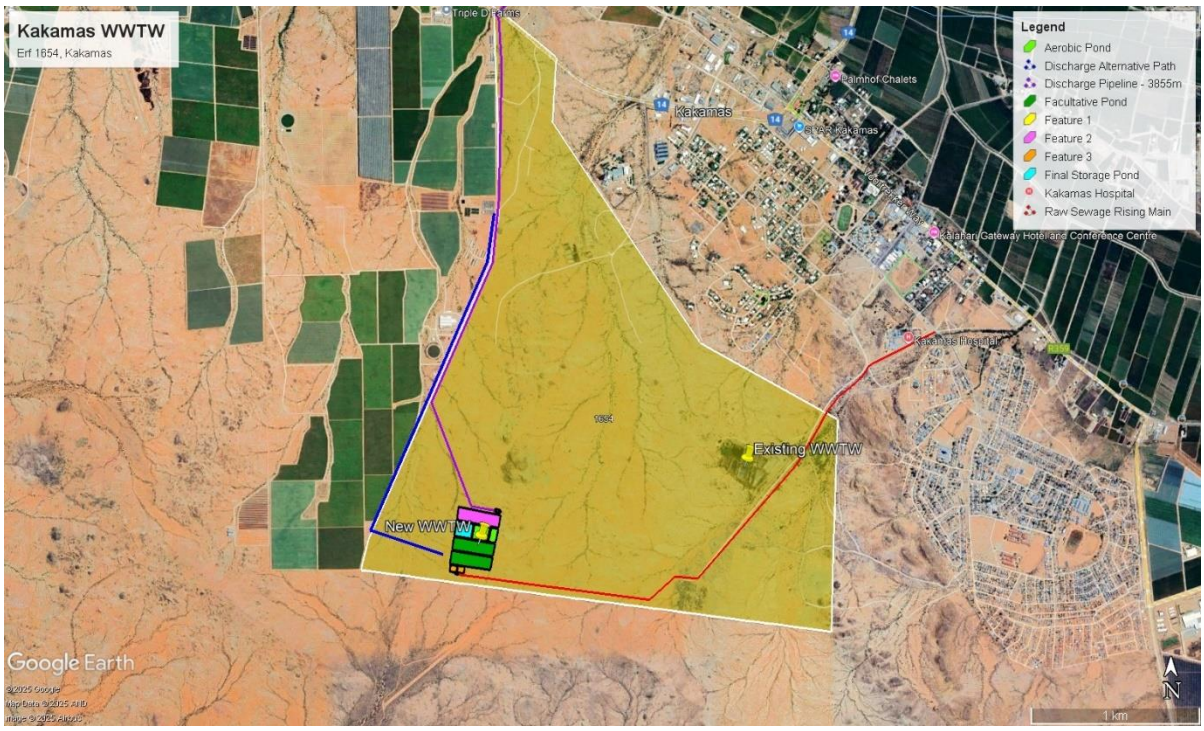
BOTANICAL & TERRESTRIAL BIODIVERSITY STATEMENT

KAKAMAS WWTW

THE PROPOSED CONSTRUCTION OF A NEW WASTEWATER TREATMENT WORKS (WWTW) ON ERF 1654, KAKAMAS KAI !GARIB MUNICIPALITY, NORTHERN CAPE PROVINCE.



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EXECUTIVE SUMMARY

Sewage wastewater generated by Kakamas, as well as all the villages and farms north and northwest of Kakamas up to Augrabies, are treated at a set of oxidation ponds located southwest of Kakamas (on high ground). Sewage are pumped or collected by municipal suction tankers from Kakamas, the surrounding villages and farms and delivered at the Kakamas oxidation ponds for treatment (at significant transport costs). These ponds are operated far beyond its capacity, resulting in constant pollution as a result of untreated wastewater overflowing from these ponds.

BVi proposed the construction of a 2 000 m^3/day conventional oxidation pond WWTW (with a rising main inlet and a gravity main outlet for treated effluent) for the town of Kakamas. The proposed development will be located on Erf 1654, to the southwest of Kakamas

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

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 relatively homogenous and does not contain any significant biophysical feature that might have resulted in special habitats for fauna or flora, apart from a cluster of two larger rocky hills ("koppies") towards the middle of the site (which will not be impacted).

LAND-USE

The proposed WWTW will be located on municipal land just south of the urban edge of Kakamas. The property borders on the urban edge to the north and east and cultivated land (vineyards) to the west. Over the years the property had been used for many purposes (including construction camps) and currently contains the Kakamas waste disposal site and the existing sewerage oxidation ponds.

VEGETATION ENCOUNTERED

Erf 1654 is a large property of about 500 ha, mostly consisting of well-preserved natural veld used informally for livestock grazing. In contrast the southeastern corner (where the oxidation ponds and waste disposal sites re located) has become severely degraded due to illegal dumping and other disturbances. The vegetation at the proposed WWTW site conformed to a dry version of Bushmanland Arid Grassland, a vegetation type not considered vulnerable or endangered. Although the area received recent rains, the vegetation cover can be described as a sparse to open low shrubland (Photo 1 – 5).

In general, the vegetation in the study area is considered of **low botanical significance**, but the fact that it falls within an area identified as an ESA area and the presence of several plant species of conservation concern raises the conservation value.

Even so, the **impact on vegetation** is still expected to be **Low Negative**.

CONSERVATION PRIORITY AREAS

According to the 2016 Northern Cape critical biodiversity areas maps the proposed WWTW will be located in an area identified as an ESA, based on the fact that the property still supports relatively large unfragmented portions of natural veld, that is located in relatively close proximity to the Augrabies Falls National Park. Erf 1654 also supports a cluster of two larger rocky hills or "koppies".

However, the property is about 29 km to the southeast of the Augrabies Falls NP (and its focus areas for expansion) with no direct natural corridors linking the two areas (Figure 7). The property itself is almost enclosed by cultivated lands and the Kakamas urban area, with direct connectivity remaining only towards the south. The koppies are relatively isolated in the landscape and does not link to any other in the area.

As a result, the potential impact on conservation worthy areas and landscape elements is considered to be **Low negative**. Erf 1654 is unlikely to become a focus area for conservation in the near future.

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.
- Apart from the several other species of conservation concern were observed as discussed in Table 10), although most of these are common and widespread species.

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 are implemented.

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.

According to the SABAP2 data set Ludwig's Bustard had not been observed in this area, but three other species of conservation concern, namely the Martial Eagle, the Lanner Falcon and the Black Stork, were observed in this pentad (Refer to Table 11), which overlaps a portion of the Orange River (the reason for the inclusion of the Black Stork) and a large area of natural veld to the south of the site (probably the reason for the inclusion of the Lanner Falcon and the Martial Eagle).

Given the location of the study area (near the urban edge), and the fact that the Ludwig's Bustard had not been observed in this pentad, it is considered unlikely that the proposed development will result in any significant additional impact on

the breeding or feeding patterns of any of these species. As a result, the animal species 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 is to identify and evaluate potential areas of terrestrial sensitivity. In this case, even though the proposed WWTW will be located in an ESA area, the disturbance footprint will be so small that even the cumulative impact is expected to be **Low negative**. The main impacts associated with the proposed development is considered to be:

- The potential impact on **plant species** of conservation concern (SoCC).
- The potential impact on <10ha of natural veld within an ESA (an ecological support area).
- The less-likely potential impacts on vegetation type, connectivity and fauna and avi-fauna.

No fatal flaws or any other obstacles were found with respect to the flora, vegetation, fauna, and terrestrial biodiversity. 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.

DETAILS OF THE AUTHOR

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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)
DD	Data Deficient
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 areas
ESA	Ecological support area (in terms of the 2017 City of Cape Town Biodiversity Network)
GN	Government Notice
LC	Least Concern
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
SoCC	Species of conservation concern
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, 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.

Sewage wastewater generated by Kakamas, as well as all the villages and farms north and northwest of Kakamas up to Augrabies, are treated at a set of oxidation ponds located southwest of Kakamas (on high ground). Sewage are pumped or collected by municipal suction tankers from Kakamas, the surrounding villages and farms and delivered at the Kakamas oxidation ponds for treatment (at significant transport costs). The design capacity of the Kakamas Oxidation Ponds is 430m³ per day, while the effluent produced by the town, villages, and farms currently exceeds 3,400m³ per day. These ponds are operated far beyond its capacity, resulting in constant pollution as a result of untreated wastewater overflowing from these ponds.

BVi Consulting Engineers (Upington) was appointed to investigate and propose a sustainable, technical, and socio-economic solution for the wastewater issues in Kakamas and surrounding villages. BVi proposed the construction of a 2 000 m^3/day conventional oxidation pond WWTW (with a rising main inlet and a gravity main outlet for treated effluent) for the town of Kakamas. The WWTW must be located on municipal land, which was one of the main constraints in terms of location alternatives. The proposed development will be located on Erf 1654, to the southwest of Kakamas (Figure 2).

The development will result in the transformation of between 7-10 ha of land still supporting natural veld. 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 an ecological support area (ESA) as identified in the 2016 Northern Cape critical biodiversity areas maps (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 **Medium 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 relatively well preserved Bushmanland Arid Grassland, but that the site itself had been variously impacted over the years and currently houses the Kakamas waste disposal site and the existing wastewater (sewerage) treatment works. Botanically speaking the site is of relatively low significance, but it does support a number of plant species of conservation concern (SoCC).

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

Kakamas is a small town founded in 1898 and located in the Kai !Garib Municipality of the Northern Cape province of South Africa, on the banks of the Orange River. It originated as at a place where the Orange River could be relatively easily crossed (and was first known as Bassonsdrif). In 1898 a proper settlement was established and under the auspices of the Dutch Reformed Church the area was developed as an agricultural spot. It became a municipality in 1954. The name Kakamas was originally given to a drift that was known as Takemas or T'Kakamas since 1779. The name means "place of the raging cow". The economy of this town is based on farming, and thanks to irrigation from the Orange River farmers from the Kakamas area are now prime exporters of table grapes peaches, dried fruit, raisins, oranges and dates (https://en.wikipedia.org/wiki/Kakamas).

The proposed WWTW will be located on Erf 1654, to the southwest of town. The footprint is expected to be between <10 ha in size (Figure 1), excluding the inlet and outlet pipelines. The study area included most of the southwestern corner of the erven (Figure 2). The larger Erf also houses the existing Kakamas wastewater treatment works and the Kakamas waste disposal site.

