PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL ASSESSMENT

KOMAGGAS BULK WATER SUPPLY UPGRADE

PROPOSED UPGRADE OF THE EXISTING BUFFELSRIVIER TO KOMAGGAS BWS SYSTEM, REM. OF FARM 200, NAMA KHOI LOCAL MUNICIPALITY,NORTHERN CAPE PROVINCE

8 July 2020

P.J.J. Botes (Pr.Sci.Nat: 400184/05)

Registered Professional Botanical, Environmental and Ecological Scientist

22 Buitekant Street
Bredasdorp
7280

Cell: 082 921 5949
Fax: 086 611 0726
Email: peet@pbconsult.co.za

EXECUTIVE SUMMARY

VEGETATION TYPE

Three vegetation types were encountered namely:

- **Namaqualand Blomveld** found in valleys and flat areas between granitic rocky hills of the Namaqualand Escarpment;
- **Namaqualand Klipkoppe Shrubland** found on the dramatic landscape of huge granite and gneiss domes, smooth glacis and disintegrating boulder koppies of the escarpment;
- **Namaqualand Riviere** vegetation were encountered within the floodplains associated with the Buffels River

All three vegetation types are considered "Least Threatened".

VEGETATION ENCOUNTERED

The vegetation is not considered a threatened vegetation type, but conservation targets have not yet been met. The Northern Cape is currently in the midst of an on-going drought which had left its mark on the vegetation encountered. Species diversity was much lower than expected and even some of the most drought resistant plants (e.g. *Euphorbia* species) were showing signs of drought stress. The landscape of the study area is dominated by magnificent rocky hills (klipkoppe) towards Komaggas, while Kwaddas and Buffelsrivier are located in the sandy valley bottoms between these hills.

It is very important to note that there will be two construction methods used for the pipeline upgrade). Placing the pipeline aboveground on small pedestals (± 12 – 13 km) will result in a potential visual impact, but the direct environmental impact is almost negligible in that there will be no excavations and very little physical impact or alteration along the footprint. Excavations (± 13 – 14 km) are much more intrusive in terms of environmental impact, even though it is temporary. In semi-desert areas, even a temporary disturbance can last a long time.

CONSERVATION PRIORITY AREAS

According to the Northern Cape CBA maps the proposed site falls within a CBA area. However, there is no alternative that will not impact on the CBA. It must also be taken into consideration that this is a replacement pipeline, in other words an existing impact.

The site will not impact on any recognised centre of endemism.

CONNECTIVITY

Excavations will result in temporary disturbance along a straight line, which might have a slight temporary impact on connectivity, but it is expected to be negligible.

LAND-USE

The footprint is on communal land that is used for livestock grazing (mainly sheep and goat herding). No intensive agriculture was observed (probably due to the lack of water).

PROTECTED PLANT SPECIES

The most significant botanical aspect of this site is the presence a number of Northern Cape Nature Conservation Act, protected species which were observed (Refer to Table 4). Please note that a number of these species are protected by default and are in fact weedy pioneer or disturbance indicators (e.g. Galenia africana or kraalbos).

MAIN CONCLUSION

The proposed development footprint is located on Communal land, with very low agricultural potential. Portions of the footprint had already been degraded as a result of past practices. The remaining vegetation is not considered vulnerable but conservation targets have not yet been met. The site overlaps an identified critical biodiversity area (according to the 2016, Northern Cape Critical Biodiversity Areas maps). In addition, a number of Northern Cape Nature Conservation Act, protected species were observed within the footprint.

According to the impact assessment given in Table 7 the development is likely to result in a **Medium-Low** impact, which can be reduced to a **Low or Very Low** through mitigation.

With the correct mitigation it is 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 plant species.
- Loss of ecosystem connectivity.

WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT PROJECT BE APPROVED, WITH THE PROPOSED MITIGATION ACTIONS.

NO-GO OPTION

The No-Go option means the *status quo* will be maintained, but veld will still be impacted by urban and agricultural related activities. Water is a basic right an all communities should have access to drinking water.

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 PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed 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. PB Consult reserve 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 en environmental legal compliance audits.

During 2010 he joined EnviroAfrica in order 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.

Mr Botes is a registered Professional Botanical, Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

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:

8 July 2020

Date:

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1. INTRODUCTION

The towns of Komaggas and Buffelsrivier are supplied with borehole water extracted from within the Buffels River, near Buffelsrivier. Water is pumped from the boreholes to various reservoirs and all the way to Komaggas (referred to as the Komaggas bulk water supply system). Because of age the Komaggas bulk water supply (BWS) system has become increasingly unreliable, leaving these towns without a reliable water supply and needs to be replaced as a matter of urgency.

BVi Engineers has been appointed to plan and supply engineering support for the refurbishment of this water supply system. The proposed upgrades will trigger listed activities under the National Environmental Management Act, (Act 107 of 1998) (NEMA) and the EIA regulations (as amended). As a result EnviroAfrica (Pty) Ltd was appointed as the independent Environmental Assessment Practitioner (EAP) to facilitate the NEMA EIA application process. Since the propose upgrade will impact on natural vegetation, PB Consult was appointed by EnviroAfrica to conduct a botanical assessment of the areas that will be impacted by the proposed upgrades.

The proposed infrastructure and pipeline route is likely to impact on two vegetation types, namely, Namaqualand Blomveld, occurring in the broad open valleys and open sandy plains between the granite rocky hills of the Namaqualand Escarpment. During wet years, geophytes, ephemeral herbs and low, spreading, leaf-succulents can result in spectacular flower displays (Mucina & Rutherford, 2006) in the Blomveld plains (especially on previously disturbed areas like old farmlands). Namaqualand Klipkoppe Shrubland is expected on the granite klipkoppe and rocky hills of the escarpment.

It is very important to note that there will be two construction methods used for the pipeline upgrades (the same as for the original pipeline). Along the lower lying sandy valleys and plains (associated with Namaqualand Blomveld) the pipeline will be placed underground. In the rocky hills and klipkoppe (associated with Namaqualand Klipkoppe Shrubland) the pipeline will be placed above ground on small pedestals. The importance of the different construction methods is in its associated environmental impact. Placing the pipeline aboveground on small pedestals will result in a potential visual impact, but the direct environmental impact is almost negligible in that there will be no excavations and very little physical impact or alteration along the footprint. Excavations are much more intrusive in terms of environmental impact, even though it is temporary. In semi-desert areas, even a temporary disturbance can last a long time.

1.1. TERMS OF REFERENCE

The terms of reference for this appointment were to:

- Determine the potential impact on significant botanical features on the hand of desktop studies, available literature/information and a field study;
- Assess habitat sensitivity and the impact on species with emphasis on protected species encountered;
- Determine and record the position of any plant species of special significance (e.g. protected tree species, or rare or endangered plant species) that should be avoided or that may require “search & rescue” intervention;
- Consider short- and long-term impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species;
- To make recommendations on impact minimisation in terms of the proposed project

The study includes the following:

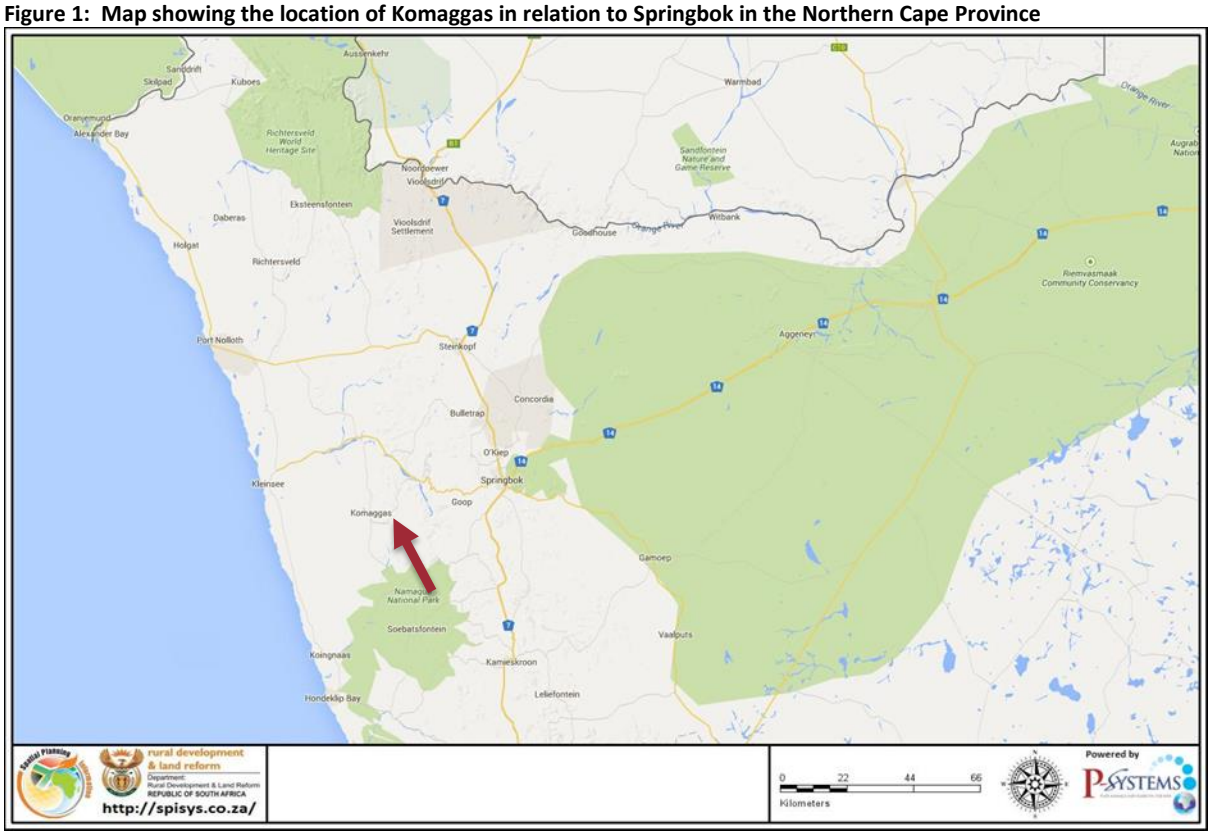
- A brief discussion of the local environment in order to provide background on the ecological factors influencing the ecological drivers associated with the specific area.
- A brief discussion of the vegetation types expected and encountered with emphasis on protected species encountered.
- A list of plant species encountered during the site visit.
- Determination of the occurrence, or possible occurrence of threatened or sensitive plant species, and sensitive plant communities, on the basis of the field survey and records obtained from the South African National Biodiversity Institute (SANBI) and available literature.
- An evaluation of the potential impact of the proposed project on habitat and species.
- A discussion of significant impacts focusing on possible mitigation and amendments to the development proposal.

