRASSICACEAE (CAPPARACEAE)	LC NCNCA, Schedule 2 Protected	One small shrubby (multi-stemmed) individual observed.
4.	*Codon royenii*	BORAGINACEAE	LC	Soetdoringbos – Occasionally in lower stratum.
5.	*Lacomucinaea lineata*	SANTALACEAE	LC	Ouma-eentand: Occasionally in shrub layer.
6.	*Mesembryanthemum* cf. *subnodosum (=Psilocaulon)*	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Succulent plant, often associated with disturbed veld.
7.	*Phaeoptilum spinosum*	NYCTAGINACEAE	LC	Occasionally throughout the site.
8.	*Prosopis* species	FABACEAE	**Alien invasive plant species: Must be removed.**	Scattered throughout the lower parts of the site:

NO.	SPECIES NAME	FAMILY	STATUS	NOTES
				MUST BE REMOVE.
9.	*Rogeria longiflora*	PEDALIACEAE	LC	Desert foxglove – common throughout the site
10.	*Senegalia mellifera*	FABACEAE	LC	Swarthaak: Medium large very thorny shrub. Common
11.	*Sesamum capense*	PEDALIACEAE	LC	Aprilbaadjie – relatively common in disturbed areas.
12.	*Tamarisk usneoides*	TAMARICACEAE	LC	One small shrub-like tree near the water course.
13.	*Tapinanthus oleifolius*	LORANTHACEAE	LC	Mistletoe – a hemiparasite occasionally growing on *Senegalia mellifera*.
14.	*Tetraena decumbens*	ZYGOPHYLACEAE	LC	Medium shrub. Common throughout.
15.	*Tetraena microcarpa*	ZYGOPHYLACEAE	LC	Medium shrub. Common throughout.
16.	*Trianthema parvifolia*	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Rooirankvygie: A small prostrate succulent occasionally observed.
17.	*Tribulus cristatus*	ZYGOPHYLLACEAE	LC	Dubbeltjie. Very common prostrate weedy herb.
18.	*Vachellia erioloba (=Acacia erioloba)*	FABACEAE	LC NFA protected species	Tall Tree: Three individuals observed.

5.3. THREATENED AND PROTECTED PLANT SPECIES

South Africa has become the first country to fully assess the status of its entire flora. Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g. overgrazing, inappropriate fire management etc.), unsustainable harvesting, demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods). South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction but may nonetheless be of high conservation importance. As a result, SANBI uses an amended system of categories to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015). A summary of protected plant species observed is given in Table 10.

Table 10: A summary of finding in terms of the status of threatened or protected plant species observed.

PROTECTED STATUS	SPECIES OBSERVED	COMMENTS
Red list of South African plant species: The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2020).	No red-listed species observed.	N/a
NEM:BA protected plant species: The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the	No NEM:BA protected species observed.	N/a

PROTECTED STATUS	SPECIES OBSERVED	COMMENTS
protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).		
NFA Protected plant species: The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (as updated).	• ***Vachellia erioloba***	Three individuals observed in close proximity to the study area (near the western boundary).
NCNCA Protected plant species: The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and provides for the sustainable utilization of wild animals, aquatic biota, and plants. Schedule 1 and 2 of the Act gives extensive lists of specially protected and protected fauna and flora species in accordance with this act. NB. Please note that all indigenous plant species are protected in terms of Schedule 3 of this act (e.g., any work within a road reserve).	• ***Boscia albitrunca*** • ***Mesembryanthemum* cf. *subnodosum (=Psilocaulon)*** • ***Trianthema parvifolia***	One Boscia individual observed, while both other species were occasionally observed. Refer to Table 11 for impact mitigation measures.

Table 11: Protected plant species with impact minimisation recommendations.

NO.	SPECIES NAME	COMMENTS	I
1.	*Mesembryanthemum cf. subnodosum (=Psilocaulon)* ***NCNCA* Schedule 2 protected** *(all species in this Family protected by default)*	Occasionally observed, mostly in disturbed areas.	This is a common widespread species, often considered a disturbance indicator. No Search & Rescue proposed. **NB: A NCNCA Permit application will have to be obtained for potential impacts on this species.**
2.	*Trianthema parvifolia* ***NCNCA* Schedule 2 protected** *(all species in this Family protected by default)*	Occasionally observed, in the undergrowth.	This is a common widespread species. No Search & Rescue proposed. **NB: A NCNCA Permit application will have to be obtained for potential impacts on this species.**
3.	*Boscia foetida* **Schedule 2 protected**	One multi-stemmed shrub was observed towards the middle of the site.	No search & rescue is proposed. *Boscia* species seldom transplant successfully, because of their extensive and deep root system. **A NCNCA Permit application must be submitted for the removal of these plant.**
4.	*Vachellia erioloba* **NFA protected species**	Three trees were observed, all of them on the outer edges of the site.	**Protect *in-situ*** None of the trees to be impacted (there should be no reason for having to remove or even trim these trees. **A NFA Permit application must be submitted (if any tree were to be impacted).**