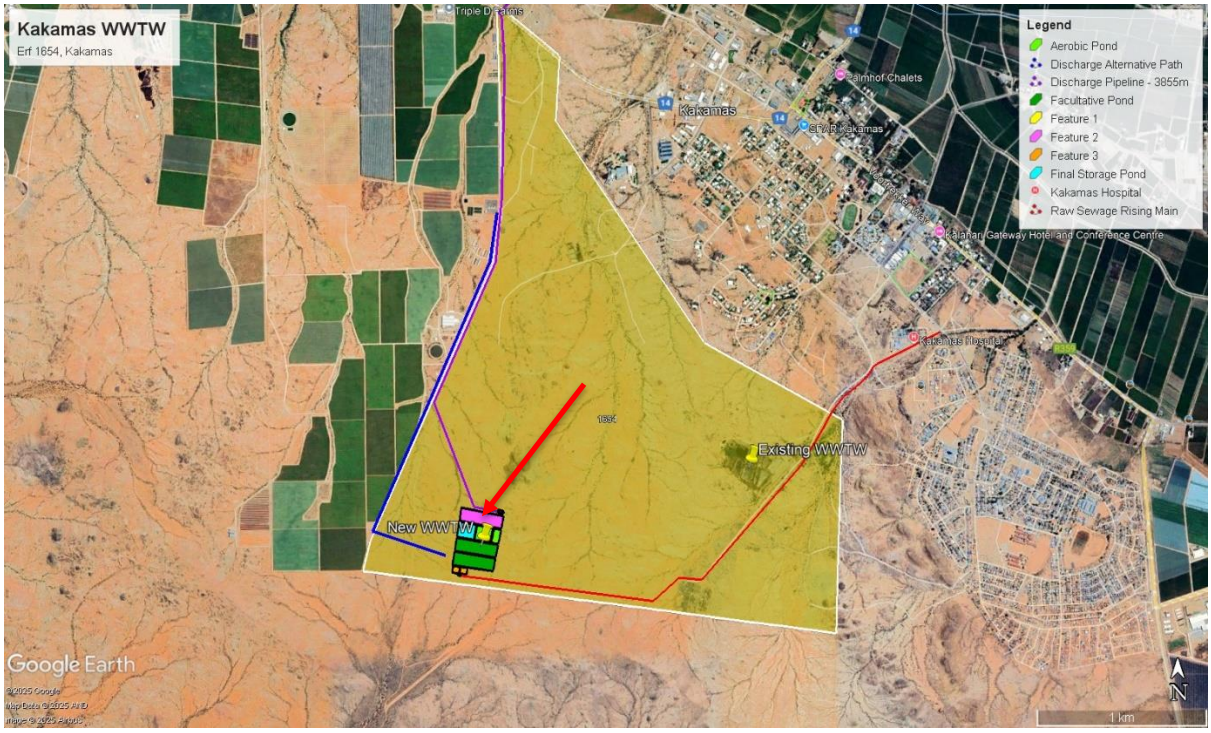

Figure 1: Google Image showing the location of the proposed Kakamas WWTW located in Erf 1654 (yellow area).

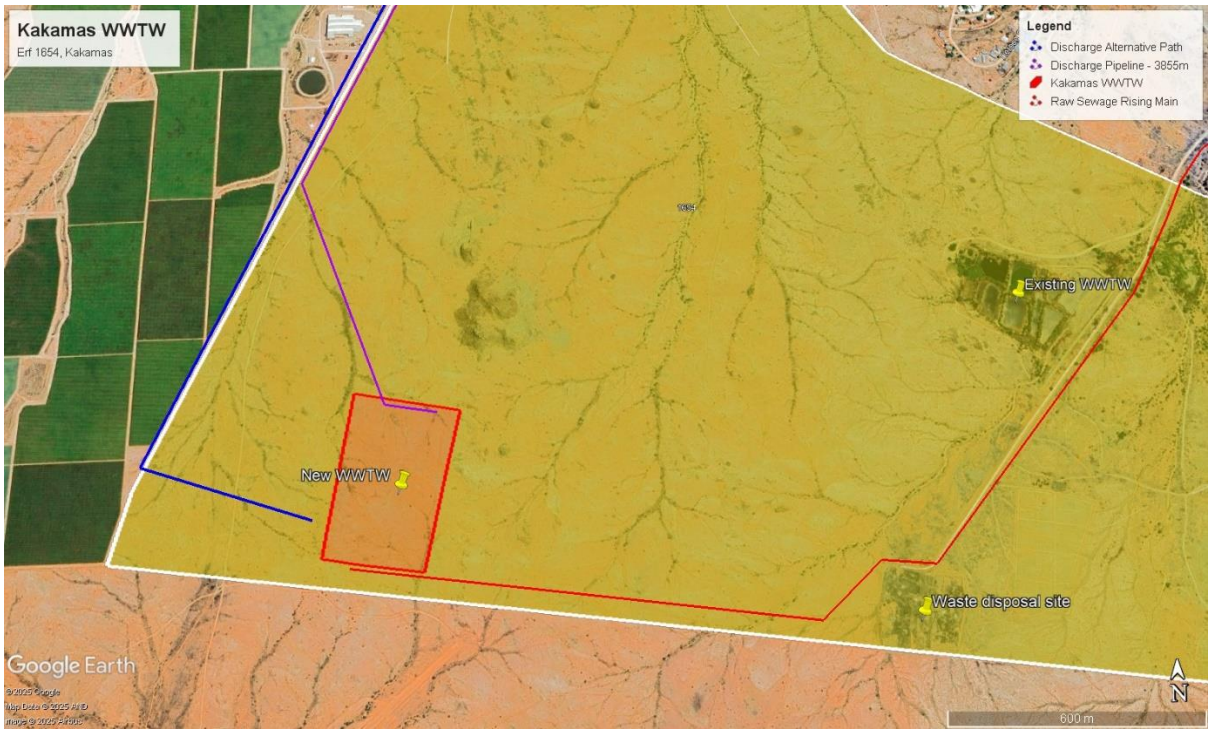

Figure 2: Google Image showing a closer view of the area within which the proposed WWTW will be located.

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

DESCRIPTION	CO-ORDINATE
Kakamas WWTW (approximate location)	S 28°47'31.40" E 20°35'47.55"

2.2. PROJECT DESCRIPTION

BVi Consulting Engineers proposed the construction of a new 2000m^3/day Conventional Oxidation Pond WWTP for the town of Kakamas, comprising the following:

- *Operational Building/Shelter*
- Inlet Works (inclusive of Tanker Truck discharge facility)
- *Screenings Removal*
- *Grit Channels*
- *Flow measurement*
- *Anaerobic Ponds x 2 (lined with HDPE membrane)*
- *Facultative Ponds x 2 (lined with HDPE membrane)*
- *Aerobic Ponds x 3 (lined with HDPE membrane)*
- *Final Storage Pond (lined with HDPE membrane)*
- Horizontal Flow Reedbed (to filter out TSS to achieve General Limit)
- Disinfection facility
- 3.57km x 250mm dia Wastewater Rising Main pipeline
- 3.87km x 300mm dia Treated Effluent Gravity Main from WWTP to Orange River
- 22kV x 2.5km overhead Electrical Power supply line + Transformer

2.3. TOPOGRAPHY, GEOLOGY AND SOILS

The study area still supports relatively undisturbed natural veld. The topography can be described as a slightly irregular plain with a sloping generally towards the north (towards the Orane River). A relatively large rocky outcrop can be found towards the southwest of the site. As is typical of this part of the Northern Cape, small drainage lines criss-crosses the property. In general aspect is not expected to have any significant influence on the vegetation, but geographical features such as the drainage lines and rocky outcrops can result in differences in vegetation densities and even species. Larger indigenous trees are occasionally associated with larger drainage lines.

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).

According to Mucina & Rutherford (2006) the geology associated with this vegetation type is dominated by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of the early Karoo age. About 20% of rock outcrops are formed by Jurassic intrusive dolerite sheets and dykes. Soils are described as soils with minimal development, usually shallow on hard or weathering rock, Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high (Mucina & Rutherford, 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 (9th & 10th of April 2025). The site survey was conducted over an 8-hour period, by walking and driving the site and sampling the vegetation, using an approach, based on the Braun-Blanquet vegetation survey method (Werger, 1974) (Figure 3).

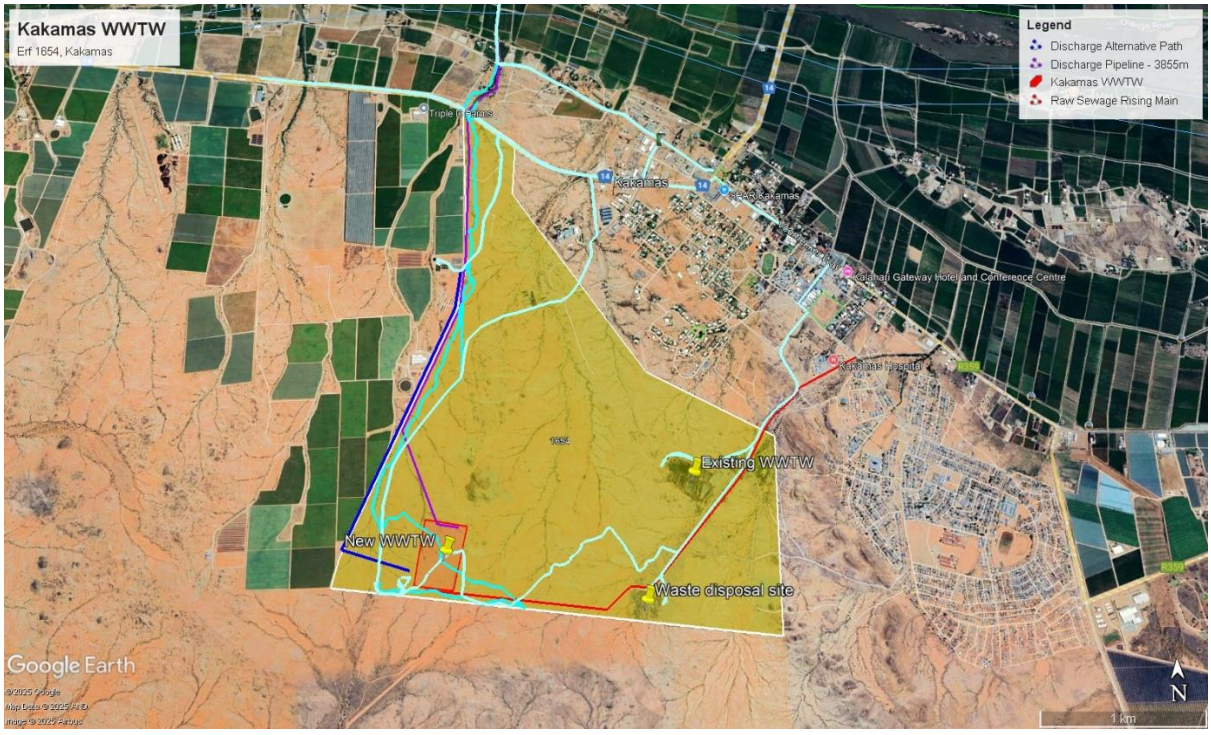

Figure 3: Google image, showing the study area (yellow) and the routes walked during the site visit (light blue).

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. 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.

SIGNIFICANCE	DESCRIPTION
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).