2. PROJECT DESCRIPTION AND BACKGROUND INFORMATION

2.1. LOCATION & LAYOUT

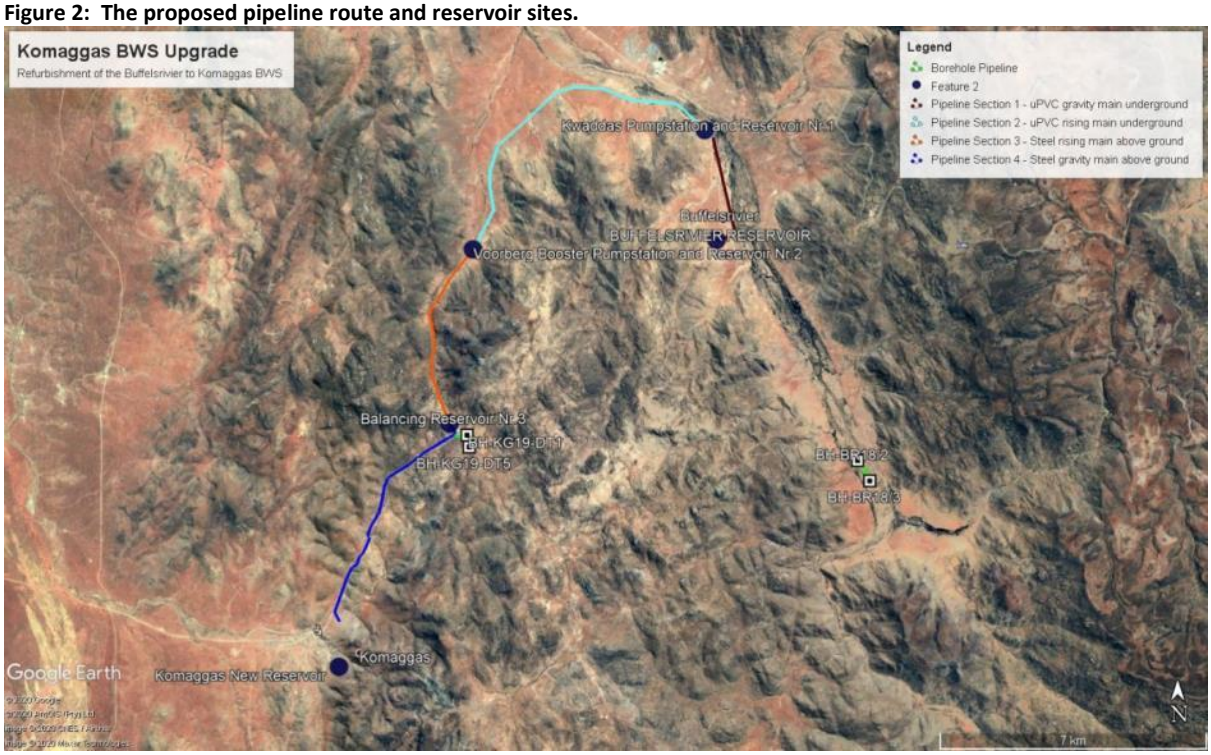
Komaggas and Buffelsrivier are two small settlements located almost due east of Springbok (approximately 60 km and 50 km respectively), south of the R355, connecting Springbok with Kleinsee. Both towns are located within the Nama Khoi Local Municipality of the Northern Cape Province (Figure 1).

Figure 1: Map showing the location of Komaggas in relation to Springbok in the Northern Cape Province



The pipeline route and reservoir locations are given in Figure 2 and Table 1.

Figure 2: The proposed pipeline route and reservoir sites.



2.2. PROJECT DESCRIPTION

The project comprise of the following:

- Construction of new 1.5 Ml Reservoir (Next to the existing reservoir at Komaggas);
- Construction of a new pipeline between borehole BR 18/2 & BR18/3 (Underground pipeline of approximately 646 m);
- Refurbishment of the existing water main from Buffelsrivier Reservoir to Kwaddas Reservoir and pump station (Underground pipeline of approximately 3.23 km with a Ø160 mm, brown section in Figure 2);
- Refurbishment of the existing water main from Kwaddas Reservoir to Voorberg Booster Pump Station and Reservoir (Underground pipeline of approximately 9.75 km with a Ø160 mm, magenta section in Figure 2);
- Refurbishment of existing water main from Voorberg to Balancing Reservoir No. 3 (Above ground pipeline of approximately 5.13 km with a Ø150, orange section in Figure 2)
- Refurbishment of existing water main from Balancing Reservoir No. 3 to Komaggas (Above ground pipeline of approximately 6.77 km with a Ø150, blue section in Figure 2)
- Refurbishment of existing pump stations;
- Construction of a new pipeline from borehole KG19-DT5 (Above ground pipeline of approximately 525 m);
- Construction of a new pipeline from borehole KG19-DT5 (Above ground pipeline of approximately 230 m);
- Construction of Electrical Supply lines to new boreholes:
- Upgrading of service roads to all boreholes

2.3. PIPELINE ROUTE

Table 1 gives a summary of the locations of the various infrastructures from east to west or from Buffelsrivier to Komaggas (the pipeline routes).

Table 1: Co-ordinates for the pipeline replacement route

Infrastructure description:	LATITUDE (S):	LONGITUDE (E):
Borehole BR18/3	29°45'31.68"S	17°38'31.81"E
Borehole BR18/2	29°45'13.97"S	17°38'19.57"E
Buffelsrivier reservoir	29°42'2.87"S	17°35'56.80"E
Kwaddas pump station & reservoir	29°40'27.11"S	17°35'45.07"E
Voorberg booster pump station & reservoir	29°42'11.26"S	17°31'52.41"E
Balancing reservoir No. 3	29°44'42.27"S	17°31'30.49"E
Borehole KG19-DT1	29°44'51.42"S	17°31'48.37"E
Borehole KG19-DT5	29°45'1.69"S	17°31'50.38"E
Komaggas new reservoir	29°48'13.18"S	17°29'38.65"E

2.4. CONSTRUCTION METHOD

The underground sections (sandy sections) of the pipeline will be placed approximately 1 meter underground and will go under the river bed level where crossings of rivers or streams might be encountered (**Error! Reference source not found.**). The only visible part of the pipeline will be valve chambers, air vents and scour valves. It is expected that the construction footprint will be approximately 20 – 25 wide.

Photo 1: Typical underground construction method (albeit for a much larger pipe), note construction footprint.

The above ground sections (**Error! Reference source not found.**) will be done in a similar way as the many of the original pipeline sections was done, where the pipeline is placed on small concrete pedestals. These pedestals rarely needs to be anchored and is cast to allow for height differences. Using this method means that the construction footprint will be very, small, temporary and should not result in any permanent impact (only single plants impacted *vs.* a 30 m construction corridor).

Photo 2: Typical above ground construction method used for the existing pipeline near Komaggas. Note the very small impact in relation to that of the underground construction method (Picture 1).

2.5. CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. The Springbok area receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid) and because it receives most of its rainfall during winter it has a Mediterranean climate.

Figure 3: Average monthly precipitation over the year (www.weather-and-climate.com)

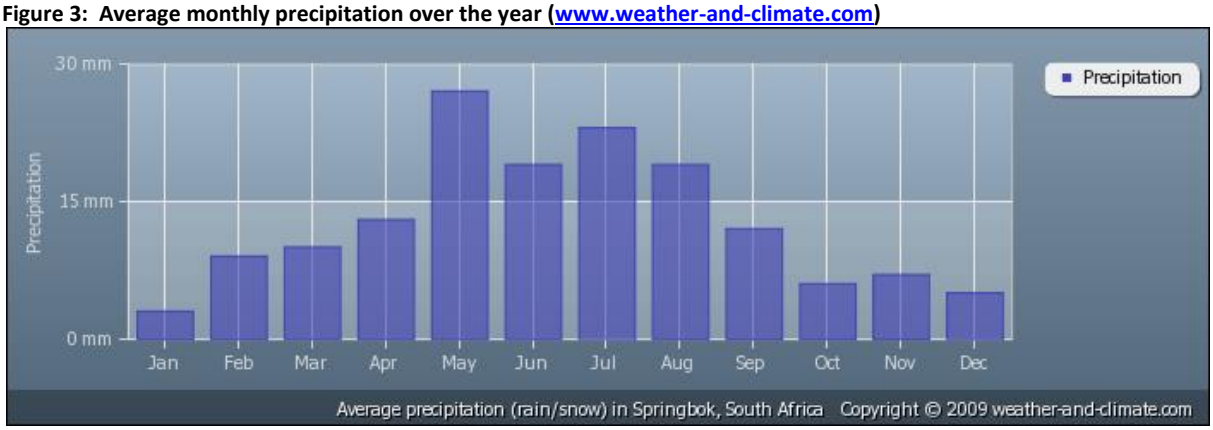
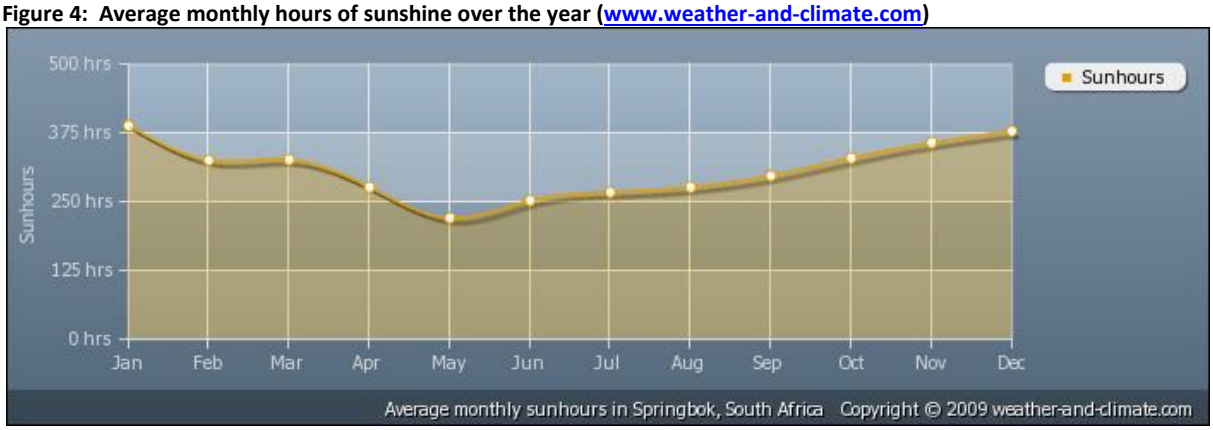


Figure 3 shows the average rainfall values for Springbok per month. It receives the lowest rainfall in January and the highest May to June. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Springbok range from 16.5°C in July to 28.3°C in February. The region is the coldest during July when the mercury drops to 3.8°C on average during the night. Figure 4 gives the average monthly hours of sunshine over the year (www.weather-and-climate.com).