5.4. PLANT SPECIES SENSITIVITY THEME

According to the **DFFE Screening** report (Appendix 2), the **plant species theme sensitivity is considered Medium Sensitive**, because of the potential for encountering one medium sensitive plant

species namely *Sensitive species 144*.

- ***Sensitive species 144*** is one of the best know plants of the family Aspodelaceae in the Northern Cape. It has a red-list status of "Vulnerable" because of a projected overall population decline of at least 26% by 2102, while climate change species distribution models predict losses of suitable habitat of between 33% and 68% by 2070. This species was **not observed** within the study area.
- However, three (3) ***Vachellia erioloba*** trees (NFA protected species) were observed, but the impacts on these plants should be easy to mitigate.
- Three (3) NCNCA protected species were observed (Refer to Table 11), but none of them are red-listed species and all of them are common widespread species. The proposed project is not likely to result in significant species or habitat loss.

As a result, a **plant species sensitivity** rating of **Medium-Low Sensitive** is supported, but it could be easily reduced to **Low Sensitive** if the impact mitigation recommendations is implemented (protection of larger *Vachellia erioloba*).

6. FAUNA & AVI-FAUNA

Historically, because of its aridity and unpredictable rainfall patterns, the Nama-Karoo region would have favoured free moving herbivores such as ostrich and springbok, nomadic birds and invertebrates with variable dormancy cued by rain. Plant defence against herbivores and seed adaption for dispersal by mammals are relatively uncommon, except along rivers and seasonal pans, where they would have lingered longer, suggesting the transient nature of herbivores. However, since the 19th century the vast herds of migratory ungulates indigenous to this biome have been replaced by domestic stock. Once farmers started fencing their properties into camps (following the Fencing Act of 1912), stock numbers were dramatically increased with dire consequences to plant and animal diversity. Grazing during and immediately after droughts periods, for instance, is regarded as one of the major causes of detrimental change in vegetation composition and the ultimately decline in palatable plants species (Mucina *et. al*., 2006).

In terms of status, very little of the Nama-Karoo has been transformed and the dominant land use is livestock farming (sheep, goat and cattle) and game farming. Farms are fenced, but large because of the low grazing capacity. The biggest threat to this vegetation remains domestic livestock grazing pressure. Grazing by livestock particularly during the summer growing season, reduces the perennial grass component, while prolonged droughts kill a high proportion of perennial plants, rapidly changing vegetation composition in favour of short-lived species with soil stored seed banks. Overgrazing after drought periods can delay vegetation recovery, which will worsen the effect of subsequent droughts.

The Northern Cape is also home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, it is important to note that this remarkable diversity is not distributed evenly throughout the region but is concentrated in many local centres of endemism (Mucina *et. al*., 2006).

Because of the location of the site (within the urban edge), no fauna or avi-fauna screening was done, but observations were made during the site visit (including droppings & burrows). However, it was clear that the site is quite disturbed and subject to constant human activity.

6.1. ANIMAL SPECIES THEME SENSITIVITY: CONCLUSIONS

According to the **DFFE Screening Tool** report (Appendix 2), the relative Animal species theme sensitivity is considered **Medium sensitivity** because the footprint area overlaps the known distribution range of one bird species, namely *Neotis ludwigii* (Ludwig's Bustard).