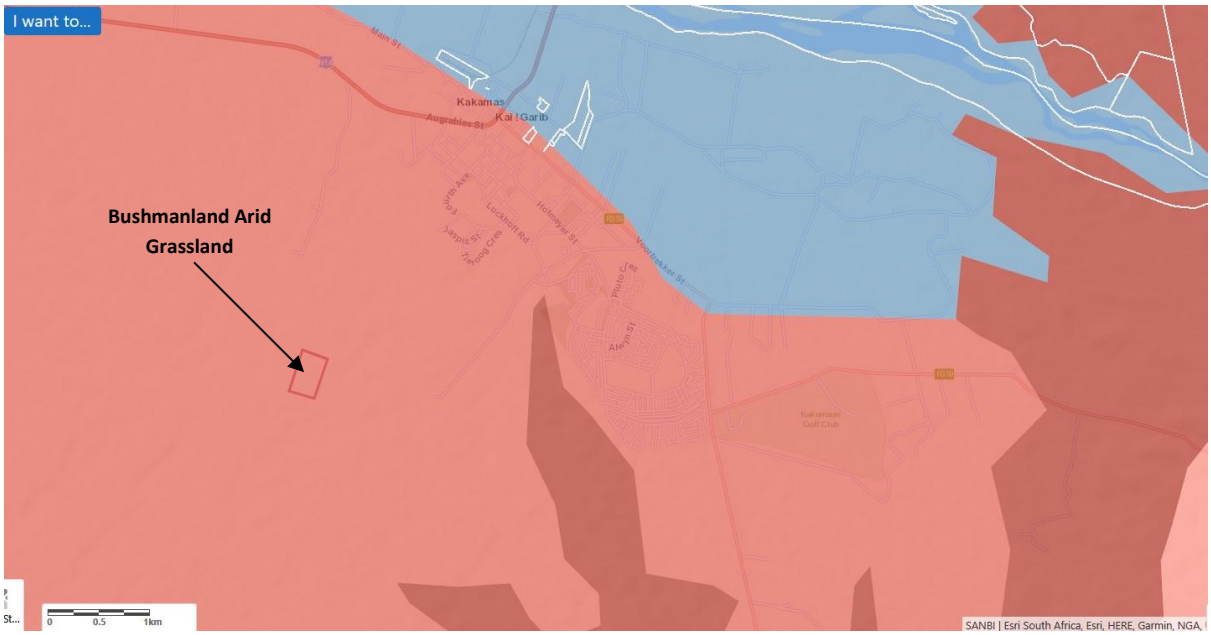

Figure 4: Vegetation map of South Africa (2012), showing the expected vegetation type (SANB BGIS)

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.

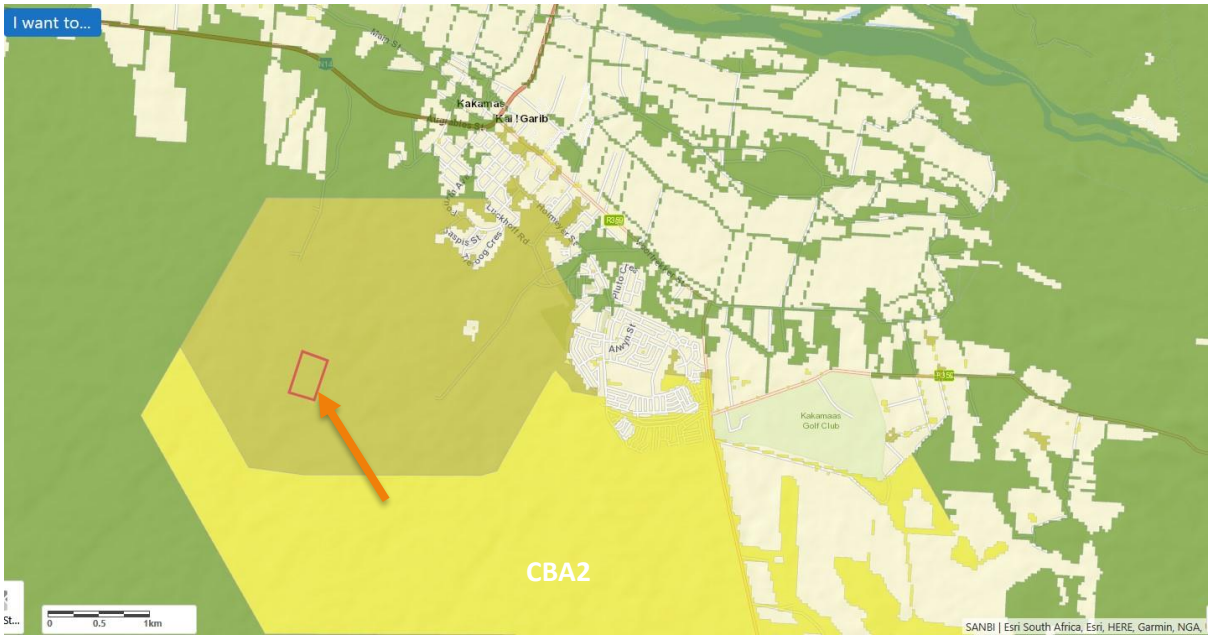

Figure 5: Northern Cape CBA map (2016) showing the proposed WWTW (red)

4.3.1. CBA Reasons

According to the 2016 Northern Cape critical biodiversity areas maps, the study area is located within an ecological support area (ESA) (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.
- **Lower Gariep Broken Veld:** Referring to the SA Vegsmap (Figure 4) and the potential impact on this vegetation type.

- **Conservation areas**: Refers to conservation areas in terms NEMA: Protected Areas Act.
- **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.

4.4. WATERCOURSES 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. A freshwater specialist had been appointed to evaluate the potential impacts on water courses and wetlands.

As is typical of this part of the Northern Cape, small drainage lines tends to criss-cross the property and the construction of the WWTW, and pipelines will impact on a number of these (Figure 6). Most of these are very small drainage lines, although several larger indigenous trees were associated with some of the lower lying watercourses.

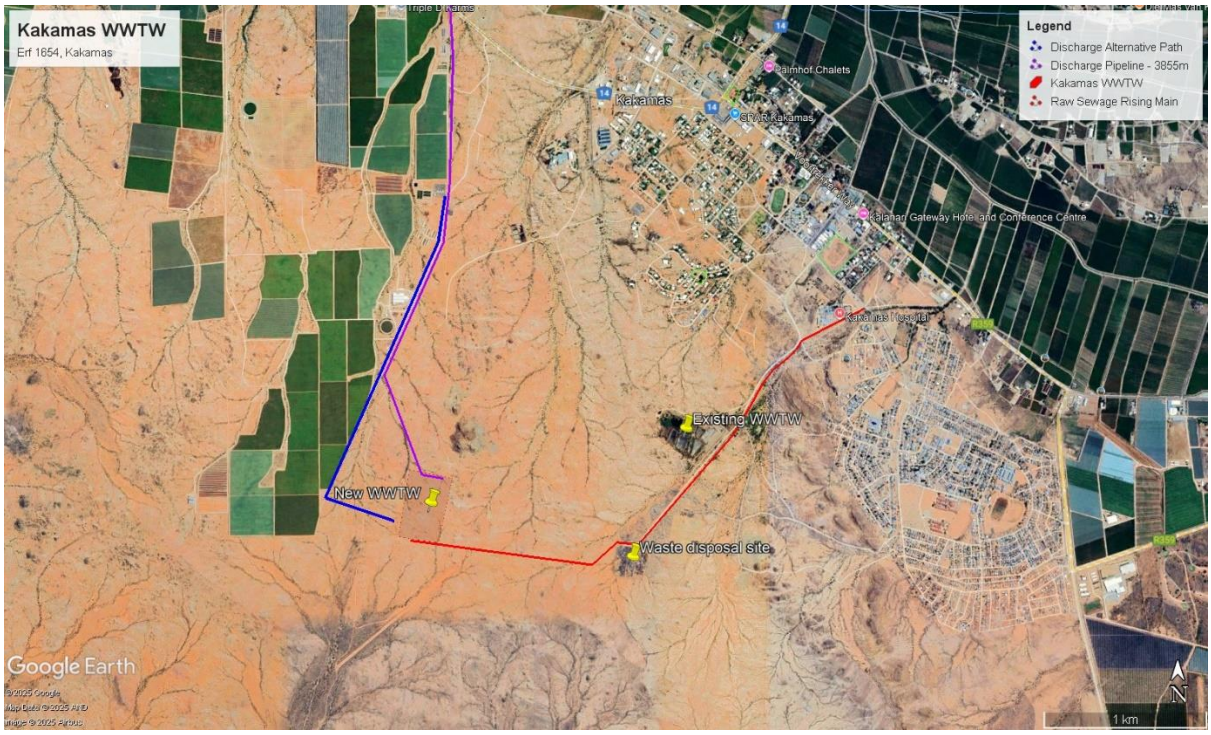

Figure 6: Google Imagery showing the proposed WWTW and pipelines and the seasonal drainage lines within the site.

4.5. POTENTIAL IMPACT ON CENTERS OF ENDEMISM

The proposed development does not impact on any recognised centre of endemism. The Gariep Centre is located to the north (quite a distance away) associated with Augrabies, Pella and Onseepkans along the border of South Africa and Namibia, while the Griqualand West Centre of Endemism starts to the east of Upington Northern Cape Province (Van Wyk & Smith, 2001).

5. VEGETATION & FLORA

Erf 1654 is a large property of about 500 ha, mostly consisting of well-preserved natural veld used informally for livestock grazing. In contrast the southeastern corner (where the oxidation ponds and waste disposal sites re located) has become severely degraded due to illegal dumping and other disturbances.

The proposed new WWTW will be located in the southwestern corner of the property, on a slight SE-NW slope (Figure 1 & Figure 2). The vegetation on the site conformed to a dry version of Bushmanland Arid Grassland, although the effect of recent rains can be seen in an emerging grass and annual herb layer (Heading 5.1).

The incoming (raw sewage) rising main, will be located next to the existing road towards the Waste disposal site (a very disturbed area), before turning west, following the boundary fence of the property towards the proposed new WWTW (Heading 5.2).

The discharge pipeline will carry treated wastewater from the WWTW along the western fence of the site, northwards, next to a small stream and into the agricultural drainage channels and on to the Orange River (Heading 5.3).

5.1. VEGETATION ENCOUNTERED: WWTW LOCATION

Although the Kakamas area received some recent rains, the vegetation cover in the area that will be impacted by the proposed WWTW was still sparse to very sparse (Photo 1 – 5). In years of good rains this vegetation type is expected to be dominated by a layer of white grasses (*Stipagrostis* species), hence it name, and a rich display of annual herbs. At the time of the site visit, the grasses and annual herbs were just beginning to show.

The vegetation can be described as a sparse or open low shrubland, mostly dominated by a combination of the following small to medium shrubs: *Justicia australis*, *Tetraena microcarpa*, *Aptosimum spinescens*, *Euphorbia gariepina*, *Senegalia mellifera*, *Rhigozum trichotomum* (driedoring), *Phaeoptilum spinosum*, *Cynanchum viminale* (melktou), *Kleinia longifolia, Rogeria longiflora Salsola zeyheri* and *Sesamum capense.* Shrubs and herbs like *Leucosphaera bainesii* and *Microloma incanum* were less common while the hemiparasite, *Tapinanthus oleifolius* (mistletoe) can often be observed growing in *Senegalia mellifera* or other trees. The most significant species of conservation concern that was observed were a several bushy *Boscia foetida* individuals scattered throughout the site, a few, *Sensitive species 144* individuals (on this site, usually near larger drainage lines) and one *Hoodia gordonii* individual to the middle of the property.