Figure 4: Average monthly hours of sunshine over the year (www.weather-and-climate.com)



NB: According to the Namakwa District Biodiversity Sector Plan (2008), it is expected that the climate will change drastically over the next millennium. Effects of global climate change lead scientists to the conclusion that the entire Succulent Karoo will most likely experience increased temperatures. It is projected that a 2°C increase in temperature in the area will lead to a 10% reduction in rainfall – a significant loss in an area that is already severely water restricted. This decrease in rainfall is projected to result in a 35% decrease in livestock carrying capacity over the coming 200 years. These projections point to the need for the development of alternative economic opportunities in the area, in order to successfully cope with the changes that are already underway.

2.6. GEOLOGY AND SOILS

According to the biodiversity information on the SANBI BGIS website, only two major soil types is expected in the study area, which are also associated with the two vegetation types expected, namely Namaqualand Klipkoppe Shrubland (rocky outcrops) and the Namaqualand Blomveld.

According to Mucina & Rutherford (2006) the soils associated with Namaqualand Klipkoppe Shrubland can be described as: Mokolian granites and gneisses which forms gentle to moderate rocky slopes with rock sizes varying from medium to large with flat to gentle rock sheets as well as rock domes. The soils is described as yellow-brown to brown loamy sand, 0.15 – 0.6 m deep (refer to **Error! Reference source not found.**).

The geology and soils associated with the Blomveld is described (Mucina & Rutherford, 2006) as soils underlain by granite-gneisses and metasediments of Mokolian age, affected by the Namaqualand Metamorphic Event. It supports relatively deep, yellow-brown, fine to coarse loamy sand derived through weathering of the granite rocks (refer to **Error! Reference source not found.**).

2.7. LANDUSE AND -COVER

Land use in the majority of the NDM is defined by livestock grazing and mining – the two major economic drivers in the region. Another significant economic factor for the NDM's economy is "flower" tourism that is based on Namaqualand's fantastic annual wildflower displays that cover regions in a kaleidoscope of colour each spring. This is a distinctly seasonal aspect of the economy, lasting only eight to ten weeks, and being highly dependent on the timing and duration of the previous winter rains. However, there are indications that in recent years the regional ecotourism industry is diversifying (e.g. 4x4 and nature tourism) with greater numbers of tourists arriving throughout the year. River rafting is also a big industry on the Orange and Doring Rivers (NDBSP, 2008).

2.8. EVALUATION METHOD

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development.

As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), with emphasis on:

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

Desktop studies coupled with a site visit were performed. The site visit was conducted on the 17st of April 2020. It must be noted that the Northern Cape is currently experiencing one of its worst drought spells in a long time. Although the timing of the site visit was reasonable plant species diversity were very restricted as a result of the persisting drought. However, it was still possible to identify most of the remaining plants even though very few were in flower.

However, the author is confident that a fairly good understanding of the biodiversity status of the site was obtained. The survey was conducted by driving and walking the site and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

3. THE VEGETATION

The Northern Cape contains about 3500 plant species in 135 families and 724 genera, with about 25% of this flora endemic to the region. It is also home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, it must be noted that this remarkable diversity is not distributed evenly throughout the region, but is concentrated in many local centres of endemism.

In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006, as updated in the 2012 beta version) two broad vegetation types are expected within the proposed footprint, namely **Namaqualand Blomveld** and **Namaqualand Klipkoppe Shrubland (Error! Reference source not found.**). Both these vegetation types are classified as "Least Threatened" (GN 1002, December 2011). Namaqualand Riviere is expected within the floodplains of the dry seasonal rivers such as the Buffels River in this study area.

Figure 5: Vegetation map of South Africa (2012 beta 2 version), showing the expected vegetation types

It is important to note that even though both these vegetation types are classified as "Least Threatened", the National Spatial Biodiversity Assessment (NSBA), 2004, also considered both as "Poorly Protected", since very little of these two vegetation types are formally protected. Fortunately, more than 95% of most of these vegetation types are still found in a relative natural state.

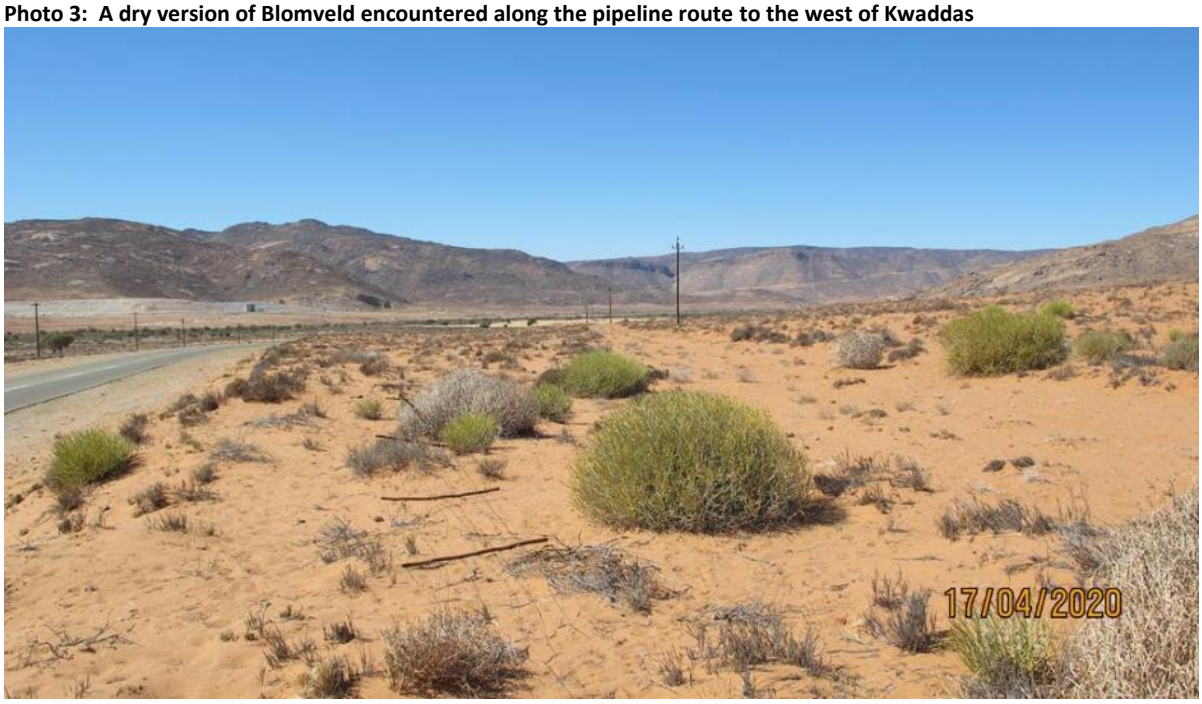
Table 2: Vegetation types expected and their status (NSBA, 2004 and Gn. 1002, of December 2011)

VEGETATION TYPE	BIOME	STATUS	REMAINING	FORMALLY CONSERVED	CONSERVATION TARGET
Namaqualand Blomveld (Darker mustard in **Error! Reference source not found.**)	Succulent Karoo	Least Threatened Hardly Protected	94%	1.5%	28%
Namaqualand Klipkoppe Shrubland (Lighter mustard in **Error! Reference source not found.**)	Succulent Karoo	Least Threatened Poorly Protected	95%	5.8%	28%

3.1. NAMAQUALAND BLOMVELD

Namaqualand Blomveld is found in valleys and flat areas between granitic rocky hills of the Namaqualand Escarpment. Usually on level to slightly undulating sedimentary surfaces between rocky granitic hills and mountains, such as wide plains and broad valleys with dry channels of intermittent water courses. Sparse dwarf shrubs with succulent or ericoid leaves dominate these shrublands. Geophytes and ephemeral herbs and in places low, spreading, leaf-succulents show spectacular flower displays in wet years (Mucina & Rutherford, 2006). Endemic taxon associated with this veld type includes (Mucina & Rutherford, 2006) – Herbs: *Lessertia capitata, Lotononis arenicola*. Succulent Herbs: *Dorotheanthus bellidiformis* subsp. *hestermalensis* and *D. rourkei*.