Status: Ludwig's Bustard is a near endemic and classified as e**ndangered** because of a projected rapid population decline. It has a large range centred on the dry biomes of the Karoo and Namib in southern Africa, being found in the extreme south-west of Angola, western Namibia and in much of South Africa (Del Hoyo *et al.* 1996, Anderson 2000). Today it occurs predominantly in the dry Karoo region of South Africa (Herold, 1988), but historically its distribution is believed to have extended to the eastern and north-eastern portions of the Grassland Biome (Brooke, 1984). **Habitat**: It inhabits open lowland and upland plains with grass and light thornbush, sandy open shrub veld and semi-desert in the arid and semi-arid Namib and Karoo biomes (Shaw, 2015). **Diet**: Ludwig's bustards have a varied diet and can eat small animals on the ground such as insects and vertebrates. Their preferred insect is the locust, which are common in their habitat. They are also capable of consuming flowers and seeds. **Breeding**:

The breeding season spans from August-December, with the species nesting on bare ground with a clutch of 2-3 eggs (Del Hoyo *et al.* 1996, Jenkins & Smallie 2009)

However, given the location of the study area (within the urban edge), the proximity to existing houses and the almost constant human presence, it is considered highly unlikely that the proposed development will result in any significant additional impact on the breeding or feeding patterns of this species.

With regards to this project the sensitivity rating is considered to be **Low Sensitive.**

7. TERRESTRIAL BIODIVERSITY THEME SENSITIVITY

The proposed development will result in the transformation of less than 2 ha of disturbed indigenous vegetation, within the urban edge of the Augrabies Settlement. The vegetation itself is not vulnerable or endangered and the site visit confirmed that the study area had been degraded and is extensively used for the dumping of construction spoil (and even general waste to a lesser degree).

7.1. EVALUATION: CONSERVATION STATUS /CONSTRAINTS & OPPORTUNITIES

According to the DFFE National Web Based Environmental Screening Tool the relative Terrestrial Biodiversity theme sensitivity is considered of **Very High Sensitivity** because portions of the study area overlaps a CBA2 (Refer to Heading 4.3 & Figure 5). The reasons for the CBA status, as given under Heading 4.3.1, is evaluated and discussed below, in terms of the findings of the verification site visit.

- **Vegetation**: Only one vegetation type will be impacted, namely Bushmanland Arid Grassland, a vegetation type that is not considered vulnerable or threatened (Lower Gariep Alluvial Vegetation will not be impacted). The proposed WWTW will be located in disturbed veld (some of it almost transformed) of low botanical significance. There three *Vachellia erioloba* trees are on the edge of the terrain and will be easy to protect (there should be no reason why they should be impacted). The remaining species of conservation concern, most notably the Northern Cape Nature Conservation Act protected species are all common and widespread species. If the impact minimisation recommendations are implemented the **impact on vegetation** is expected to be **Low Negative**.
- **Namakwa CBA2 and Associated**: The NC CBA maps included all remaining natural veld in close proximity to larger river systems. This area, as all the surrounding have been included by default because of its proximity to the Orange River. Because of the location of the site and its disturbed nature the site is considered of **Low to Very Low Sensitivity**.
- **Wetlands, Rivers and FEPAS:** A small degraded seasonal stream runs just east of the property, with a small almost compromised section of this drainage line crossing into the study area, ending in pond, that seems to be the result of historical excavation and the construction of the internal roads. Although very degraded, a freshwater specialist had been appointed to evaluate the potential impacts on water courses and wetlands. The DFFE Screening report (Appendix 2), gives the relative Aquatic biodiversity theme sensitivity as **Low sensitive**, which is supported by the

findings of this study.

- **NPAES PA + Focus**: The urban edge of the Augrabies settlement is just over 5 km southeast of the Augrabies National Park. The study area itself is located within the urban edge of the settlement and is surrounded by urban development or agri-industrial enterprises. As is, it is considered highly unlikely that this area will ever become a conservation priority area (especially because connectivity to the site has been severely compromised).
- **Landscape Structural Elements**: Although portions of the site is characterised by granite rocks and outcrops, it is just outcrops, not small hills or mountains. In addition, connectivity and the vegetation of the site had been all but compromised. The potential impact on landscape structural elements is considered very low negative.

7.2. INDIRECT IMPACTS

Indirect impacts occur away from the 'action source' i.e., away from the development site. The impact assessed here is specifically how the proposed development would have an indirect impact on vegetation, flora, mammals, birds, reptiles, and invertebrates away from the development site.

The indirect impact in this case will be the loss of less than 2 ha of disturbed natural veld within the Augrabies urban edge, but also in relative close proximity to the Orange River and within 10km of the Augrabies National Park. However, the vegetation is already degraded, and connectivity has been compromised. The additional impact on connectivity will be negligible.

As a result, the indirect impact is also considered to of relatively **Low Significance**.