In between the larger shrubs, prostrate and low growing shrubs like *Acanthopsis hoffmannseggiana*, *Aptosimum lineare*, *Aloe claviflora,* the small *Anacampseros albissima* (=*Avonia albissima)*, *Barleria lichtensteiniana, Blepharis furcata*, *Blepharis mitrata, Euphorbia spinea*, *Geigeria filifolia*, *Hermannia stricta, Kewa salsoloides*, *Limeum aethiopicum*, *Monsonia crassicaulis*, *Ptycholobium biflorum* and *Tribulus cristatus*.

Photo 1: Looking west over the site from the southeastern corner towards Tripple D Farms (in the background). Note the sparse vegetation cover.

Photo 2: Looking to the northwest over the site from its southeastern (Tripple D Farms in the background).

Photo 3: Looking from the southeastern corner of the site, north over the site. Note the location of the rocky outcrop in the background and the *Sensitive species 144* individual near a drainage line.

The following species were usually observed next to or in close vicinity to drainage lines: *Asparagus pearsonii*, , *Justicia spartioides*, *Mesembryanthemum subnodosum* (=*Psilocaulon* species), *Lycium cinereum, Momordica balsamina* (laloentjie), *Montinia caryophyllacea*, *Tetraena decumbens*, herbs like *Chascanum garipense* and *Cleome angustifolia* subsp. *diandra*. Lower down and almost always associated with larger watercourses trees such as *Pappea capensis*, *Parkinsonia africana* and *Ziziphus mucronata* (blinkblaar wag-'n-bietjie).

Photo 4: Looking west over the site from the northeastern corner of the site (Tripple D in the background).

Photo 5: Looking southwest over the site from the northeastern corner of the site (Tripple D to the right).

5.2. VEGETATION ENCOUNTERED: INCOMING PIPELINE (RISING MAIN)

The general vegetation would have been very similar to that described above. However, the portion of the property from the Kakamas hospital to the Kakamas waste disposal had been severely degraded as a result of illegal dumping (Photo 6 & Photo 7). In addition, wastewater overflow from the old treatment work has resulted in dense stands of *Prosopis* trees surrounding the existing WWTW and the (almost permanent overflowing) water streams (Photo 8). It is only from the waste disposal site westwards where the veld becomes more natural and less disturbed and similar to that described in the previous section (Photo 9).

Photo 6: Looking over the proposed pipeline route (next to the road) from about halfway into the site towards town. Note the disturbed nature of the veld and the *Prosopis* trees in the background.

Photo 7: Showing the proposed pipeline route (next to the road) with the town in the background. Again, note the degraded status of the site.

Photo 8: Dense stands of mainly *Prosopis* trees surrounding the existing WWTW.

Photo 9: Typical vegetation encountered towards the back of the site (the southern boundary). Looking from east to west towards the location of the new WWTW. The lager shrubs being *Senegalia mellifera* and *Boscia foetida* individuals.

5.3. VEGETATION ENCOUNTERED: DISCHARGE PIPELINE

From the proposed new WWTW the discharge pipeline will run towards and then follow the western boundary fence of the property (Refer to Figure 2). the vegetation remains the same as described under Heading 5.1 (Photo 10 - Photo 12). The only difference being the more frequent vegetation occurrence of larger trees (mostly *Pappea capensis* or *Ziziphus mucronata*), next to the larger drainage lines in this lower-lying area (Photo 10 & Photo 11). However, they should be easy to avoid.

Photo 10: Typical vegetation encountered in the vicinity of the western boundary of the property. Note the scattered larger trees next to drainage lines. They should be easily avoided.

Photo 11: An example of two trees (*Pappea* & *Ziziphus*) growing next to each other in one of the larger drainage lines in the lower-lying areas. Driedoring and *Cynanchum viminale* also visible to the left and right of the watercourse.

Photo 12: Typical vegetation encountered towards the northwestern corner of the property (Triple D farms to the left of picture).

At the northwestern corner of the site, the pipeline will cross the N14 using an existing culvert (Photo 13). It will then run next to a slightly larger seasonal stream (where the vegetation has been significantly degraded and often dominated by *Prosopis* stands (Photo 14 - Photo 16). The pipeline will then release the treated effluent into the existing concrete channel system next to the Orange River (Photo 17).

The channel system is located in agricultural land and the pipeline will not impact on any remaining natural veld of any signicance.

Photo 13: The culvert in the northwestern corner of the site through which the pipeline will cross underneath the N14.

Photo 14: The vegetation west of the drainage line north of the N14. Larger shrubs mostly *Senegalia mellifera* with *Prosopis* in the background.

Photo 15: Denser stands of Prosopis further north next to the drainage line.

Photo 16: An old cemetery observed to the west of the watercourse.

Photo 17: The drainage channel into which the treated water will be disposed.

5.4. 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 two-day site visit. However, 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
•	*Acanthopsis hoffmannseggiana,*	ACANTHACEAE	LC	A short-lived dwarf herb, relatively common.
•	*Aloe claviflora*	ASPHODELACEAE	LC NCNCA, Schedule 2 Protected	Low succulent plant occasionally observed.
•	*Sensitive species 144*	ASPHODELACEAE	VU NCNCA, Schedule 1 Protected	Kokerboom: A few individuals, of which two are near the proposed WWTW footprint.
•	*Anacampseros albissima (=Avonia albissima)*	ANACAMPSEROTACEAE	LC	Small perennial herb, common after the recent rains.
•	*Aptosimum lineare*	SCROPHULARIACEAE	LC	Dwarf shrub relatively common throughout.
•	*Aptosimum spinescens*	SCROPHULARIACEAE	LC	Doringviooltjie: Dwarf shrub, common throughout.
•	*Asparagus pearsonii*	ASPARAGACEAE	LC	Thorny straggling shrub occasionally in drainage lines.
•	*Barleria lichtensteiniana*	ACANTHACEAE	LC	Rolvarkie: Occasionally underneath larger shrubs.
•	*Blepharis furcata*	ACANTHACEAE	LC	A spiny prostrate shrub, occasionally observed.
•	*Blepharis mitrata*	ACANTHACEAE	LC	Klapperbossie: A spiny dwarf shrub, relatively common.
•	*Boscia foetida*	BRASSICACEAE (CAPPARACEAE)	LC NCNCA, Schedule 2 Protected (all species in this Genus)	Stink-bush: medium sized shrub to small tree, occasionally observed throughout.
•	*Chascanum garipense*	VERBENACEAE	LC	A large herb, occasional near watercourses or wet areas.
•	*Cleome angustifolia* subsp. *diandra*	BRASSICACEAE	LC	A large herb, occasional in drainage lines.
•	*Cynanchum viminale (=Sarcostemma viminale)*	APOCYNACEAE	NCNCA, Schedule 2 Protected (all species in this Family)	Melktou, medium large shrub occasional in open areas.

NO.	SPECIES NAME	FAMILY	STATUS	NOTES
•	*Euphorbia gariepina*	EUPHORBIACEAE	LC NCNCA, Schedule 2 Protected (all species in this Genus)	Neat, medium large shrub, relatively common.
•	*Euphorbia spinea*	EUPHORBIACEAE	LC NCNCA, Schedule 2 Protected (all species in this Genus)	A spinescent dwarf shrub, relatively common throughout.
•	*Geigeria filifolia*	ASTERACEAE	LC	Occasionally observed in open veld.
•	*Hermannia stricta*	STERCULIACEAE	LC	Woestynroos: Occasionally near drainage lines and in open veld.
•	*Hoodia gordonii*	APOCYNACEAE	**DD (Data Deficient)** Protected in terms of NEM:BA NCNCA, Schedule 1 Protected	
•	*Justicia australis (=Monechma genistifolium)*	ACANTHACEAE	LC	Medium sized shrub, common to dominant in open veld.
•	*Justicia spartioides (=Monechma spartioides)*	ACANTHACEAE	LC	Maklikbreekbos: Occasionally near drainage lines.
•	*Kewa salsoloides (=Hypertelis salsoloides)* *	MOLLUGINACEAE	LC	Blaassuring: Dwarf shrub, occasionally observed.
•	*Kleinia longiflora*	ASTERACEAE	LC	Medium-small shrub, occasionally observed.
•	*Leucosphaera bainesii*	AMARANTHACEAE		Silverbossie – occasionally observed.
•	*Limeum aethiopicum*	LIMEACEAE	LC	Aarbossie: Prostrate herb, relatively common.
•	*Lycium cinereum*	SOLANACEAE	LC	Kriedoring: Spiny shrub, often near drainage lines.
•	*Mesembryanthemum subnodosum (=Psilocaulon)*	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Succulent plant, often associated with disturbed veld.
•	*Microloma incanum*	APOCYNACEAE	LC	Bokhorinkie: Dwarf shrub occasionally observed.
•	*Momordica balsamina*	CUCURBITACEAE	LC	Laloentjie: A climber, one observation in a drainage line.
•	*Monsonia crassicaulis (=Sarcocaulon)*	GERANIACEAE	LC	Boesmankers: Spiny dwarf shrub, occasionally observed.
•	*Montinia caryophyllacea*	MONTINIACEAE	LC	Peperbos: Large twiggy shrub, occasional near drainage lines.
•	*Pappea capensis*	SAPINDACEAE	LC	Jacket plum: Medium sized tree, in larger drainage lines.
•	*Parkinsonia africana*	FABACEAE	LC	Lemoendoring: Medium-sized tree, near drainage lines.
•	*Phaeoptilum spinosum*	NYCTAGINACEAE	LC	Brosdoring: Large woody shrub, occasionally near drainage lines.
•	*Prosopis* species	FABACEAE	Alien invasive plant species: Must be removed.	Next to the larger watercourses to the north of the site. **MUST BE REMOVE**.
•	*Ptycholobium biflorum*	FABACEAE	LC	Dwarf shrub, occasionally observed near drainage lines.
•	*Rhigozum trichotomum*	BIGONACEAE	LC	Driedoring: Medium large shrub, relatively common.
•	*Rogeria longiflora*	PEDALIACEAE	LC	Desert foxglove – common throughout the site
•	*Salsola zeyheri*	AMARANTHACEAE	LC	Small shrub, occasionally observed in open areas.
•	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE	LC	Swarthaak: Medium large very thorny shrub. Common

NO.	SPECIES NAME	FAMILY	STATUS	NOTES
•	*Sesamum capense*	PEDALIACEAE	LC	Aprilbaadjie – relatively common throughout.
•	*Tapinanthus oleifolius*	LORANTHACEAE	LC	Mistletoe – a hemiparasite often in *Senegalia mellifera*.
•	*Tetraena decumbens (=Zygophyllum decumbens)*	ZYGOPHYLLACEAE	LC	Medium shrub: occasionally, often near watercourses.
•	*Tetraena microcarpa (=Zygophyllum)*	ZYGOPHYLACEAE	LC	Medium shrub. Common to dominant in open veld.
•	*Tribulus cristatus*	ZYGOPHYLLACEAE	LC	Dubbeltjie. Very common prostrate weedy herb.
•	*Ziziphus mucronata*	RHAMNACEAE	LC	Blinkblaar wag-'n-bietjie: very thorny tree near watercourses.

5.5. 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).