Photo 3: A dry version of Blomveld encountered along the pipeline route to the west of Kwaddas

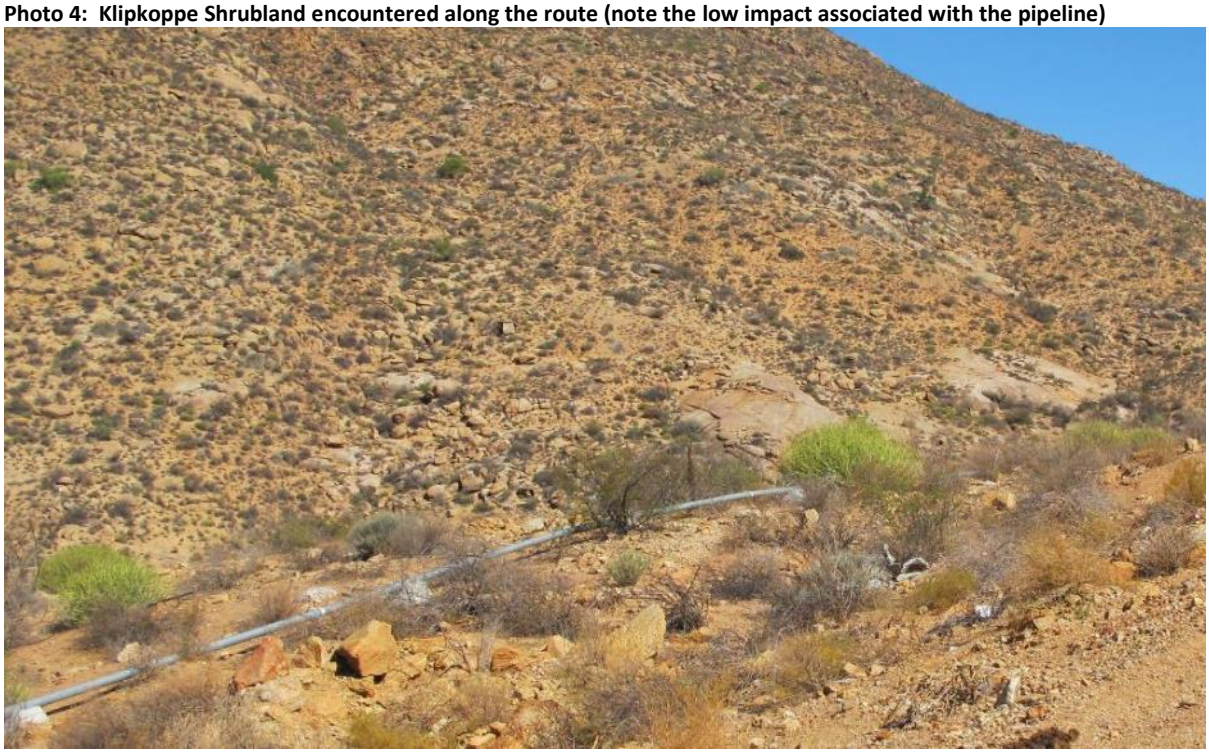


3.2. NAMAQUALAND KLIPKOPPE SHRUBLAND

Namaqualand Klipkoppe Shrubland is described as a dramatic landscape of huge granite and gneiss domes, smooth glacis and disintegrating boulder koppies supporting open shrubland up to 1 m tall, dominated by shrubs of dwarf to medium stature and with ericoid or succulent leaves. A few scattered Kokerboom trees (*Aloidendron dichotoma* var. *dichotoma*) are often found, mostly on north-facing slopes. Flat or gentle sloping rock sheets (the dominant feature of this unit) support dwarf or prostrate succulents in shallow pockets with soil or in cracks. Fringe vegetation at the bottom of steep rock sheets (collecting run-off water) could house 1-3 m tall shrubs with non-succulent leaves and canopy cover reaching 40-100% (Mucina & Rutherford, 2006).

According to Mucina & Rutherford (2006), the Namaqualand Klipkoppe Shrubland has 15 endemic plant species namely: Succulent Shrubs: *Ottosonderia montincola, Tylecodon nigricaulis*. Low Shrubs: *Lotononis benthamiana, L. longiflora, L. quinata, Wiborgia incurvata*. Herbs: *Tripteris spathulata, Zaluzianskya collina*. Geophytic Herbs: *Ornithogalum leeupoortense, O. louisae, Xysmalobium pearsonii*. Succulent Herbs: *Quagua bayeriana, Q pallens, Stapeliopsis khamiesbergensis*.

Photo 4: Klipkoppe Shrubland encountered along the route (note the low impact associated with the pipeline)



3.3. THE VEGETATION IN CONTEXT

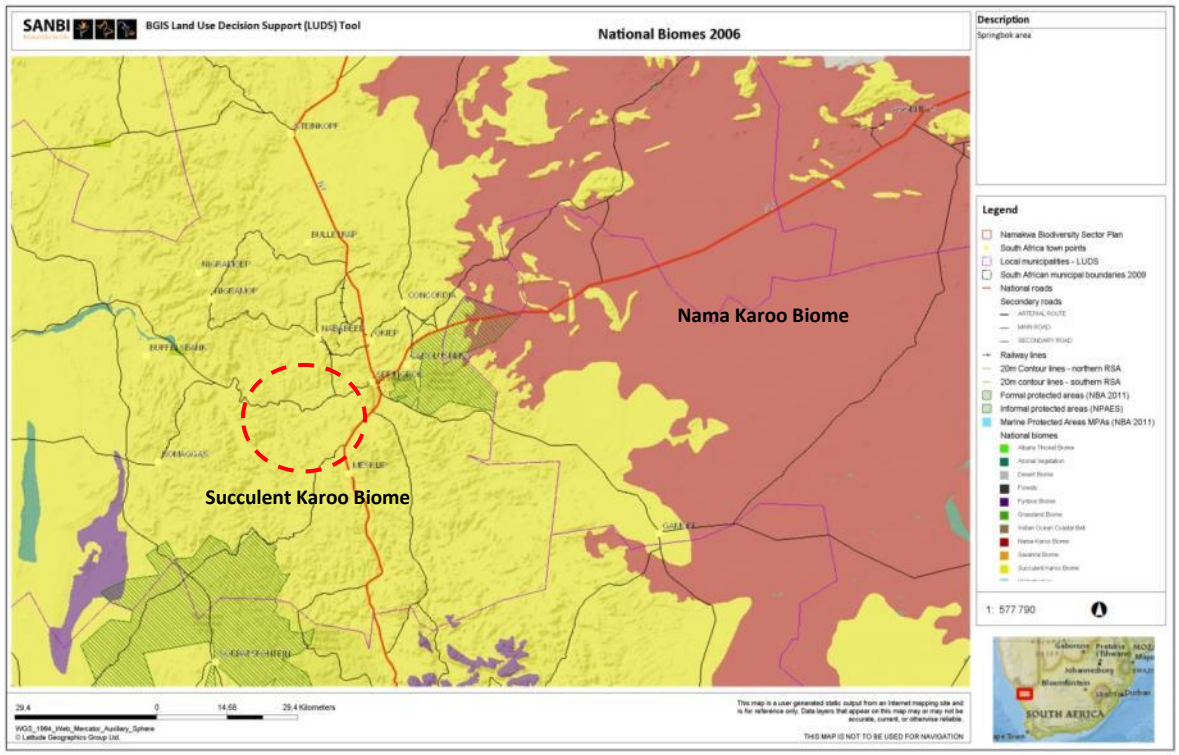
Namaqualand is a narrow semi-desert and desert area along the west coast of South Africa. Although covering a small area of land (approximately 50 000 m^2) it is home to a unique plant composition and its biodiversity is without equal among the arid areas of the world and is home to more than 3 000 plant species, which is more than four times more than any other winter-rainfall desert area (Manning, 2008).

The Namaqualand falls within the Succulent Karoo Biome (Figure 6), which is the fourth largest Biome in South Africa and is unrivalled in its status as the world's only entirely arid region diversity hotspot with its high diversity of dwarf leaf-succulent shrubs (Mucina *et al*, 2006). According to the Namakwa Municipal Biodiversity Sector Plan (2008), the area surrounding Springbok contains the most endemics per quarter degree square in the Succulent Karoo (NDBSP, 2008). The Succulent Karoo is sub-divided in a number of eco-regions based on soil-, landscape-, and climatic conditions. The study area is located within the Namaqualand Hardeveld eco-region (Mucina *et al*, 2006).

3.3.1. Succulent Karoo Biome

The Succulent Karoo Biome (Figure 6) covers a flat to gently undulating plain, with some hilly and "broken" veld, mostly situated to the west and south of the escarpment, and north of the Cape Fold Belt. The altitude is mostly below 800 m, but in the east it may reach 1 500 m. A variety of geological units occur in the region. There is little difference between the soils of the Succulent Karoo and Nama Karoo Biomes - both are lime-rich, weakly developed soils on rock. The vegetation is dominated by dwarf, succulent shrubs, of which the Vygies (Mesembryanthemaceae) and Stonecrops (Crassulaceae) are particularly prominent. Mass flowering displays of annuals (mainly Daisies, Asteraceae) occur in spring, often on degraded or fallow lands. Grasses are rare, except in some sandy areas, and are of the C3 type. The number of plant species (mostly succulents) is very high and unparalleled elsewhere in the world for an arid area of this size (Mucina et al, 2006).

Figure 6: National Biomes of South Africa (2006) showing the Springbok area



The Karoo used to support millions of antelope, mainly springbuck, but also numerous other larger antelope (and other grazing animal). These animals roamed the vast plains of the Karoo, utilizing different selections of plants and allowing for long "rest" periods as they move around, and as a result preventing overgrazing (Shearing, 1994). The Succulent Karoo has little agricultural potential due to the lack of water. The scarcity of grasses limits grazing, and the low carrying capacity requires extensive supplementary feeds. Much soil has been lost from the biome, through sheet erosion, as a consequence of nearly 200 years of grazing. Tourism is a major industry with the coastal scenery and the spring mass flower displays the main attractions. Mining is important, especially in the north (Mucina *et al*, 2006).

However, it remains important to note that less than 0.5% of the Succulent Karoo Biome is formally conserved. The high species richness, high number of rare and Red Data Book species and unique global status of the biome require urgent conservation attention.

3.3.2. Ecological drivers

The Succulent Karoo Biome is primarily determined by the presence of low winter rainfall and extreme summer aridity. Rainfall varies between 20 and 290 mm per year. The rains are cyclonic and not in the form of thunderstorms, which means that its erosive power is far less than what is experienced in the summer rainfall biomes and the rain itself is more penetrative. During summer, temperatures in excess of 40°C are common. Fog is common nearer the coast. Frost is infrequent. Desiccating, hot, Berg Winds may occur throughout the year. However, the main feature of this climate is the predictability of its rainy season (Van Wyk & Smith, 2001 and Mucina *et al*, 2006).

The unique plant species diversity is thought to be maintained and even thrive as a result of the reliable rainy season, with prolonged droughts almost non-existent. This climatic predictability is considered to be one of the main reasons for the remarkably rapid diversification of at least one of the key plant families, namely the Aizoaceae. One of the viewpoints is that succulents (with their limited water storage capacity and shallow root

system) are highly successful in the Namaqualand, because of its predictable rainfall patterns and because extensive droughts periods are almost non-existent, since succulents are also highly sensitive to periodic drought (Mucina et al, 2006).

3.4. VEGETATION ENCOUNTERED

According to most definitions the Namaqualand region would be classified as a desert region, barren for almost three-quarters of the year (summer, autumn and winter), but can become green and covered in carpets of beautiful flowers for two to three seasons (Le Roux, 2015). The Northern Cape is currently in the midst of an on-going drought which had left its mark on the vegetation encountered. Species diversity was much lower than expected and even some of the most drought resistant plants (e.g. *Euphorbia* species) were showing signs of drought stress.