7.3. CUMULATIVE IMPACTS

Refer to Table 12. In this impact assessment method, cumulative impacts are calculated by using the worst scenarios for each aspect as input into the cumulative impact calculation.

7.4. THE "NO-GO" ALTERNATIVE

The **"No Go" alternative** means there would be no change to the *status quo*. The No-Go alternative will mean no loss of vegetation or protected species and no immediate impact on CBA2. Landuse will continue and is likely to result continual degradation of the site, as may external factors such as climate change.

However, the potential positive impact of adequate Municipal services will not be realized. The 'No Go' alternative is included in the impact table below (Table 12).

7.5. TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT

The following table rates the significance of environmental impacts associated with the proposed development. It also evaluates the expected accumulative effect of the proposed development as

well as the No-Go option (Refer to Heading 3.4 for the details of the method used).

Table 12: Terrestrial biodiversity impact associated with the proposed development.

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Special habitats: Potential impact on special habitats (e.g. true quartz or "heuweltjies")	Without mitigation	1	1	5	1	1	8	No special habitats observed, apart from the degraded (likely manmade) watercourse and pond in the northern part of the site.
	With mitigation	1	1	5	1	1	8	Refer to the recommendations of the Freshwater Specialist Report.
Watercourses & Wetlands: Potential impact on natural water resources and it's ecological support areas.	Without mitigation						0	A freshwater specialist had been appointed to evaluate these impacts.
	With mitigation						0	N/a
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	1	1	5	1	1	8	Permanent transformation of less than 2 ha of degraded veld, used for the dumping of spoil.
	With mitigation	1	1	5	1	1	8	The positive impact from adequate Municipal services is likely to outweigh the loss of a relatively small piece of land.
Vegetation status: **L**oss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	1	1	5	1	1	8	Permanent transformation of less than 2 ha of degraded vegetation (least threatened).
	With mitigation	1	1	5	1	1	8	Refer to the impact minimisation recommendations.
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	1	2	5	1	1	9	Permanent transformation of less than 2 ha of degraded vegetation (least threatened) within a CBA2 (Close proximity to a Protected Area).
	With mitigation	1	1	5	1	1	8	Refer to the discussion under Heading 7.1.
Connectivity: Potential loss of ecological migration corridors.	Without mitigation	1	1	5	1	1	8	The additional impact on connectivity should be negligible.
	With mitigation	1	1	5	1	1	8	Refer to the impact minimisation recommendations.
Plant SoCC: Potential impact on threatened or protected plant species.	Without mitigation	3	2	5	1	1	27	Potential impact on 3 mature *Vachellia erioloba* trees as well as several NCNCA protected species.
	With mitigation	1	1	5	1	1	8	Refer to the impact minimisation recommendations in Table 11
Fauna & Avi-fauna Potential impact on mammals, reptiles, amphibians & birds.	Without mitigation	1	1	5	1	1	8	The potential impact on animal and bird species as discussed under Heading 6.1.
	With mitigation	1	1	5	1	1	8	Refer to the impact minimisation recommendations.

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	3	2	5	1	1	27	Permanent transformation of less than 2 ha of degraded vegetation, but that might impact on 3 mature *Vachellia erioloba* trees.
	With mitigation	1	1	5	1	1	8	Refer to the impact minimisation recommendations.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	1	3	3	1	1	8	The No-Go alternative will not necessarily result in no further impact. Land use will remain the same and urban related impacts will continue slow degradation of the site.
	With mitigation							

The aim of the Terrestrial biodiversity assessment (Table 12) is to identify areas of terrestrial sensitivity, based on the findings of this study. In this case, because of the location and least threatened status of the vegetation even the cumulative impact will be **Low**. According, this assessment, the main impacts associated with the proposed development will be:

- The potential impact on plant species of conservation concern (SoCC), specifically 3 mature *Vachellia erioloba* trees.

No fatal flaws or any other obstacles were found with respect to the flora, vegetation, fauna, and terrestrial biodiversity. **Even with minimum mitigation it is considered highly unlikely that the development will contribute significantly to any of the following:**

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g., migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened species.
- Loss of ecosystem connectivity.

The findings of this assessment suggests that the relative terrestrial biodiversity theme sensitivity should be **Low Sensitive** (not Very High Sensitive as suggested in the DFFE screening report).