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). Two red-listed species were observed namely (Refer to Table 10):

- ***Hoodia gordonii****:* This species declined sharply after 2001 due to demand for its appetite suppressant qualities, especially from 2004–2006. Recently, stricter laws and falling international demand have reduced wild harvesting in South Africa.
- ***Sensitive species 144***: Current projections show that climate change is a significant factor affecting this species. Climate models estimate that by 2070, the species may lose between 33% and 67% of its suitable bioclimatic range.

NEM:BA protected plant species: The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).

- ***Hoodia gordonii*** is also protected in terms of NEM: BA.

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).

- No species protected in terms of the NFA was observed.

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 give 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).

- Eight (8) species protected in terms of the NCNCA was observed within the footprint (Refer to Table 10).

Table 10: Protected plant species with impact minimisation recommendations.

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
1.	*Aloe claviflora* **Schedule 2 protected.** **(All plants in this Family)**	Several individuals were observed throughout the site. This is a relatively common and widespread species with a red-list status of Least Concern.	**Search & rescue** Even though a widespread species it is recommended that as many of these plants as possible are transplanted to areas that will not be disturbed (within the same property). **A NCNCA Permit application must be obtained for the impacts on this species.**
2.	*Sensitive species 144* **Schedule 1 protected.**	Two individuals were observed in the general location of the proposed new WWTW.	**Search & rescue** The footprint layout should aim to avoid any impact on these plants, but if not possible all individuals must be transplanted outside of the footprint and a watering program must be implemented until they have established themselves. **A NCNCA Permit application must be obtained for the impacts on this species**
3.	*Boscia foetida* **Schedule 2 protected**	Several multi-stemmed shrub was observed throughout the property, and it is likely that some of these plants will be impacted (Photo 18).	No search & rescue is proposed. *Boscia* species seldom transplant successfully, because of their extensive and deep root system. Where possible the footprint layout should aim to avoid as many of these plants as possible. **A NCNCA Permit application must be obtained for the removal of any individuals**.
4.	*Cynanchum viminale* **Schedule 2 protected (All plants in this Family)**	Several individual were observed throughout the site, and it is likely that some of them will be impacted. However, it is a common and widespread species with a red-list status of Least Concern.	No Search & rescue proposed. Topsoil should be re-used for the rehabilitation of disturbed areas, which will allow for seed store protection). **A NCNCA Permit application must be obtained for the impacts on this species**
5.	*Euphorbia gariepina* **Schedule 1 protected** **(All plants in this Genus)**	This species was relatively common in certain areas of the site and some individuals might be impacted. However, it is a widespread species with a red-list status of Least Concern.	**Search & rescue**. Even though a widespread species it is recommended that as many of these plants as possible is transplanted to areas that will not be disturbed (within the same property). **A NCNCA Permit application must be submitted for the removal of these plants.**
6.	*Euphorbia spinea* **Schedule 1 protected** **(All plants in this Genus)**	This species was relatively common throughout the site and some individuals are likely to be impacted. Although never common, it is a widespread species with a red-	**Search & rescue**. Even though a widespread species it is recommended that as many of these plants as possible is transplanted to areas that will not be disturbed (within the same property). **A NCNCA Permit application must be submitted for**

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
		list status of Least Concern.	**the removal of these plants.**
7.	*Hoodia gordonii* ***NEMBA protected species*** ***NCNCA* Schedule 1 protected.**	One individual was observed away from the WWTW, but more is expected in the larger area. It is possible that a few individuals might be impacted.	**Search & rescue** The footprint layout should aim to avoid any impact on these plants, but if not possible all individuals must be transplanted outside of the footprint and a watering program must be implemented until they have established themselves. **A NCNCA Permit application must be obtained for the impacts on this species**
8.	*Mesembryanthemum cf. subnodosum (=Psilocaulon)* ***NCNCA* Schedule 2 protected** *(all species in this Family protected by default)*	Occasionally observed, mostly in disturbed areas or near drainage lines. A common widespread species that is often considered a disturbance indicator species.	No Search & Rescue proposed. Topsoil should be re-used for the rehabilitation of disturbed areas, which will allow for seed store protection). **NB: A NCNCA Permit application will have to be obtained for potential impacts on this species.**

5.6. 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". Current projections show that climate change is a significant factor affecting this species. Climate models estimate that by 2070, the species may lose between 33% and 67% of its suitable bioclimatic range. At least two individuals might be impacted by general location of the proposed WWTW. Refer to the impact mitigation recommendations in Table 10.
- Apart from the several other species of conservation concern were observed as discussed in Table 10), although most of these are common and widespread species.

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 are implemented.

Photo 18: Two *Boscia foetida* individuals observed. Note the low, multi-stem shrubby nature of the plants, which was typical of most of these plants observed on the property.

6. FAUNA & AVI-FAUNA

The Northern Cape is home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, this remarkable diversity is not distributed evenly throughout the region but is concentrated in many local centres of endemism. The Bushmanland is an arid area inland of the Namaqualand and is often described as one of the most inhospitable areas in South Africa. Apart from being very arid, the soils are infertile, and the groundwater is mostly saline. Wildlife is sparse but often interesting.

The property borders on the Kakamas urban edge or agricultural to the north, east and west, but still shows good connectivity to the south. Because of its proximity to the urban edge the site itself is subject to relatively constant human activity (used by the local community as a shortcut between the town and surrounding farming areas) and shows various signs of previous and existing disturbances (e.g., excavations, illegal dumping, old building foundations, ploughing). Because of the continual anthropogenic impacts, the study area is unlikely to be favoured by larger game or avi-fauna. As a result, a formal fauna or avi-fauna screening was not considered necessary, but observations were made during the site visit.

6.1. 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.

Smaller mammals like the aardvark (*Orycteropus afer*), steenbok (*Raphicerus campestris*), common duiker (*Sylvicapra grimmia*), suricate (*Suricata suricatta*), bat-eared fox (*Otocyon megalotis*), Cape fox (*Vulpes chama*), and black-backed jackal (*Canis mesomelas*) may still be found on farmlands south of the area. The endangered honey badger (*Mellivora capensis*) might also occur locally, though it is widely distributed and the development is unlikely to impact its habitat significantly. Due to the site's proximity to Kakamas, agricultural areas, and ongoing human activity, these species are unlikely to

frequent or visit the site.

Apart from insects, reptiles and a few smaller mammal species (e.g. rodents) that might still occur on site, the **project is not expected to have any significant long term impact on any fauna species**.

6.2. AVI-FAUNA

According to the Southern Africa Bird Atlas Project (SABAP 2) (https://sabap2.birdmap.africa/) data about 95 bird species are known from the pentad (Refer to Appendix 2 for the full list of species). This includes 3 species of conservation concern (IUCN listed species) (refer to Table 11).

Table 11: Species of conservation concern listed in the SABAP2 data set for the Kakamas Pentad 2845_2030

No.	Common group	Common species	Genus	Species	Regional	Global
30	Eagle	Martial	*Polemaetus*	*bellicosus*	**EN**	**VU**
34	Falcon	Lanner	*Falco*	*biarmicus*	**VU**	**LC**
76	Stork	Black	*Ciconia*	*nigra*	**VU**	**LC**

Refer to Table 12 for a discussion and evaluation of these species together with other sensitive animal species as identified by the DFFE Screening tool for this study area.

6.3. ANIMAL SPECIES SENSITIVITY THEME

According to the **DFFE Screening tool report** for the site (Appendix 1), the Animal Species Theme Sensitivity is considered **MEDIUM SENSITIVE** because the footprint overlaps the known distribution range of one sensitive bird species, namely **Ludwig's Bustard**. Ludwig's Bustard is a near endemic and classified as e**ndangered** because of a projected rapid population decline.

According to the SABAP2 data set Ludwig's Bustard had not been observed in this area, but three other species of conservation concern, namely the Martial Eagle, the Lanner Falcon and the Black Stork, were observed in this pentad (Refer to Table 11). However, it must be noted that this pentad overlaps a portion of the Orange River (the reason for the inclusion of the Black Stork) and a large area of natural veld to the south of the site (probably the reason for the inclusion of the Lanner Falcon and the Martial Eagle).

Table 12: Animal species theme sensitivity evaluation and discussions

SPECIES	STATUS & DISCUSSION
Falco biarmicus (Lanner Falcon / Edelvalk) **Vulnerable (VU)**	**Status**: The Lanner falcon appears to be decreasing at a rate that satisfies the population-trend criterion for regionally **Vulnerable**. It occurs widely but sparsely throughout South Africa, Lesotho and Swaziland, with the highest densities recorded in Western Cape and KwaZulu-Natal. Not threatened globally but *Near-threatened* in South Africa, due to local extinctions possibly caused by a vulnerability to agrochemicals. It has however benefited from the clearing of savanna and the increasing availability of free-range poultry (Taylor, 2015). **Habitat**: It generally favours open grassland, cleared or open woodland and

SPECIES	STATUS & DISCUSSION
	agricultural land (Birdlife International, 2023). **Diet**: It hunts mainly birds, especially doves, pigeons and chickens, using extreme speed to surprise its prey. It often hunts from a high perch or while soaring high up in the air, making a steep and rapid dive to intercept a bird either aerially or on the ground. It often hunts in pairs, enabling them to catch large or highly illusive prey (Hockey *et. al*., 2005). **Breeding**: The species seems to be monogamous and territorial solitary nesters (probably with a long pair bond). The nest is typically a simple scrape in sand or soil on a cliff ledge or is placed in another structure such as a building or nest box. It may also use the stick nest of another bird such as a White-necked raven, Verreaux's eagle or Bateleur, sometimes displacing them while they are breeding and possibly killing their chicks in the process. As these stick nests are often on utility pylons and poles, Lanner falcons have been able to colonise treeless areas where they have not previously occurred (Hockey *et. al*., 2005). The species is partial migrant in southern Africa, as many juveniles depart from their breeding grounds around December-January in the eastern grasslands of South Africa, heading west and south-west to the Kalahari, Karoo and the Western Cape, returning May-June (Van Zyl *et. al.,* 1994). **Conclusion**: According to the SABAP2 data the Lanner Falcon has been observed in this pentad and is likely to hunt over the larger area. The study area, itself does not support any significant numbers of prey (in fact none of its prey was observed, although dove and pigeons might visit the site). The proposed development might have a low (most probably insignificant) impact on its hunting area but will have no impact on its breeding or nesting habitats. Overall, it is considered unlikely that the proposed development (because of its location) will result in any significant additional impact on the hunting or breeding patterns of this species. With regards to this project the sensitivity rating is considered to be **Low Sensitive**.
Neotis ludwigii (Ludwig's Bustard) **Endangered (EN)**	**Status**: Ludwig's Bustard is a near endemic and classified as **endangered** 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)