The landscape of the study area is dominated by magnificent rocky hills (klipkoppe) towards Komaggas, while Kwaddas and Buffelsrivier are located in the sandy valley bottoms between these hills. The dry seasonal Buffels River is the most defining feature of the landscape from the Kwaddas turn-off into the valley in which the small settlement of Buffelsrivier is located. The rocky hills supports Namaqualand Klipkoppe Shrubland, while the valleys and flat areas in-between supports Namaqualand Blomveld, with Namaqualand Riviere vegetation associated with the Buffels River. Sheep and goat herding seems to be the main agricultural practices.

Starting at Buffelsrivier, including the proposed new pipeline between boreholes BR18/3 to BR18/2, the first sections of the pipeline will be placed underground (approximately 13.626 km in length), which is the portion of the pipeline associated with the valleys and open plains of the Namaqualand Blomveld vegetation type and Namaqualand Riviere vegetation in the within the Buffels River or near tot the Buffels River. From the Voorberg booster pump station the pipeline will run above ground (approximately 12.585 km), which is the portion of the pipeline associated with the Namaqualand Klipkoppe Shrubland (Refer to Heading 2.2, for a detailed description of the pipeline and its route).

3.4.1. New pipeline between Borehole BR18/2 & BR18/3

The new proposed connecting pipeline between boreholes BR18/2 and BR18/3 will be located within the floodplain of the Buffels River (Photo 5, Photo 6 & Figure 7). The vegetation is typical of what is expected in most of the dry seasonal streams and rivers found in the Namaqualand, and conforms to Namaqualand Riviere vegetation as described by Mucina & Rutherford (2006).

Photo 5: *Vachellia karroo* dominated vegetation along the edge of the Buffels River, with the floodplain in the foreground.

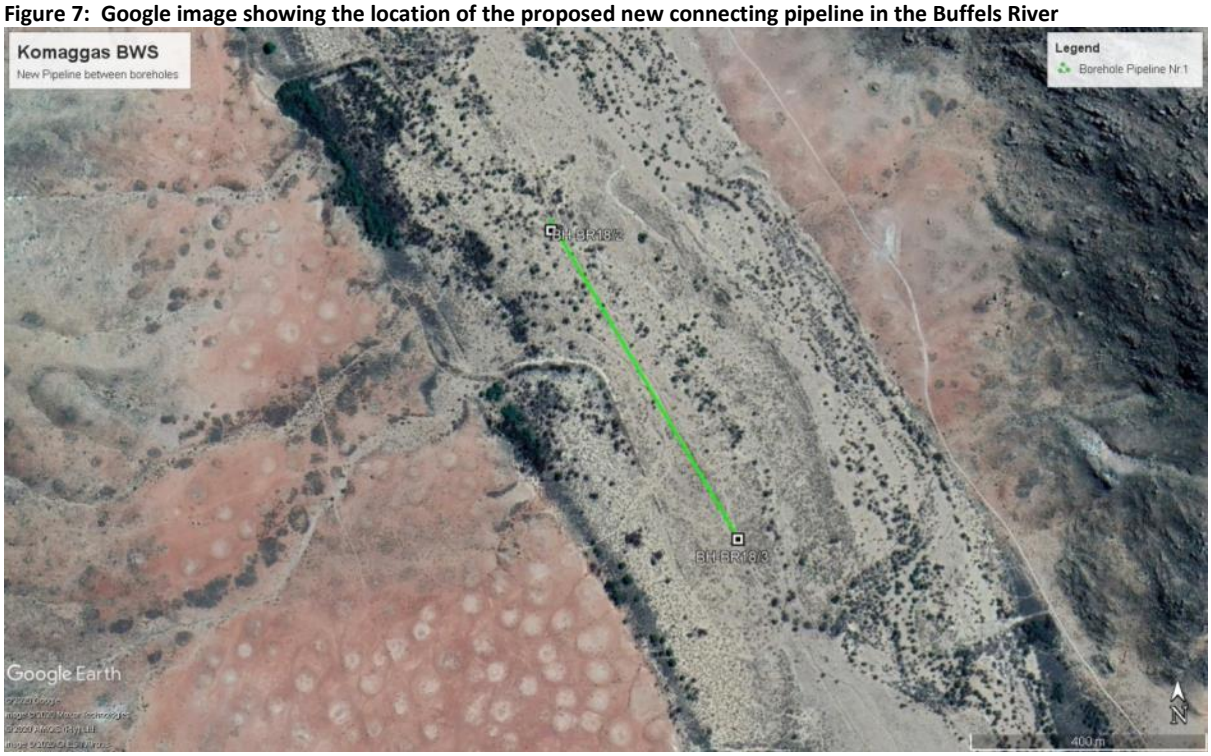
In the area where the proposed pipeline will be located, the vegetation defining the riparian zone tended to be dominated by medium sized *Vachellia karroo* (Sweet thorn) tree's, with *Tamarix usneoides* less common

(Photo 5). In the vicinity of BR18/2 a number of *Vachellia karroo* were also observed, although most of these trees are to the north and west of the borehole (and is unlikely to be impacted by the proposed development). The pipeline itself will be located in the floodplain area towards the middle of the river corridor (Figure 7).

Photo 6: The vegetation encountered between the two boreholes within the Buffels River floodplain. In this area the vegetation was dominated by *Salsola* cf. *aphylla*, with *Vachellia karroo* occasionally encountered. Evidence of an historic pipeline can also be observed in this photo.

The floodplain area, where the pipeline is to be installed (Photo 6) was dominated by larger individuals of *Salsola* cf. *aphylla* (new name: *Caroxylon aphyllum*) and *Tetraena retrofracta* together with a few other hardy salt resistant plans like *Suaeda fruticosa*, *Phaeoptilum spinosum*, *Mesembryanthemum* cf. *arenosum* (=*Brownanthus arenosus*) and the disturbance indicator *Mesembryanthemum guerichianum* (Soutslaai). It is almost certain that the severe drought is one of the reasons so few plant species were observed (most in poor condition). The following plants were also observe, but mostly on the edge or just outside of the riparian zone, namely; the occasional individual of *Euphorbia mauritanica*, *Galenia africana* (kraalbos), the weedy *Gomphocarpus fruticosus,* dried out individuals of *Hermannia disermifolia, Hermbstaedtia glauca, Lacomucinaea lineata (=Thesium lineatum),* invasive *Nicotiana glauca* and *Stoeberia frutescens*. Evidence of an old decommissioned pipeline, more or less in the same location as the proposed pipeline, was also observed (Photo 6).

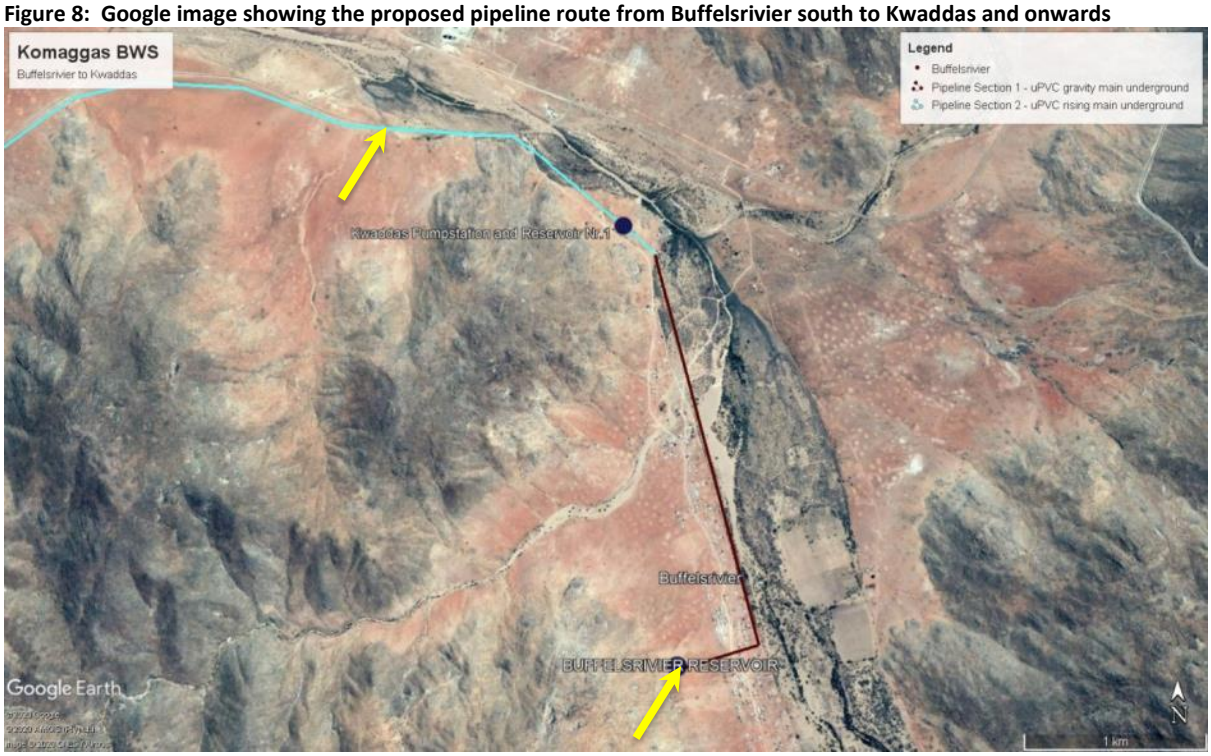
Figure 7: Google image showing the location of the proposed new connecting pipeline in the Buffels River



3.4.2. Buffelsrivier to Kwaddas

From the Buffelsrivier reservoir, the replacement pipeline will run (east) through the town to the edge of the urban area from where it turns south, following the western bank of the river to the settlement of Kwaddas and the Kwaddas Reservoir (the reservoir being located on a small koppies) (Figure 8). The pipeline going through the urban area of Buffelsrivier will not impact on any significant plant or tree species (almost no natural veld remaining), but as it turns south it will run along the edge of town, which is also more or less along the edge or within the floodplain of the Buffels River.

Figure 8: Google image showing the proposed pipeline route from Buffelsrivier south to Kwaddas and onwards



As the replacement pipeline runs along the Buffels River from Buffelsrivier to Kwaddas and then further north-west, towards the entrance road to Komaggas and Buffelsrivier it will impact almost exclusively on Namaqualand Riviere vegetation, which is the vegetation associated with the alluvial floodplains found in this part of the Namaqualand (Photo 7 to Photo 10).