7.6. TERRESTRIAL BIODIVERSITY SENSITIVITY MAP

No special areas or sensitive areas were identified and as a result the Sensitivity map (Figure 8) focuses on the location of the 3 *Vachellia erioloba* trees.

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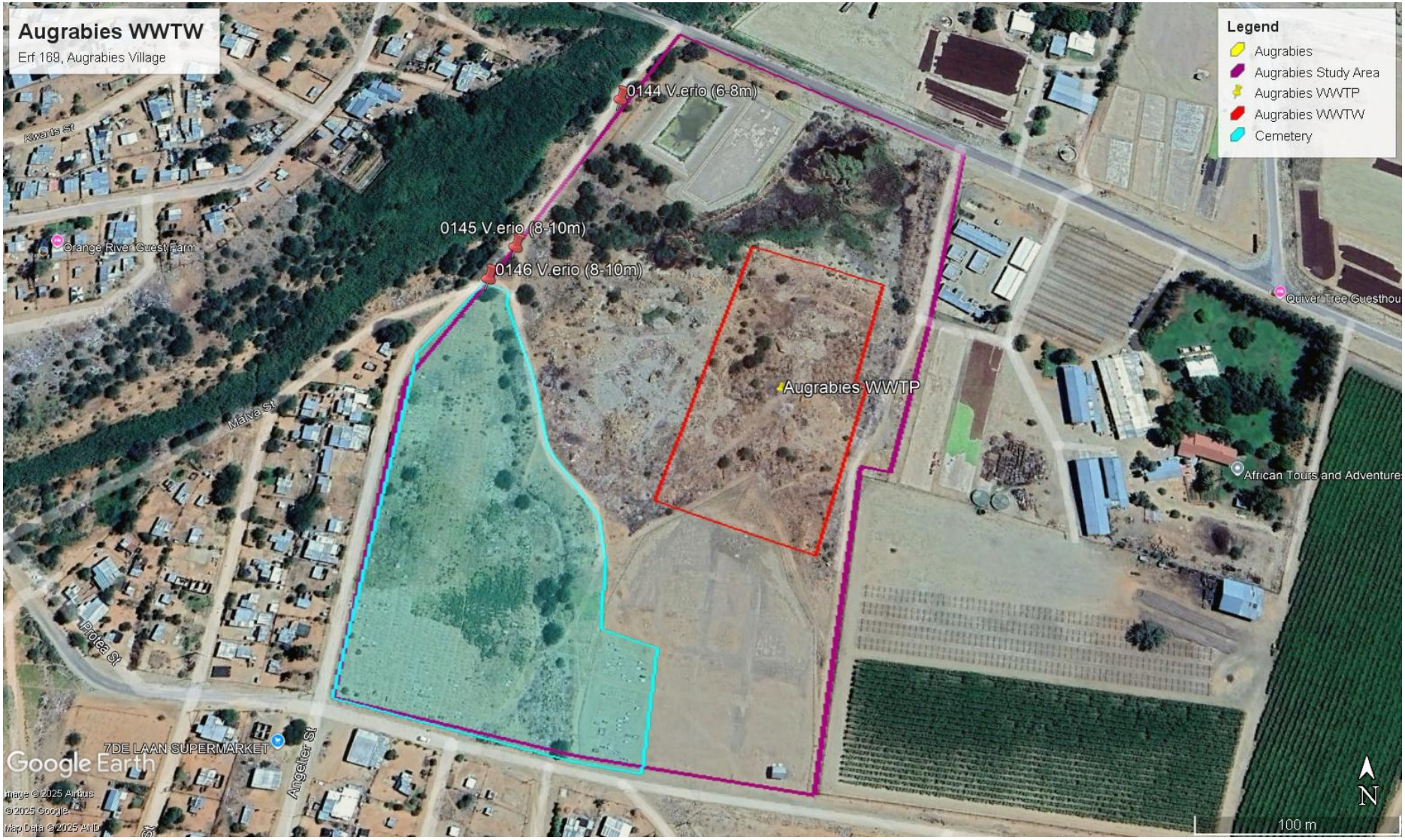
Figure 8: Site sensitivity map – focusing on the location of the protected tree species. Red waypoints shows the *Vachellia erioloba* trees.



8. MITIGATION RECOMMENDATIONS

The study area is considered of relatively **Low sensitivity** in terms of terrestrial biodiversity, but some mitigation is still recommended, especially with regards to the management of protected plant species. Impact minimisation focuses on the protection of these species. During construction the overriding goal should be to clearly define the final layout, to minimise the disturbance footprint.