SPECIES	STATUS & DISCUSSION
	Conclusion: According to the SABAP2 data sets the Ludwig's Bustard had not been observed within the pentad associated with the study area. Because of its location and constant human activity it is considered highly unlikely that the proposed development will result in any significant impact on the breeding or feeding patterns of this species. With regards to this project the sensitivity rating is considered to be **Low Sensitive.**
Polemaetus bellicosus (Martial eagle) **Endangered (EN)**	**Status**: The Martial Eagle is a low density apex predator which normally holds large territories but can also be "floaters" (not holding a territory but moving around). It is southern Africa's largest eagle and is considered **endangered**, because of deliberate or accidental poisoning, habitat loss, and loss of available prey, collisions with power lines etc. The remaining population is believed to be 800 pairs in South Africa (Taylor, 2015). It has an extensive range across much of sub-Saharan Africa but is generally scarce to uncommon or rare. **Habitat**: It inhabits open woodland, wooded savanna, bushy grassland, thornbush and, in southern Africa, more open country and even subdesert, from sea level to 3,000 m but mainly below 1,500 m (Ferguson-Lees & Christie 2001). **Breeding**: Evidence suggests that breeding pairs select strongly against human-disturbed habitats. They need large trees for nests and prefer protected areas as breeding spots. **Conclusion**: According to the SABAP2 data sets, the Martial Eagle had been observed in the larger pentad, but in this case, it is believed that the bird might hunt (and breed) over the farmlands to the south but is unlikely to occur so close to the urban edge. The proposed development is not expected to have had any significant additional impact on the breeding or feeding patters of this species. With regards to this project the sensitivity rating should be **Low Sensitive**.
Ciconia nigra (Black Stork) **Vulnerable (VU)**	**Status**: The regional population estimated for the Black Stork is less than 1 000 mature individuals which satisfies the population size criterion for regionally **Vulnerable**. In addition, a population size reduction of greater than 30% is suspected to have occurred over the last 47 year period (Taylor *et. al.*, 2015). The Black Stork occur widely from Western Europe to northern China and Japan, with non-breeding birds migrating annually to East Africa and the Sahel, northern India and eastern China. What makes the southern African population unusual is the fact that they are resident breeders and are believed to undergo only regional migrations between seasons. **Habitat**: Although the Black Stork of southern Africa have a widespread distribution, ranging from Zambia to South Africa, the population is fairly sparse as these birds prefer remote areas and have particular feeding habits. It is reliant on shallow waterbodies, such as estuaries and rivers, in which it forages (Chevallier *et al.* 2008). The degradation of wetlands and the damming of small rivers have undoubtedly had a negative impact on this species. **Diet**: The Black Stork's diet consists mainly of fish, caught in clear streams, estuaries and dams. **Breeding**: Unlike Black Stork in Eurasia, which breeds in trees, the southern African population breeds on cliffs in remote mountainous regions. Breeding occurs during winter (May to July) when the birds can capitalise on the abundance of prey

SPECIES	STATUS & DISCUSSION
	available when the water is receding. **Conclusion**: According to the SABAP2 data sets, the Black Stork had been observed in this pentad, but in this case, it is believed that this is only because the pentad overlaps a portion of the Orange River. The proposed footprint area does not support the breeding or feeding requirements for this species, and it is considered highly unlikely that the proposed development will result in any impact on this species. With regards to this project the sensitivity rating is considered to be **Low Sensitive**.

The discussion above suggests that apart from insects, rodents and a few smaller reptile species, the development is not expected to have any significant additional impact on fauna or avi-fauna.

AS A RESULT, THE **ANIMAL SPECIES THEME SENSITIVITY** FOR THIS PROJECT IS CONSIDERED **LOW SENSITIVE** (NOT MEDIUM SENSITIVE AS GIVEN BY THE DFFE SCREENING TOOL).

7. TERRESTRIAL BIODIVERSITY THEME SENSITIVITY

The DFFE Environmental Screening Report shows the relative Terrestrial Biodiversity theme sensitivity as **Very High Sensitivity** because the study area overlaps an Ecological Support Area (ESA) (Refer to Heading 4.3 & Figure 5). The reasons for the ESA status are discussed below in terms of the proposed development after site verification.

7.1. CONSERVATION STATUS /CONSTRAINTS & OPPORTUNITIES

The proposed development will result in the transformation of 7 – 10 ha relatively undisturbed natural veld located on Municipal land (Erf 1654), about 1.7km south of the Kakamas urban edge. It will also result in temporary disturbances along the routes for the incoming pipeline (about 3.6 km in length) and the outgoing pipeline (about 3.87 km in length). The main impacts will be on Erf 1654, which is about 500 ha in size. The existing WWTW and the Municipal waste disposal site is located on the property, while the remainder of the site is probably used for informal grazing by the local community, while the northwestern corner of the property still shows the concrete foundations of the old Water Affairs construction team housing that was located in that area years before.

7.1.1. VEGETATION & FLORA

Site verification confirmed that the proposed WWTW and associated pipelines will only impact on one vegetation type, namely Bushmanland Arid Grassland (Figure 4), a vegetation type that is not considered vulnerable or threatened (Lower Gariep Alluvial Vegetation will not be impacted). The

vegetation is in relatively good condition and still shows good connectivity to the south.

Several Species of Conservation Concern (SoCC) were recorded on the larger erf, including two red-listed species (*Hoodia gordonii* and *Sensitive species 144*), one of which is protected under NEM:BA. Additionally, several species protected by the Northern Cape Nature Conservation Act were observed, most notably *Boscia foetida* (refer to Table 10). Two individuals of *Sensitive species 144* is located close to the proposed footprint, while several other protected species is likely to be impacted, which might include *Boscia foetida* individuals.

The potential impact on vegetation type is expected to be very low negative, but because of the fact that the proposed development is located in an ESA and may impact on SoCC the impact on vegetation & flora combined is considered be **Medium-Low negative**.

7.1.2. CONSERVATION –, NPAES PA FOCUS AREAS & LANDSCAPE ELEMENTS

According to the 2016 Northern Cape critical biodiversity areas maps the proposed WWTW will be located in an area identified as an ESA, based on the fact that the property still supports relatively large unfragmented portions of natural veld, that is located in relatively close proximity to the Augrabies Falls National Park. Erf 1654 also supports a cluster of two larger rocky hills or "koppies".

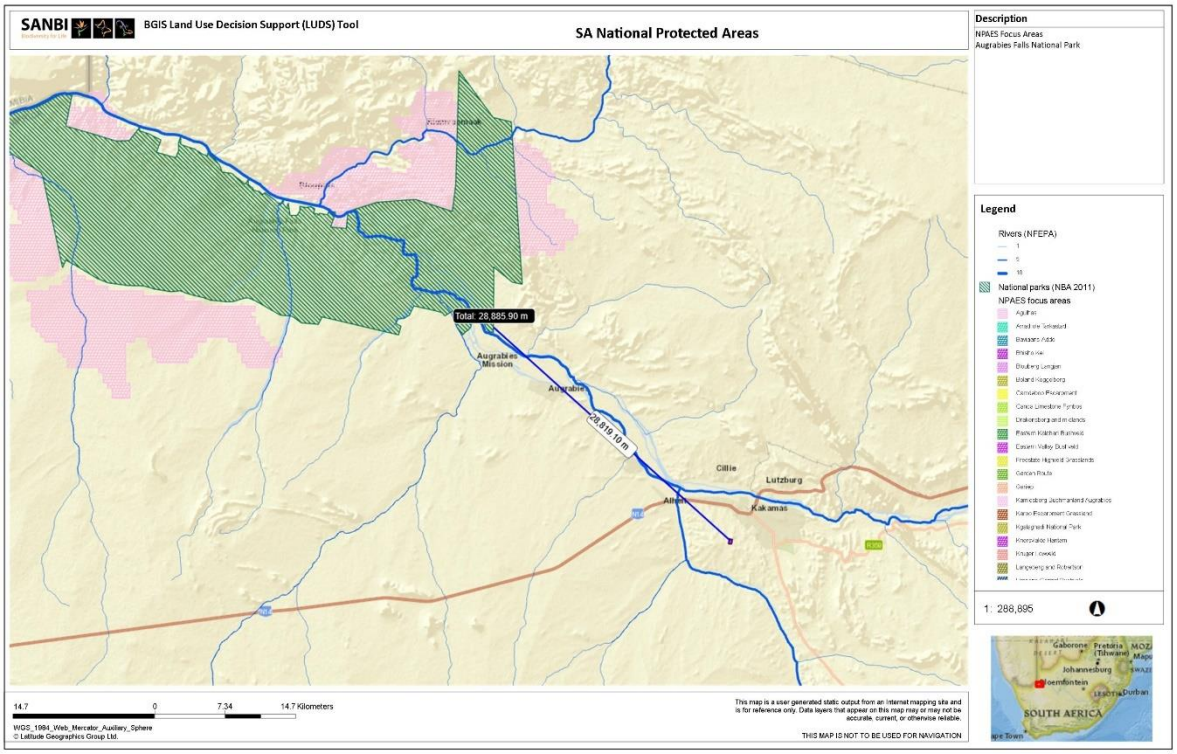

Figure 7: The SA National Protected Areas maps showing the Augrabies Falls NP (green) and focus areas for expansion (pink) in relation to the location of the proposed Kakamas WWTW.

However, the property is about 29 km to the southeast of the Augrabies Falls NP (and its focus areas for expansion) with no direct natural corridors linking the two areas (Figure 7). The property itself is almost enclosed by cultivated lands and the Kakamas urban area, with direct connectivity remaining only towards the south. The koppies are relatively isolated in the landscape and does not link to any

other in the area.

As a result, the potential impact on conservation worthy areas and landscape elements is considered to be **Low negative**. Erf 1654 is unlikely to become a focus area for conservation in the near future.

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 10 ha of natural veld on Municipal land just south of the Kakamas urban edge, but also in relative close proximity to the Orange River and within 30 km of the Augrabies National Park. In this case, the main indirect impact is likely to be associated with the potential of water pollution due to treated sewerage that will be released into a river system (to be evaluated by the Freshwater Specialist report).

In terms of Terrestrial impacts, the indirect impact is considered to of relatively **Low Significance**.

7.3. CUMULATIVE IMPACTS

Refer to Table 13. 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 in a slow degradation of the site, as a result of its proximity to the urban edge of Kakamas.

However, the existing WWTW was never designed to treat the volumes of wastewater that it is currently receiving. As a result, untreated or poorly treated effluent overflows into the surrounding environment (close to the urban edge), which is not only an **environmental pollution** risk but also a significant **health & safety** risk. The No-Go alternative will mean that the Municipal will not be able to provide adequate treatment facilities for current and future sewerage demands.

The 'No Go' alternative will mean that environmental pollution and health & safety risks will continue which in itself is a significant negative impact.