Photo 7: The proposed pipeline replacement route, along the urban edge of the small town of Buffelsrivier. Note the floodplain associated patch of *Suaeda fruticosa* in the foreground of the photo, with *Prosopis*- and *Vachellia karroo* forming the riparian zone in the background.

In this floodplain area, the plant species remains more or less the same, but the composition may differ from area to area. Patches of the salt tolerant *Suaeda fruticosa* were encountered in places (Photo 7), to be replaced by a mix of *Salsola* cf. *aphylla*, *Tetraena retrofractum, Euphorbia mauritanica* and *Suaeda fruticosa*

together with the small trees *Vachellia karroo* and *Tamarix usneoides* (Photo 8 & Photo 10). The invasive alien *Prosopis* tree was also observed in this area.

Photo 8: Typical patch of Namaqualand Riviere vegetation encountered between Buffelsrivier and Kwaddas. Note the small *Vachellia karroo* trees together with *Salsola* cf. *aphylla*, *Tetraena retrofractum* and *Suaeda fruticosa*.

Photo 9: Looking back from Kwaddas reservoir towards Buffelsrivier (in the background), showing the Buffels River floodplain area.

The small hillock on which the Kwaddas reservoir is located is elevated out of the floodplain and supports a sparse shrubland which is part of the klipkoppe vegetation. A few other species were observed, like *Montinia caryophyllacea,* one small individual of the poplar-leaved karee, *Searsia populifolia*, *Euphorbia mauritanica*, *Galenia africana* and *Cynanchum viminale*.

Photo 10: A dense patch of *Salsola* cf. *aphylla* dominated vegetation found just west of Kwaddas. Apart from *Salsola*, *Suaeda fruticosa, Tamarix usneoides*, *Lycium cinereum*, *Vachellia karroo* and *Prosopis*, were also present in this patch.

3.4.3. Komaggas turn-off to Voorberg pump station

From the Komaggas turn-off to Voorberg pump station the pipeline moves away from the Buffels River and its associated floodplain (Figure 9). The landscape becomes more typical (albeit a very dry version) of Blomveld on yellow sandy soils. However, most of the proposed footprint seems to have disturbed as a result of previous construction activities (including an overhead power line).

Figure 9: Google image showing the proposed replacement pipeline route from Komaggas turn-off to Voorberg

Because of the on-going drought the vegetation cover was very sparse (Photo 11 & Photo 12) and no geophytes or spring annual flowers were visible (as a result of the timing of the site visit). The vegetation was dominated by *Tetraena retrofractum*, with *Euphorbia mauritanica* also prominent. Other species observed includes: *Cynanchum viminale, Galenia africana*, *Lacomucinaea lineata (=Thesium lineatum), Mesembryanthemum cf. arenosum (=Brownanthus arenosus), Mesembryanthemum guerichianum, Wiborgia obcordata* (kinnabos) and patches of the river bushman grass, *Stipagrostis namaquensis*.

Photo 11: The vegetation encountered in the Blomveld area with *Euphorbia mauritanica* in the foreground. Note the existing disturbance footprint to the right of picture.

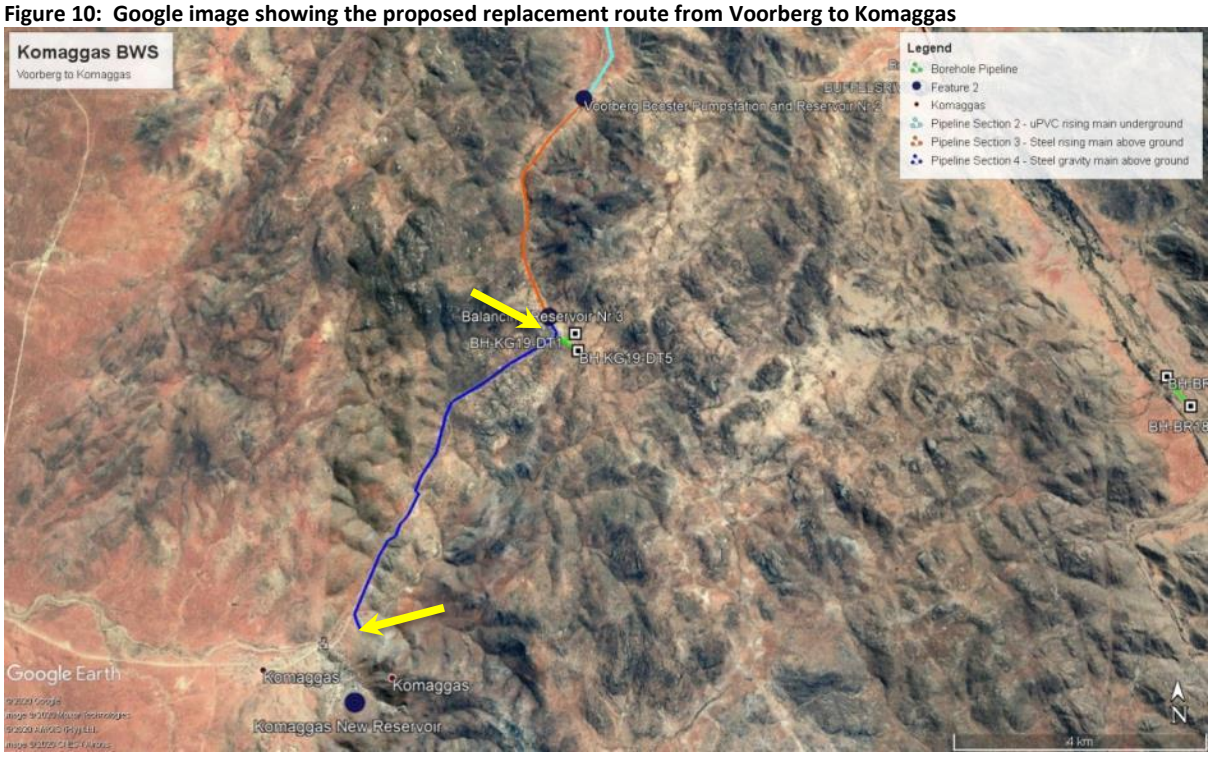
In general this portion of the footprint was already disturbed to some degree and apart from a number of common species protected in terms of the Northern Cape Nature Conservation Act, no plants of special significance were observed.

Photo 12: The vegetation encountered in the Blomveld area with *Euphorbia mauritanica* in the foreground and the dominant *Tetraena retrofractum* in the background.

3.4.4. Voorberg to Komaggas

From Voorberg the replacement pipeline will be placed above ground (on small movable concrete pedestals, Refer to Photo 2). The construction method means that the impact on vegetation will be almost negligible, especially as access will be almost exclusively by foot (meaning that construction vehicles will have limited access). As a result even the potential effect of trampling will be very limited. It should also be possible to negate almost any impact on any significant plant encountered (by slight alterations to the pipeline route).

Figure 10: Google image showing the proposed replacement route from Voorberg to Komaggas



The rocky hills are characterised by huge boulders and domes, slowly being weathered into course sand which are deposited as a shallow sandy layer on top or between these rocks. Again, because of the on-going drought the number of plant species observed was low (more species were expected). Fortunately, the construction method means that the potential impact will be relatively low to negligible. Plant species were mostly reduced to hardy drought resistant species, with the following observed: *Acanthopsis carduifolia, Asparagus* species, *Atriplex lindleyi* subsp. *Inflate, Berkheya fruticosa*, *Cynanchum viminale, Eriocephalus* species (only dried leaves remaining), *Ficus cordata* (observed in rocky crevasses near small streams – away from the footprint), *Galenia*

africana (common), *Lycium cinereum*, *Mesembryanthemum crystallinum*, *Mesembryanthemum guerichianum*, *Monsonia crassicaulis* (bushman candle), *Montinia caryophyllacea,* a *Pteronia* species*, Rogeria longiflora, Salsola kali,* the aerial hemi-parasite *Tapinanthus oleifolius and Tylecodon pearsonii.* Near streams the following small trees or large shrubs were also encountered: *Euclea tomentosa*, *Ficus cordata*, *Mesembryanthemum noctiflorum* (vleisbos), *Searsia burchellii*, *Searsia incisa*, *Tamarix usneoides* and *Vachellia karroo* (Photo 15).

Photo 13: a view of some of the dry vegetation encountered within the Namaqualand klipkoppe just south of Voorberg pump house.

Photo 14: *Euphorbia* dominated veld in the klipkoppe, just north of Komaggas.

Photo 15: Some of the denser vegetation encountered along streams.

3.4.5. Komaggas reservoir

The project also includes the construction of a new Reservoir next to the existing reservoir at Komaggas. The vegetation on the lower slopes of the small hill on which the reservoir will be located is probably some of the

most interesting in terms of plant species encountered during this study. Apart from common species that were found all over the klipkoppe like *Euphorbia mauritanica*, *Galenia africana*, *Cynanchum viminale* there were also species such as the small *Cheiridopsis denticulata* and *Tylecodon pearsonii* along the lower slopes beneath the proposed new location. A large planted alien *Schinus molle* tree was also observed beneath the existing reservoir.

Figure 11: Google image showing the existing Komaggas reservoir and the proposed location for the new reservoir

Fortuanately, there is an existing disturbance area within and next to the existing reservoir site. As long as the new reservoir is located within this existing disturbance footprint additional impact would be minimal (Figure 11 & **Error! Reference source not found.**).