- All construction should be done in accordance with an approved construction phase Environmental Management Plan (EMP) approved by the Northern Cape Department of Environmental Affairs.
- A suitably qualified Environmental Control Officer should be appointed to monitor the construction phase in terms of the EMP and any other conditions pertaining to specialist studies.
- Before any work is done the footprint must be clearly demarcated. The demarcation must aim at minimising impacts outside of the approved development footprint.
- All efforts should be made to protect the mature *Vachellia erioloba* (trees larger than 6m in height). A NFA permit application must be submitted for any impacts on these trees.
- The recommendations given in Table 11 must be implemented and a Northern Cape Nature Conservation Act permit must be obtained for the potential impacts on the NCNCA protected species.
- All alien invasive species within the footprint and its immediate surroundings must be removed responsibly.
    - Care must be taken with the eradication method to ensure that the removal does not impact or lead to additional impacts (e.g., spreading of these species due to incorrect eradication methods);
    - Care must be taken to dispose of alien plant material responsibly.
- An integrated waste management approach must be implemented during construction and all waste within the footprint area must be removed and disposed to the local Municipal waste disposal site.
    - Construction related general and hazardous waste may only be disposed of at Municipal approved waste disposal sites.

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APPENDIX 1: REQUIREMENTS FOR SPECIALIST REPORTS

Minimum Content Requirements for Botanical and Terrestrial Biodiversity Specialist Reports as per Protocol for the Specialist Assessment of Environmental Impacts on Terrestrial Biodiversity (GN 320 of 20 March 2020).

Protocol Ref	**Botanical and Terrestrial Biodiversity Specialist Assessment Report Content**	**Section / Page**
3.1.1.	Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Page iv - v
3.1.2.	a signed statement of independence by the specialist;	Page v
3.1.3.	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Heading 3.2
3.1.4.	a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	Heading 3.1, 3.2 & 3.3.
3.1.5.	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Heading 3.3
3.1.6.	a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Heading 7.6
3.1.7.	additional environmental impacts expected from the proposed development;	Heading 7
3.1.8.	any direct, indirect and cumulative impacts of the proposed development;	Heading 7
3.1.9.	the degree to which impacts and risks can be mitigated;	Heading 8
3.1.10.	the degree to which the impacts and risks can be reversed;	Heading 7 & 8
3.1.11.	the degree to which the impacts and risks can cause loss of irreplaceable resources;	Heading 7.5
3.1.12.	proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Heading 8
3.1.13.	a motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a "low" terrestrial biodiversity sensitivity and that were not considered appropriate;	NA
3.1.14.	a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	Page iii
3.1.15.	any conditions to which this statement is subjected.	N/A

APPENDIX 2: DFFE SCREENING REPORT

APPENDIX 3: CURRICULUM VITAE – P.J.J. BOTES

Curriculum Vitae: Peet JJ Botes

Address: 22 Buitekant Street, Bredasdorp, 7280; **Cell**: 082 921 5949

Nationality:	South African
ID No.:	670329 5028 081
Language:	Afrikaans / English
Profession:	Environmental Consultant & Auditing
Specializations:	Botanical & Biodiversity Impact Assessments
	Environmental Compliance Audits
	Environmental Impact Assessment
	Environmental Management Systems
Qualifications:	**BSc** (Botany & Zoology), with Nature Conservation III & IV as extra subjects; Dept. of Natural Sciences, Stellenbosch University 1989.
	Hons. BSc (Plant Ecology), Stellenbosch University, 1989
	More than 20 years of experience in the Environmental Management Field (Since 1997 to present).
Professional affiliation:	Registered Professional Botanical, Environmental and Ecological Scientist at SACNASP (South African Council for Natural Scientific Professions) since 2005.
SACNAP Reg. No.:	400184/05

BRIEF RESUME OF RELEVANT EXPERIENCE

1997-2005: Employed by the Overberg Test Range (a Division of Denel), responsible for managing the environmental department of OTB, developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve).

2005-2010: Joined Enviroscientific, as an independent environmental consultant specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits.

2010-2017: Joined EnviroAfrica, as an independent Environmental Assessment Practitioner and Biodiversity Specialist, responsible for Environmental Impact Assessments, Biodiversity & Botanical specialist reports and Environmental Compliance Audits. During this time Mr Botes compiled more than 70 specialist Biodiversity & Botanical impact assessment reports ranging from agricultural-, infrastructure pipelines- and solar developments.