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 13: 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	2	1	5	1	1	16	No special habitats observed, apart from two rocky hills, which will not be impacted by the proposed development.
	With mitigation	2	1	5	1	1	16	Minimise the disturbance footprint during construction.
Watercourses & Wetlands: Potential impact on natural water resources and it's ecological support areas.	Without mitigation						N/a	A freshwater specialist had been appointed to evaluate the potential impact on watercourses and wetlands.
	With mitigation						N/a	
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	2	2	5	1	1	18	Transformation of a small portion of Municipal land, potentially used for informal grazing.
	With mitigation	2	1	5	1	1	16	The positive impact of service delivery should far outweigh the potential impact on grazing.
Vegetation status: Loss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	3	2	5	1	1	27	Transformation of <10ha of natural veld (LT) BUT located in an ESA and potentially supporting plants SoCC.
	With mitigation	3	1	5	1	1	24	Refer to the impact mitigation recommendations.
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	3	3	5	1	2	33	Transformation of <10ha of natural veld within an ESA within 30km of a National Park.
	With mitigation	3	1	5	1	1	24	Refer to the impact mitigation recommendations.
Connectivity: Potential loss of ecological migration corridors.	Without mitigation	3	2	5	1	1	27	Transformation of <10ha of natural veld in an area still supporting relatively large unfragmented portions of natural veld BUT with remaining connectivity only to the south.
	With mitigation	3	1	5	1	1	24	Refer to the impact mitigation recommendations.
Plant SoCC: Potential impact on threatened or protected plant species.	Without mitigation	3	4	5	1	2	36	The potential impact on red-listed and protected plant species as described in Table 10.
	With mitigation	3	2	3	1	1	21	Refer to the impact mitigation recommendations.
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 in Table 12.
	With mitigation	1	1	5	1	1	8	Refer to the impact mitigation recommendations

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	3	4	5	1	2	36	Transformation of <10ha of natural veld within an ESA that might impact on SoCC.
	With mitigation	3	2	5	1	1	27	Minimise the impact on protected plant species and minimise the disturbance footprint.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	3	3	3	1	2	27	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 is to identify and evaluate potential areas of terrestrial sensitivity. In this case, even though the proposed WWTW will be located in an ESA area, the disturbance footprint will be so small that even the cumulative impact is expected to be **Low negative**. The main impacts associated with the proposed development is considered to be:

- The potential impact on **plant species** of conservation concern (SoCC).
- The potential impact on <10ha of natural veld within an ESA (an ecological support area).
- The less-likely potential impacts on vegetation type, connectivity and fauna and avi-fauna.

No fatal flaws or any other obstacles were found with respect to the flora, vegetation, fauna, and terrestrial biodiversity. 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 shows the more disturbed areas and locations of red-listed species.

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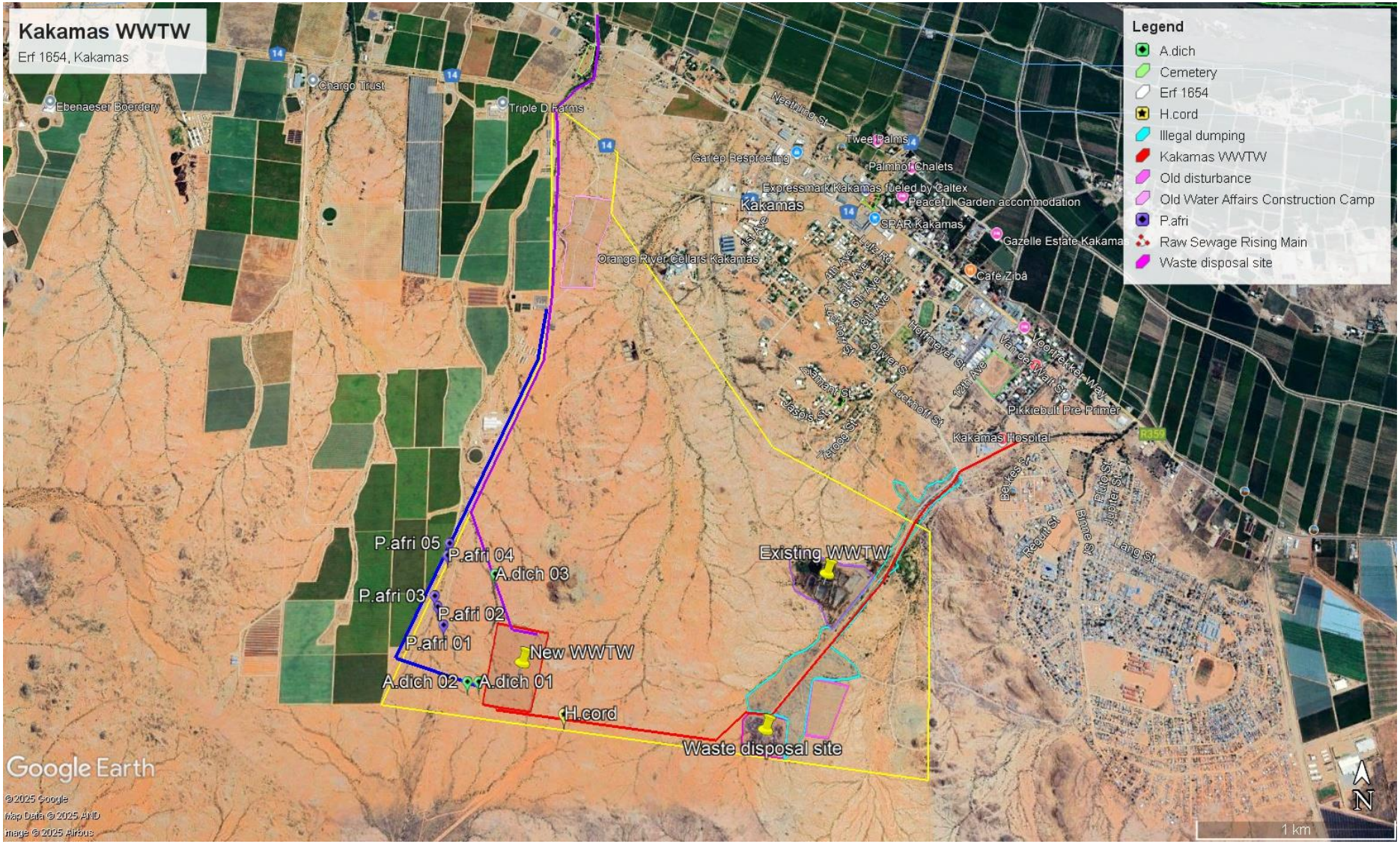
Figure 8: Site sensitivity map – focusing on the location of the protected and other larger tree species. A.dich = *Sensitive species 144*; H.cord = *Hoodia gordonii.*



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 thus focuses on the protection of these species and footprint minimisation. During construction the overriding goal should be to clearly define the final layout, in order to manage protected species and 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 minimisation the impact on SoCC.
- The "Search & Rescue" recommendations given in Table 10 must be implemented:
    - A botanist or a suitably qualified ECO must inspect the demarcated routes for plants SoCC that needs to be searched & rescued .
    - Search & Rescue must include an aftercare period, during which the plants are watered from time to time to give them the best possible chance of survival.
    - In addition, all efforts should be made to protect all mature indigenous trees (e.g., *Pappea capensis* individuals).
    - Northern Cape Nature Conservation Act permit must be obtained for the potential impacts on the NCNCA protected species.
    - In addition, a NEM:BA permit must be obtained, should any of the *Hoodia gordonii* individuals had to be re-planted.
- 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: DFFE SCREENING REPORT

APPENDIX 2: SABAP2 – BIRD SPECIES LIST

The SABAP2 species list for Pentad 2845_2030. Regional and Global red list categories are from the 2019 BirdLIfe South Africa list categorisation. Red listed species are marked in green.

No.	Common Group	Common species	Genus	Species	Regional	Global
1		Bokmakierie	*Telophorus*	*zeylonus*		
2		Hamerkop	*Scopus*	*umbretta*		
3	Barbet	Acacia Pied	*Tricholaema*	*leucomelas*		
4	Barbet	Crested	*Trachyphonus*	*vaillantii*		
5	Bee-eater	Swallow-tailed	*Merops*	*hirundineus*		
6	Bishop	Southern Red	*Euplectes*	*orix*		
7	Bulbul	African Red-eyed	*Pycnonotus*	*nigricans*		
8	Bunting	Lark-like	*Emberiza*	*impetuani*		
9	Canary	Black-throated	*Crithagra*	*atrogularis*		
10	Canary	White-throated	*Crithagra*	*albogularis*		
11	Canary	Yellow	*Crithagra*	*flaviventris*		
12	Chat	Familiar	*Oenanthe*	*familiaris*		
13	Chat	Karoo	*Emarginata*	*schlegelii*		
14	Cisticola	Levaillant's	*Cisticola*	*tinniens*		
15	Cormorant	Reed	*Microcarbo*	*africanus*		
16	Cormorant	White-breasted	*Phalacrocorax*	*lucidus*		
17	Coucal	Burchell's	*Centropus*	*burchellii*		
18	Crake	Black	*Zapornia*	*flavirostra*		
19	Crombec	Long-billed	*Sylvietta*	*rufescens*		
20	Cuckoo	Diederik	*Chrysococcyx*	*caprius*		
21	Cuckoo	Jacobin	*Clamator*	*jacobinus*		
22	Darter	African	*Anhinga*	*rufa*		
23	Dove	Cape Turtle	*Streptopelia*	*capicola*		
24	Dove	Laughing	*Spilopelia*	*senegalensis*		
25	Dove	Namaqua	*Oena*	*capensis*		
26	Dove	Red-eyed	*Streptopelia*	*semitorquata*		
27	Dove	Rock	*Columba*	*livia*		
28	Duck	Yellow-billed	*Anas*	*undulata*		
29	Eagle	Booted	*Hieraaetus*	*pennatus*		
30	Eagle	Martial	*Polemaetus*	*bellicosus*	**EN**	**VU**
31	Eagle-Owl	Spotted	*Bubo*	*africanus*		
32	Egret	Little	*Egretta*	*garzetta*		
33	Egret	Western Cattle	*Bubulcus*	*ibis*		
34	Falcon	Lanner	*Falco*	*biarmicus*	**VU**	**LC**
35	Falcon	Pygmy	*Polihierax*	*semitorquatus*		
36	Firefinch	Red-billed	*Lagonosticta*	*senegala*		
37	Fiscal	Southern	*Lanius*	*collaris*		
38	Goose	Egyptian	*Alopochen*	*aegyptiaca*		
39	Goose	Spur-winged	*Plectropterus*	*gambensis*		