Photo 16: Showing the existing disturbance footprint at the proposed new reservoir location

3.5. CRITICAL BIODIVERSITY AREAS MAPS

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

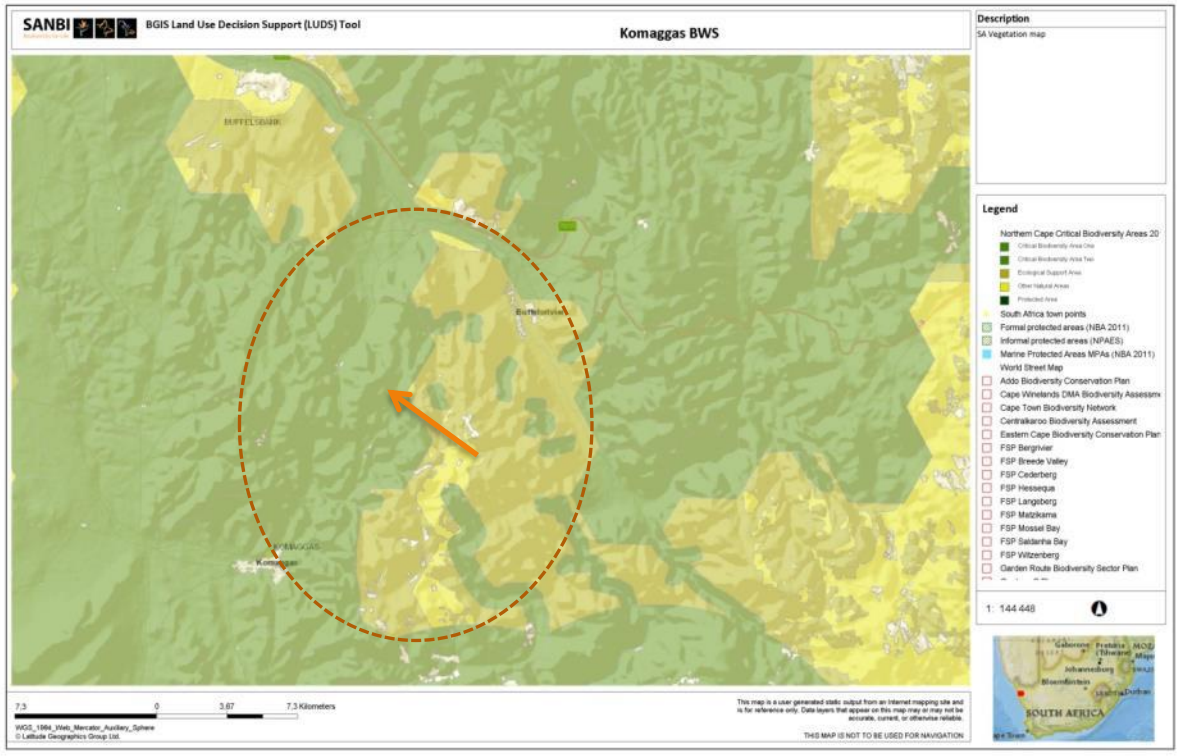
ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector 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 in order 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 in order 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 12: The Northern Cape Critical Biodiversity Areas Map (2016) showing the proposed development



From a land-use planning perspective it is useful to think of the difference between CBA's and ESA's in terms of where in the landscape the biodiversity impact of any land-use activity action is most significant:

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).
- For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

According to the Northern Cape CBA map (Figure 12), the proposed development footprint falls within a terrestrial CBA. However, it must be noted that most of the infrastructure is existing and the impact will be temporary (for the underground pipelines) or minimal (above ground pipelines).

3.6. POTENTIAL IMPACT ON CENTRES OF ENDEMISM

The proposed development will not impact on any recognised centre of endemism (Van Wyk & Smith, 2001). The Kamiesberg Centre is located to the south and east of Komaggas (Kamieskroon / Leliefontein), while the Gariep Centre is to the north of Komaggas (Steinkopf /Port Nolloth).

3.7. FLORA ENCOUNTERED

Table 2 gives a list of the plant species encountered during this study. Because of the limitations (timing and a single site visit as well as the drought) it is very likely that a number of plant species might have been missed (especially annuals and geophytes).

Table 3: List of indigenous species encountered within or near the proposed footprint

No.	Species name	FAMILY	Status	Alien & invader plant (AIP)
1.	*Acanthopsis carduifolia*	ACANTHACEAE	LC	
2.	*Asparagus* species	ASPARAGACEAE	LC	
3.	*Atriplex lindleyi*	AMARANTHACEAE	**Naturalised invasive**	**CARA Cat. 3 invader NEMBA Cat. 1b AIP (in Northern Cape)**
4.	*Berkheya fruticosa*	ASTERACEAE	LC	
5.	*Cheiridopsis denticulata*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	
6.	*Cynanchum viminale (=Sarcostemma viminale)*	APOCYNACEAE	LC NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
7.	*Eriocephalus species*	ASTERACEAE	LC	
8.	*Euclea tomentosa*	EBEMACEAE	LC	
9.	*Euphorbia mauritanica*	EUPHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	
10.	*Ficus cordata*	MORACEAE		

No.	Species name	FAMILY	Status	Alien & invader plant (AIP)
11.	*Galenia africana*	AIZOACEAE	LC NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
12.	*Gomphocarpus fruticosus*	APOCYNACEAE	LC **Weedy indigenous species**	
13.	*Hermannia disermifolia*	MALVACEAE	LC	
14.	*Hermbstaedtia glauca*	AMARANTHACEAE	LC	
15.	*Hypericum perforatum*	HYPERICACEAE	**Naturalised invasive**	
16.	*Lacomucinaea lineata (=Thesium lineatum)*	SANTALACEAE	LC	
17.	*Lycium cinereum*	SOLANACEAE	LC	
18.	*Mesembryanthemum* cf. *arenosum (=Brownanthus arenosus)*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	
19.	*Mesembryanthemum crystallinum*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	
20.	*Mesembryanthemum guerichianum*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	
21.	*Mesembryanthemum noctiflorum (=Aridaria noctiflora)*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	
22.	*Monsonia crassicaulis*	GERANIACEAE	LC	
23.	*Montinia caryophyllacea*	MONTINIACEAE	LC	
24.	*Nicotiana glauca*	SOLANACEAE	**Naturalised invasive**	
25.	*Phaeoptilum spinosum*	NYCTAGINACEAE	LC	
26.	*Pteronia* species	ASTERACEAE		
27.	*Prosopis glandulosa*	FABACEAE	**Invasive alien**	**CARA Cat. 2 invader** **NEMBA Cat. 3 AIP (in Northern Cape)**
28.	*Rogeria longiflora*	PEDALIACEAE	LC	
29.	*Salsola* cf. *aphylla*	AMARANTHACEAE	LC	
30.	*Salsola kali*	AMARANTHACEAE	Naturalised invasive	**1b**
31.	*Schinus molle*	ANACARDACEAE	**Naturalised invasive**	
32.	*Searsia burchellii (streams)*	ANACARDIACEAE	LC	
33.	*Searsia incisa*	ANACARDIACEAE	LC	
34.	*Searsia incisa*	ANACARDIACEAE	LC	
35.	*Searsia populifolia*	ANACARDIACEAE	LC	
36.	*Stipagrostis namaquensis*	POACEAE	LC	
37.	*Stoeberia frutescens*	AIZOACEAE	LC Protected in terms of schedule 2 of the NCNCA	**Apply for a NCNCA Flora permit (DENC)**
38.	*Suaeda fruticosa*	AMARANTHACEAE	LC	
39.	*Tamarisk usneoides*	TAMARICACEAE	LC	
40.	*Tapinanthus oleifolius*	LORANTHACEAE	LC	
41.	*Tetraena retrofracta (=Zygophyllum retrofractum)*	ZYGOPHYLLACEAE	LC	
42.	*Tylecodon pearsonii*	CRASSULACEAE	LC	
43.	*Vachellia karroo*	FABACEAE	LC	

3.8. 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 a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- 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).
- National Forest Act, Act 84 of 1998, provides for the protection of forests as well as specific tree species through the "*List of protected tree species*" (GN 908 of 21 November 2014).
- Northern Cape Nature Conservation Act, Act of 2009, provides for the protection of "*specially protected species*" (Schedule 1), "*protected species*" (Schedule 2) and "*common indigenous species"* (Schedule 3).

3.8.1. 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, 2015).

- **No red-listed species** was observed.

3.8.2. 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).

- **No NEM: BA protected species was observed.**

3.8.3. 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.

3.8.4. NCNCA protected plant species

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and also 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).

- The following species protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 4: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
1.	*Cheiridopsis denticulata* **Schedule 2 protected**		**Search & rescue:** Only observed in the vicinity of the proposed new reservoir at Komaggas. Individuals within footprint to be transplanted to surrounding area.
2.	*Cynanchum viminale* **Schedule 2 protected**		Larger *Cynanchum* plants are expected to transplant poorly. Species protection through topsoil conservation.
3.	*Euphorbia mauritanica* **Schedule 2 protected**		Very common plant in this area. Species protection through topsoil conservation.
4.	*Galenia africana* **Schedule 2 protected**	This plant is weedy a disturbance indicator and commonly found in the Northern Cape.	No special measures needed, this is a weedy pioneer species.
5.	*Mesembryanthemum crystallinum* **Schedule 2 protected**	This plant is weedy a disturbance indicator and commonly found in the Northern Cape.	No special measures needed, this is a weedy pioneer species.
6.	*Mesembryanthemum guerichianum* **Schedule 2 protected**	This plant is weedy a disturbance indicator and commonly found in the Northern Cape.	No special measures needed, this is a weedy pioneer species.
7.	*Mesembryanthemum noctiflorum* **Schedule 2 protected**		Very common plant in this area. Species protection through topsoil conservation.
8.	*Stoeberia frutescens* **Schedule 2 protected**	Only occasionally observed and none directly within any footprint.	**Search & rescue:** Individuals within footprint to be transplanted to surrounding area.

4. IMPACT ASSESSMENT METHOD

The objective of this study was to evaluate the botanical diversity of the property area in order to identify significant environmental features which might have been impacted as a result of the 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

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 (Refer to Table 5).

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

Table 5: Categories and criteria used for the evaluation of the significance of a potential impact

ASPECT / CRITERIA	LOW (1)	MEDIUM/LOW (2)	MEDIUM (3)	MEDIUM/HIGH (4)	HIGH (5)
CONSERVATION VALUE Refers to the intrinsic value of an attribute 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	The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.	The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.	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.	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.	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.
LIKELIHOOD Refers to the probability of the specific impact occurring as a result of the proposed activity	Under normal circumstances it is almost certain that the impact will not occur.	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.	The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur.	It is very likely that the impact will occur under normal circumstances.	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.
DURATION Refers to the length in time during which the activity is expected to impact on the environment.	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).	Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require on-going mitigation. Rehabilitation time is expected to be longer (5-15 years).	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 on-going mitigation. Rehabilitation time is expected to be longer (15-50 years).	The impact is expected to be permanent.
EXTENT Refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur.	Under normal circumstances the impact will be contained within the construction footprint.	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.	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).
SEVERITY Refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur.	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.	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.	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.	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.	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.

4.2. 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 in order 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. In order 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 significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 6.

Table 6: 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 as a result 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 as a result 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 either easily achieved. Social, cultural and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and fairly 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 cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international.