2017-Present: Establish a small independent consultancy (PB Consult) specialising in Environmental Audits, Biodiversity and Botanical specialist studies as well as Environmental Impact Assessment.

LIST OF MOST RELEVANT BOTANICAL & BIODIVERSITY STUDIES

Botes. P. 2007: Botanical assessment. Schaapkraal, Erf 644, Mitchell's Plain. A preliminary assessment of the vegetation in terms of the Fynbos Forum: Ecosystem guidelines. 13 November 2007.

Botes, P. 2010(b): Botanical assessment. Proposed Loeriesfontein low cost housing project. A preliminary Botanical Assessment of the natural veld with regards to the proposed low cost housing project in/adjacent to Loeriesfontein, taking into consideration the National Spatial Biodiversity Assessment of South Africa. 10 August 2010.

Botes, P. 2012(a): Proposed Danielskuil Keren Energy Holdings Solar Facility on Erf 753, Danielskuil. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 17 March 2012.

Botes, P. 2012(b): Proposed Disselfontein Keren Energy Holdings Solar Facility on Farm Disselfontein no. 77, Hopetown. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 28 March 2012.

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Botes, P. 2012(d): Proposed Keimoes Keren Energy Holdings Solar Facility at Keimoes. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 9 March 2012.

Botes, P. 2012(e): Proposed Leeu-Gamka Keren Energy Holdings Solar Facility on Portion 40 of the Farm Kruidfontein no. 33, Prince Albert. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 27 March 2012.

Botes, P. 2012(f): Proposed Mount Roper Keren Energy Holdings Solar Facility on Farm 321, Kuruman. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 28 March 2012.

Botes, P. 2012(g): Proposed Whitebank Keren Energy Holdings Solar Facility on Farm no. 379, Kuruman. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 27 March 2012.

Botes, P. 2012(h): Proposed Vanrhynsdorp Keren Energy Holdings Solar Facility on Farm Duinen Farm no. 258, Vanrhynsdorp. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 13 April 2012.

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Botes, P. 2013(a): Groot Mier proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

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Botes, P. 2013(c): Noenieput proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

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Botes, P. 2013(g): Onseepkans Canal: Repair and upgrade of the Onseepkans Water Supply and Flood Protection Infrastructure, Northern Cape. A Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required). August 2013.

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Botes, P. 2016(b): Onseepkans Agricultural development. The proposed development of ±250 ha of new agricultural land at Onseepkans, Northern Cape Province. Biodiversity and Botanical Scan. January 2016.

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Botes, P. 2016(d): Proposed Namaqualand Regional Water Supply Scheme high priority bulk water supply infrastructure upgrades from Okiep to Concordia and Corolusberg. Biodiversity Assessment of the proposed footprint. March 2016.

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Botes, P. 2019(b): Verneujkpan Trust agricultural development – The proposed development of an additional ±250 ha of agricultural land on Farms 1763, 2372 & 2363, Kakamas, Northern Cape Province. 27 June 2019.

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Botes, P. 2021(b) New Wave Dam, Trawal – Botanical Statement for the proposed construction of a new irrigation dam on Portions 101 & 168 of farm Melkboom 384, Vanrhynsdorp, Matzikama Local Municipality, Western Cape Province. 16 November 2021.

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Botes, P. 2023(a) Reitfontein Cemetery – Terrestrial Biodiversity Compliance Statement for the proposed extension of the Rietfontein cemetery on the remainder of Farm Mier no. 585, near Rietfontein, Dawid Kruiper Local Municipality, Northern Cape Province. 17 March 2023.

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Botes, P. 2023(d) ZCC N14 Akkerboom – Botanical & Terrestrial Biodiversity Assessment for the proposed development of an electrical vehicle recharge facility and a renewable photovoltaic energy generation plant at Akkerboom farm stall (Portions 19 & 47 of Farm Frier's Dale No. 466),along the N14 between Kakamas and Keimoes, Dawid Kruiper Municipality, Northern Cape Province. 22 Augustus 2023.

Botes, P. 2023(e) Upington low-cost housing: Site 2 – Botanical Scan & Terrestrial Biodiversity Compliance Statement for the Proposed development of low-cost housing on Erven 5414, 21907 & 26627, Upington, Dawid Kruiper Municipality, Northern Cape Province. 27 October 2023.