No.	Common Group	Common species	Genus	Species	Regional	Global
40	Goshawk	Pale Chanting	*Melierax*	*canorus*		
41	Grebe	Little	*Tachybaptus*	*ruficollis*		
42	Greenshank	Common	*Tringa*	*nebularia*		
43	Guineafowl	Helmeted	*Numida*	*meleagris*		
44	Heron	Black-headed	*Ardea*	*melanocephala*		
45	Heron	Goliath	*Ardea*	*goliath*		
46	Heron	Grey	*Ardea*	*cinerea*		
47	Hoopoe	African	*Upupa*	*africana*		
48	Ibis	African Sacred	*Threskiornis*	*aethiopicus*		
49	Ibis	Hadada	*Bostrychia*	*hagedash*		
50	Kestrel	Rock	*Falco*	*rupicolus*		
51	Kingfisher	Pied	*Ceryle*	*rudis*		
52	Kite	Black-winged	*Elanus*	*caeruleus*		
53	Lapwing	Blacksmith	*Vanellus*	*armatus*		
54	Lapwing	Crowned	*Vanellus*	*coronatus*		
55	Lark	Sabota	*Calendulauda*	*sabota*		
56	Martin	Brown-throated	*Riparia*	*paludicola*		
57	Martin	Rock	*Ptyonoprogne*	*fuligula*		
58	Mousebird	Red-faced	*Urocolius*	*indicus*		
59	Mousebird	White-backed	*Colius*	*colius*		
60	Pigeon	Speckled	*Columba*	*guinea*		
61	Pipit	African	*Anthus*	*cinnamomeus*		
62	Plover	Three-banded	*Charadrius*	*tricollaris*		
63	Prinia	Black-chested	*Prinia*	*flavicans*		
64	Quelea	Red-billed	*Quelea*	*quelea*		
65	Robin-Chat	Cape	*Cossypha*	*caffra*		
66	Sandgrouse	Namaqua	*Pterocles*	*namaqua*		
67	Scrub Robin	Karoo	*Cercotrichas*	*coryphoeus*		
68	Shrike	Red-backed	*Lanius*	*collurio*		
69	Sparrow	Cape	*Passer*	*melanurus*		
70	Sparrow	House	*Passer*	*domesticus*		
71	Sparrow	Southern Grey-headed	*Passer*	*diffusus*		
72	Spurfowl	Cape	*Pternistis*	*capensis*		
73	Starling	Cape	*Lamprotornis*	*nitens*		
74	Starling	Wattled	*Creatophora*	*cinerea*		
75	Stilt	Black-winged	*Himantopus*	*himantopus*		
76	Stork	Black	*Ciconia*	*nigra*	**VU**	**LC**
77	Sunbird	Dusky	*Cinnyris*	*fuscus*		
78	Swallow	Barn	*Hirundo*	*rustica*		
79	Swallow	Greater Striped	*Cecropis*	*cucullata*		
80	Swallow	White-throated	*Hirundo*	*albigularis*		
81	Swift	African Palm	*Cypsiurus*	*parvus*		
82	Swift	Alpine	*Tachymarptis*	*melba*		

No.	Common Group	Common species	Genus	Species	Regional	Global
83	Swift	Little	*Apus*	*affinis*		
84	Swift	White-rumped	*Apus*	*caffer*		
85	Thrush	Karoo	*Turdus*	*smithi*		
86	Wagtail	African Pied	*Motacilla*	*aguimp*		
87	Wagtail	Cape	*Motacilla*	*capensis*		
88	Warbler	African Reed (Old, Use Common Reed Warbler)	*Acrocephalus*	*baeticatus*		
89	Warbler	Lesser Swamp	*Acrocephalus*	*gracilirostris*		
90	Warbler	Namaqua	*Phragmacia*	*substriata*		
91	Weaver	Sociable	*Philetairus*	*socius*		
92	Weaver	Southern Masked	*Ploceus*	*velatus*		
93	Wheatear	Capped	*Oenanthe*	*pileata*		
94	White-eye	Orange River	*Zosterops*	*pallidus*		
95	Whydah	Pin-tailed	*Vidua*	*macroura*		

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.

Botes, P. 2012(c): Proposed Kakamas Keren Energy Holdings Solar Facility on Remainder of the Farm 666, Kakamas. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 13 March 2012.

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.

Botes, P. 2012(i): Askham (Kameelduin) 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. 1 November 2012.

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.

Botes, P. 2013(b): Loubos 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.

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.

Botes, P. 2013(d): Paballelo 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.

Botes, P. 2013(e): Welkom 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.

Botes, P. 2013(f): Zypherfontein Dam Biodiversity & Botanical Scan. Proposed construction of a new irrigation dam on Portions 1, 3, 5 & 6 of the Farm Zypherfontein No. 66, Vanrhynsdorp (Northern Cape) and a scan of the proposed associated agricultural enlargement. September 2013.

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.

Botes, P. 2014(a): Brandvlei Bulk Water Supply: Proposed construction of a 51 km new bulk water supply pipeline (replacing the existing pipeline) from Romanskolk Reservoir to the Brandvlei Reservoir, Brandvlei (Northern Cape Province). A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required). 24 February 2014.

Botes, P. & McDonald Dr. D. 2014: Loeriesfontein Bulk Water Supply: Proposed construction of a new bulk water supply pipeline and associated infrastructure from the farm Rheeboksfontein to Loeriesfontein Reservoir, Loeriesfontein. Botanical scan of the proposed route to determine the possible impact on vegetation and plant species. 30 May 2014.

Botes, P. 2014(b): Kalahari-East Water Supply Scheme Extension: Phase 1. Proposed extension of the Kalahari-East Water Supply Scheme and associated infrastructure to the Mier Municipality, ZF Mgcawu District Municipality, Mier Local Municipality (Northern Cape Province). Biodiversity & Botanical scan of the proposed route to determine the possible impact on biodiversity with emphasis on vegetation and plant species. 1 July 2014.

Botes, P. 2014(d): Postmasburg WWTW: Proposed relocation of the Postmasburg wastewater treatment works and associated infrastructure, ZF Mgcawu District Municipality, Tsantsabane Local Municipality (Northern Cape Province). Biodiversity and botanical scan of the proposed pipeline route and WWTW site. 30 October 2014.

Botes, P. 2015(b): Steenkampspan proving ground. Proposed establishment of a high speed proving (& associated infrastructure) on the farm Steenkampspan (No. 419/6), Upington, ZF Mgcawu (Siyanda) District Municipality, Northern Cape Province. Biodiversity and Botanical Scan of the proposed footprint. 20 February 2015.

Botes, P. 2016(a): OWK Raisin processing facility, Upington, Erf 151, Kenhardt, Northern Cape Province. A Botanical scan of the proposed footprint. 26 May 2016.

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.

Botes, P. 2016(c): Henkries Mega-Agripark development. The proposed development of ±150 ha of high potential agricultural land at Henkries, Northern Cape Province. Biodiversity and Botanical Scan of the proposed footprint. 28 February 2016.

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.

Botes, P. 2017: The proposed new Namaqua N7 Truck Stop on Portion 62 of the Farm Biesjesfontein No. 218, Springbok, Northern Cape Province. Botanical scan of the proposed footprint. 10 July 2017.

Botes, P. 2018(a): Kamiesberg Bulk Water Supply – Ground water desalination, borehole- and reservoir development, Kamiesberg, Northern Cape Province. Botanical scan of the proposed footprint. 20 February 2018

Botes, P. 2018(b): Rooifontein Bulk Water Supply – Ground water desalination, borehole- and reservoir development, Rooifontein, Northern Cape Province. Botanical scan of the proposed footprint. 23 February 2018

Botes, P. 2018(c): Paulshoek Bulk Water Supply – Ground water desalination, borehole- and reservoir development, Paulshoek, Northern Cape Province. Botanical scan of the proposed footprint. 27 March 2018.

Botes, P. 2018(d): Kakamas Wastewater Treatment Works Upgrade – Construction of a new WWTW and rising main, Khai !Garib Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint. 1 August 2018.

Botes, P. 2018(e): Kakamas Bulk Water Supply – New bulk water supply line for Kakamas, Lutzburg & Cillie, Khai !Garib Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint. 4 August 2018.

Botes, P. 2018(g): Steynville (Hopetown) outfall sewer pipeline – Proposed development of a new sewer outfall pipeline, Hopetown, Northern Cape Province. Botanical assessment of the proposed footprint. 8 October 2018.

Botes, P. 2018(h): Tripple D farm agricultural development – Development of a further 60 ha of vineyards, Erf 1178, Kakamas, Northern Cape Province. Botanical assessment of the proposed footprint. 8 October 2018.

Botes, P. 2019(a): Lethabo Park Extension – Proposed extension of Lethabo Park (Housing Development) on the remainder of the Farm Roodepan No. 70, Erf 17725 and Erf 15089, Roodepan Kimberley. Sol Plaaitje Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint (with biodiversity inputs). 15 May 2019.

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.

Botes, P. 2020(a): Gamakor & Noodkamp Low cost housing – Botanical Assessment of the proposed formalization of the Gamakor and Noodkamp housing development on the remainder and portion 128 of the Farm Kousas No. 459 and Ervin 1470, 1474 and 1480, Gordonia road, Keimoes. Kai !Gariep Local Municipality, Northern Cape Province. 6 February 2020.

Botes, P. 2020(b): Feldspar Prospecting & Mining, Farm Rozynen Bosch 104, Kakamas. Botanical assessment of the proposed prospecting and mining activities on Portion 5 of The Farm Rozynen Bosch No. 104, Kakamas, Khai !Garib Local Municipality, Northern Cape Province. 12 February 2020.

Botes, P. 2020(c): Boegoeberg housing project – Botanical assessment of the proposed formalization and development of 550 new erven on the remainders of farms 142 & 144 and Plot 1890, Boegoeberg settlement, !Kheis Local Municipality, Northern Cape Province. 1 July 2020.

Botes, P. 2020(d): Komaggas Bulk Water supply upgrade – Botanical assessment of the proposed upgrade of the existing Buffelsrivier to Komaggas BWS system, Rem. of Farm 200, Nama Khoi Local Municipality, Northern Cape Province. 8 July 2020.

Botes, P. 2020(e): Grootdrink housing project – Botanical assessment of the proposed formalization and development of 370 new erven on Erf 131, Grootdrink and Plot 2627, Boegoeberg Settlement, next to Grootdrink, !Kheis Local Municipality, Northern Cape Province. 14 July 2020.

Botes, P. 2020(f): Opwag housing project – Botanical assessment of the proposed formalization and development of 730 new erven on Plot 2642, Boegoeberg Settlement and Farm Boegoeberg Settlement NO.48/16, Opwag, !Kheis Local Municipality, Northern Cape Province. 16 July 2020.

Botes, P. 2020(g): Wegdraai housing project – Botanical assessment of the Proposed formalization and development of 360 new erven on Erven 1, 45 & 47, Wegdraai, !Kheis Local Municipality, Northern Cape Province. 17 July 2020.

Botes, P. 2020(h): Topline (Saalskop) housing project – Botanical assessment of the pproposed formalization and development of 248 new erven on Erven 1, 16, 87, Saalskop & Plot 2777, Boegoeberg Settlement, Topline, !Kheis Local Municipality, Northern Cape Province. 18 July 2020.

Botes, P. 2020(i): Gariep housing project – Botanical assessment of the proposed formalization and development of 135 new erven on Plot 113, Gariep Settlement, !Kheis Local Municipality, Northern Cape Province. 20 July 2020.

Botes, P. 2021(a) Calvinia Bulk Water Supply – Botanical assessment for the proposed development of new boreholes and connecting pipelines along the R355, R27 and a number of minor gravel roads Hantam Local Municipality, Northern Cape Province. 8 March 2021.

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.

Botes, P. 2022 Witvlei Boerdery Trust, Kakamas – Terrestrial Biodiversity Statement for the Proposed Development of an aggregate quarry (<5ha) on plot 2372, Kakamas South Settlement near Alheit, Kakamas, Khai !Garib Local Municipality, Northern Cape Province. 1 September 2022.

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.

Botes, P. 2023(b) Paballelo Jupiter Cemetery – Botanical Scan & Terrestrial Biodiversity Compliance Statement for the proposed extension of the Paballelo Jupiter Cemetery on Erven 553 Upington (Paballelo), Dawid Kruiper Municipality, northern Cape Province. 25 March 2023.

Botes, P. 2023(c) Upington low-cost housing: Site 1 – Botanical Scan & Terrestrial Biodiversity Compliance Statement for the Proposed development of low-cost housing on Erven 23228 & 23229 Upington, Dawid Kruiper Municipality, Northern Cape Province. 14 April 2023.

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.