5. DISCUSSING BOTANICAL SENSITIVITY

The aim of impact assessment is to determine the vulnerability of a habitat to a specific impact. In order to do so, the sensitivity of the habitat should be determined by identifying and assessing the most significant environmental aspects of the site against the potential impact(s). For this development the following biodiversity aspects was considered:

- **Location**: The proposed development footprint is located on Communal land, with very low agricultural potential. Portions of the footprint had already been degraded as a result of past practices.
- **Activity**: It is very important to note that there will be two construction methods used for the pipeline upgrade). Placing the pipeline aboveground on small pedestals (± 12 – 13 km) will result in a potential visual impact, but the direct environmental impact is almost negligible in that there will be no excavations and very little physical impact or alteration along the footprint. Excavations (± 13 – 14 km) are much more intrusive in terms of environmental impact, even though it is temporary. In semi-desert areas, even a temporary disturbance can last a long time.
- **Geology & Soils**: No special features such as true quarts patches or heuweltjies were observed in or near to the larger footprint area that may result in specialised plant habitat.
- **Land use and cover**: The footprint is on communal land that is used for livestock grazing (mainly sheep and goat herding).
- **Vegetation status**: The vegetation is not considered a threatened vegetation type, but conservation targets have not yet been met. In addition the impact will be either temporary or should be very low (placed above ground on small movable concrete pedestals). It is also possible to place the new reservoir at Komaggas almost entirely on an existing disturbance footprint (which will minimise the impact on remaining natural veld).
- **Conservation priority areas:** According to the Northern Cape CBA maps the proposed site falls within a CBA area. However, there is no alternative that will not impact on the CBA. It must also be taken into consideration that this is a replacement pipeline, in other words an existing impact. The site will not impact on any recognised centre of endemism.
- **Connectivity**: Excavations will result in temporary disturbance along a straight line, which might have a slight temporary impact on connectivity, but it is expected to be negligible.
- **Watercourses and wetlands**: Not evaluated in this study as a separate freshwater impact assessment has been commissioned as part of the NEMA EIA process.
- **Protected or endangered plant species**: The most significant botanical aspect of this site is the presence a number of Northern Cape Nature Conservation Act, protected species which were observed (Refer to Table 4). Please note that a number of these species are protected by default and are in fact weedy pioneer or disturbance indicators (e.g. Galenia africana or kraalbos).
- **Alien and Invasive Plant species**: A number of *Prosopis* trees and other weedy species were observed. Prosopis trees within the footprint and its immediate surroundings should be removed responsibly.

5.1. IMPACT ASSESSMENT

Table 7 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.

Table 7: Impact assessment associated with the proposed development

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Geology & soils: Potential impact on special habitats (e.g. true quartz or "heuweltjies")	Without mitigation	2	1	2	1	1	10	No special habitats observed.
	With mitigation	2	1	1	1	1	8	Minimising of construction footprint through good environmental control.
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	3	3	3	1	1	24	Temporary disturbance along the underground pipeline route (13 - 14km), which might impact on grazing practices.
	With mitigation	2	2	2	1	1	12	Minimising the construction footprint and making sure the local herders are aware of the proposed development.
Vegetation status: Loss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	3	3	3	2	2	30	Temporary disturbance along the underground pipeline route (13 - 14km), which will have an impact on vegetation in the construction footprint.
	With mitigation	2	2	3	1	1	14	Minimising of construction footprint through good environmental control.
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	4	3	3	2	2	40	Temporary impact on a proposed CBA, but is no alternative that will not impact on the CBA. Also take into account that this is 95% a replacement project.
	With mitigation	3	2	2	1	1	18	Minimising of construction footprint through good environmental control.
Connectivity: Potential loss of ecological migration corridors.	Without mitigation	2	3	3	2	2	20	Temporary impact on connectivity during the construction phase, but should have minimal impact on surrounding landscape.
	With mitigation	2	2	2	1	1	12	Minimising of construction footprint through good environmental control.
Watercourses and wetlands: Potential impact on natural water courses and it's ecological support areas.	Without mitigation						0	N/a (Refer to the Freshwater specialist report).
	With mitigation						0	
Protected & endangered plant species: Potential impact on threatened or protected plant species.	Without mitigation	3	3	3	2	2	30	A number of protected species were observed, but not nationally protected or red listed species.
	With mitigation	2	2	2	1	1	12	Implement impact minimisations practices described for each protected species.
Invasive alien plant species: Potential invasive plant infestation as a result of the activities.	Without mitigation	3	2	3	2	2	27	Prosopis and other alien species densities are generally low. Construction must ensure that it does not result favouring Prosopis distribution.
	With mitigation	2	1	2	1	1	10	Special care must be taken during alien control (in order to avoid re-sprouting).

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Veld fire risk: Potential risk of veld fires as a result of the activities.	Without mitigation	1	2	3	2	2	9	Veld fire risk low.
	With mitigation	1	1	1	1	1	4	Address fire danger throughout construction.
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	4	3	3	2	2	40	Temporary impact on a portion of land located within a CBA and which might result in impact on a number of NCNCA protected plant species.
	With mitigation	2	2	3	2	2	18	Refer to all the mitigation recommendations above.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	3	3	4	2	2	33	The status quo will be maintained, but veld will still be impacted by urban and agricultural related activities. Water is a basic right an all communities should have access to drinking water.
	With mitigation						0	

According Table 7, the main impacts associated with the proposed development will be:

- The temporary impact on indigenous vegetation within a proposed CBA; and
- The potential impact on a number of provincially protected plant species.

However, this is a replacement project, meaning that 95% of the project will be located within an existing disturbance footprint.

The No-Go option means the *status quo* will be maintained, but veld will still be impacted by urban and agricultural related activities. Water is a basic right an all communities should have access to drinking water.

The cumulative impact (even without mitigation) is expected to be **Medium-Low**, but this can be reduced to **Low or Very Low** through mitigation.

6. IMPACT MINIMISATION RECOMMENDATIONS

The proposed development footprint is located on Communal land, with very low agricultural potential. Portions of the footprint had already been degraded as a result of past practices. The remaining vegetation is not considered vulnerable but conservation targets have not yet been met. The site overlaps an identified critical biodiversity area (according to the 2016, Northern Cape Critical Biodiversity Areas maps). In addition, a number of Northern Cape Nature Conservation Act, protected species were observed within the footprint.

According to the impact assessment given in Table 7 the development is likely to result in a **Medium-Low** impact, which can be reduced to a **Low or Very Low** through mitigation.

With the correct mitigation it is 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 plant species.
- Loss of ecosystem connectivity.

6.1. MITIGATION ACTIONS

The following mitigation actions should be implemented to ensure that the proposed development does not pose a significant threat to the environment:

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must include the recommendations made in this report.
- A suitably qualified Environmental Control Officer must 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** search & rescue as discussed in Table 4 must be completed.
- Lay-down areas or construction sites must be located within the construction footprint.
- No clearing of any area outside of the construction footprint may be allowed.
- All waste that had been illegally dumped within the footprint must be removed to a Municipal approved waste disposal site.
- An integrated waste management approach must be implemented during construction.
    - Construction related general and hazardous waste may only be disposed of at Municipal approved waste disposal sites.
- Alien invasive *Prosopis* plants within the footprint (and immediate surroundings) must be removed in a responsible way (to ensure against regrowth).

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APPENDIX 1: COMPLIANCE WITH APPENDIX 6 OF GN. NO. 982 (4 DECEMBER 2014)

Specialist reports

1. A specialist report prepared in terms of these regulations must contain -	
a) Details of –	**Refer to:**
(i) The specialist who prepared the report; and	Refer to Page ii & Appendix 2
(ii) The expertise of the specialist to compile a specialist report including a curriculum vitae;	Refer to Appendix 2
b) A declaration that the specialist is independent in a form as may be specified by the competent authority;	Refer to Page ii
c) An indication of the scope of, and the purpose for which the report was prepared;	Refer to Heading 1.1
d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Refer to Heading 2.8
e) A description of the methodology adopted in preparing the report or carrying out the specialist process inclusive of equipment and modelling used;	Refer to Heading 2.8
f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructures, inclusive of a site plan identifying site alternatives;	Refer to Headings 3.3, 3.4, 3.5, 3.6, 3.8.
g) An identification of any areas to be avoided, including buffers;	Refer to Figure 7 to 11
h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Refer to Figure 7 to 11
i) A description of any assumptions made and any uncertainties or gaps of knowledge;	Refer to Heading 2.8
j) A description of the findings and potential implications of such findings on the impact of the proposed activity, [including identified alternatives on the environment] or activities;	Refer to Heading 5
k) Any mitigation measures for inclusion in the EMPr;	Refer to Heading 6.1
l) Any conditions for inclusion in the environmental authorization;	None
m) Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Refer to Heading 6.1
n) A reasoned opinion -	
(i) [as to] whether the proposed activity, activities or portions thereof should be authorized;	Refer to the "*Main conclusion*" within the executive summary (Page i)
(iA) regarding the acceptability of the proposed activity or activities; and	
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable the closure plan;	Refer to Heading 6.1
o) A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/a
p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/a
q) Any information requested by the competent authority.	N/a
2. Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

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-, 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.

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

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Botes, P. 2013(h): Biodiversity scoping assessment with regards to a Jetty Construction On Erf 327, Malagas (Matjiespoort). 24 October 2013.

Botes, P. 2013(i): Jacobsbaai pump station and rising main (Saldanha Bay Municipality). A Botanical Scan of the area that will be impacted by the proposed Jacobsbaai pump station and rising main. 30 October 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(c): The proposed Freudenberg Farm Homestead, Farm no. 419/0, Tulbagh (Wolseley Area). A Botanical scan of possible remaining natural veld on the property. 26 August 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(a): Jacobsbaai pump station and rising main (Saldanha Bay Municipality) (Revision). A Botanical Scan of the area that will be impacted by the proposed Jacobsbaai pump station and rising main. 21 January 2015.

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 2015(c): Proposed Bredasdorp Feedlot, Portion 10 of Farm 159, Bredasdorp, Cape Agulhas Municipality, Northern Cape Province. A Botanical scan of the area that will be impacted. 28 July 2015.

Botes, P. 2016(a): OWK Raisin processing facility, Blaauwskop Settlement, 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): Kamieskroon 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 Waste Water 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(f): Wagenboom Weir & Pipeline – Construction of a new pipeline and weir with the Snel River, Breede River Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint. 7 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. 2018(i): 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. 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.