PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL ASSESSMENT

PAULSHOEK BULK WATER SUPPLY

GROUND WATER DESALINATION, BOREHOLE- AND RESERVOIR DEVELOPMENT
KAMIESBERG LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE.

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SUMMARY - MAIN CONCLUSIONS

VEGETATION TYPE	**Namaqualand Blomveld & Namaqualand Granite Renosterveld** Both vegetation types are considered least threatened, but it is also poorly protected and much still needs to be done to reach its conservation targets. Please note that although the Vegetation Map of South Africa suggests that the proposed footprint is likely to fall within the vegetation type known as Namaqualand Granite Renosterveld, the complete absence of the indicator species for this vegetation type, namely Renosterbos (*Elytropappus rhinocerotis*), together with the plant species composition encountered, led the author to believe that the larger footprint area is more likely to be associated with Namaqualand Blomveld than with Namaqualand Renosterveld. The author is of the opinion that both proposed sites are located within degraded Namaqualand Blomveld.
VEGETATION ENCOUNTERED	The larger development footprint falls within the Paulshoek settlement and show all the signs of being degraded as a result of overgrazing over a long period of time. Because of overgrazing and poor fire management regimes, complete destruction of natural vegetation is quite common around settlements in the region. In this case the veld that will be impacted can be described as degraded and is dominated by *Galenia africana* (Kraalbos) a well-known disturbance indicator.
CONSERVATION PRIORITY AREAS	According to the Northern Cape Critical Biodiversity Areas (2016), the site is located within the edge of an ESA (ecological support area) identified as a terrestrial migration corridor. Moving the site slightly to the east (e.g. to area 3, marked in Figure 8) will move the footprint out of the ESA. However, it is unlikely that it will make a significant difference whether the site remains were it is, or is moved east, as there is already urban settlement just to the south of Site 1, which also impacts on the ESA. In addition the proposed footprint is very small. Paulshoek is located on the eastern boundary of the Kamiesberg Centre. However, because the KBC is mainly associated with the Fynbos elements at higher altitudes it is highly unlikely that the proposed development will have any significant impact on the KBC.
CONNECTIVITY	The vegetation of the larger footprint is still well connected to the north, west and south, but is slightly compromised to the east, where it meets urban development.
LAND-USE	The proposed development will impact on a small area (with degraded vegetation) used for grazing by the local population, but because of the low carrying capacity and the small size of the development, the loss of grazing should be barely perceptible within the larger property.
PROTECTED PLANT SPECIES	No, NEM:BA, NFA protected or red-listed plant species were observed. However, 5 NCNCA protected species was encountered, of which one is considered a weedy pioneer and three is recommended for Search & Rescue (Refer to Table 3).
WATER COURSES AND WETLANDS	A small seasonal drainage line crosses the lower south-western corner of the proposed Site 2. However, it should be easy to fit the proposed evaporation ponds within the disturbed footprint without impacting on this feature (even if Site 2 is chosen as the preferred option).
MAIN CONCLUSION	The impact assessment took into account that the vegetation type is not considered vulnerable or endangered and no Nationally or red-listed plants were observed. However, a number of NCNCA protected plants were observed. No special habitats are likely to be impacted but the development will have a small impact on a terrestrial migration ESA and may have a potential (although highly unlikely) impact on the Kamiesberg Centre of Endemism. According to the impact assessment given in Table 6, it is clear that the accumulated impact, even before mitigation, is regarded as Low, but can still be further reduced through responsible management and mitigation. The most significant potential aspects identified are the potential impact on the vegetation,

conservation priority areas, connectivity and flora because of the fact that the sites fall within an Ecological Support Area as well as potentially within the Kamiesberg Centre of Endemism and 5 Northern Cape Nature Conservation Act, protected species were observed. However, it was also determined that the impacts on these features are regarded as relatively low and most in almost all cases it can be further reduced through responsible management and mitigation, which should include the following:

- ensuring that the infrastructure is placed within the already disturbed footprints, preferably at Site 1 or 3, but also 2 if needed;
- ensuring that there is no impact on the small seasonal drainage line (near Site 2) by avoiding this feature;
- implementing the impact minimisation strategies described in Table 3, with regard to NCNCA protected plant species.

With the correct mitigation it is considered highly unlikely that the proposed development will contributed 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.

Apart from the protected species that may be impacted no other botanical features of significance were observed.

WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT PROJECT BE APPROVED SINCE IT IS UNLIKELY TO RESULT IN IRREVERSIBLE ENVIRONMENTAL IMPACT.

NO-GO OPTION

Since the development is relative small and within an already disturbed area and within the urban edge, the no-go option will not contribute significantly to national or provincial conservation targets.

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. 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 OTB and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve). In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits. During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes EIA applications, biodiversity assessment, botanical assessment, environmental compliance audits and environmental control work.

Mr. Botes is also 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.

Yours sincerely,

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1. INTRODUCTION

Paulshoek is a small town located within the Namaqua District Municipal area, about 53 km east-north-east of Garies and 55 km east-south-east of Kamieskroon (on the eastern edge of the Kamiesberg Mountains) within the Northern Cape Province. Kamiesberg Municipality faces numerous challenges in terms of sustainable provision of water which are already under pressure because of the limited water resources. Over the past years water had to be limited at times and water demand management initiatives had to be implemented in order to ensure sustainable water supply (Kamiesberg IDP, 2015/2016). Water for domestic purpose is still the highest user of water in the area followed by industrial sector and lastly agriculture. The increasing demand for proper housing in Paulshoek and the movement of people that used to be living on farms to the nearby towns has further increased the demands for potable water in a number of the smaller towns in the Kamiesberg Municipal area, including Paulshoek.

As a result, BVi Consulting Engineers (Springbok) was appointed to carry out investigations into the potential for upgrading the bulk water infrastructure and to source additional water supply in order to meet the expected increase in water demands within the Kamiesberg Municipal Area. At Paulshoek BVi, proposes the establishment of a new Water Treatment Works (Desalination Plant) and evaporation ponds, placed near to the existing Bulk water storage tanks. Both the proposed development options are located within disturbed natural vegetation. The proposed development will trigger listed activities under the National Environmental Management Act, (Act 107 of 1998) (NEMA) and the EIA regulations (as amended). PB Consult was appointed to evaluate the potential impact of such a development on significant botanical features that might be encountered.

Communities in the Kamiesberg are in general very poor and livestock grazing offers one of the few ways of sustainable income. Paulshoek is no exception and is located on communal land, used mainly for livestock grazing (goats, sheep and donkeys). Because of the arid nature of the region the carrying capacity of the veld is very low, and much of the Kamiesberg had been degraded as a result of severe overgrazing. In some areas this is further compounded by farmers implementing short interval burns in order to improve grazing, which had an extremely negative effect, especially on the Mountain Fynbos. Complete destruction of natural vegetation is quite common around settlements in the region. The vegetation in the immediate vicinity of Paulshoek (including the proposed footprint) also shows signs of overgrazing and veld in a poor condition, but not as severe as in some other instances.

According to the 2012 (beta 2) version of the Vegetation map of SA (Mucina & Rutherford, 2006) the proposed footprint is expected to fall within a vegetation type known as Namaqualand Granite Renosterveld. However, the vegetation encountered (specifically relating to the open sandy areas targeted for the proposed development) can only be described as degraded as a result of severe overgrazing and dominated by *Galenia africana* (Kraalbos) a well-known disturbance indicator. Please note that although the VegMap suggests that the proposed footprint is likely to fall within the vegetation type known as Namaqualand Granite Renosterveld, the complete absence of the indicator species for this vegetation type, namely Renosterbos (*Elytropappus rhinocerotis*), together with the plant species composition encountered, led the author to believe that the larger footprint area is more likely to be associated with Namaqualand Blomveld than with Namaqualand Renosterveld as indicated on the Vegetation Map of South Africa (2012, beta 2 version).

The author is of the opinion that the two areas proposed for the new evaporation ponds are both located within degraded Namaqualand Blomveld.

2. TERMS OF REFERENCE

The terms of reference for this appointment were to:

- Evaluate the proposed site(s) in order to determine whether any significant botanical features will be impacted as a result of the proposed development.
- 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.
- Locate and record sensitive areas from a botanical perspective within the proposed development footprint that may be interpreted as obstacles to the proposed development.
- Make recommendations on impact minimization should it be required
- Consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

3. STUDY AREA

3.1. LOCATION & LAYOUT

The town of Paulshoek is located about 53km east-north-east of Garies and 55km east-south-east of Kamieskroon within the Kamiesberg Local Municipality (Namakwa District Municipality) of the Northern Cape Province (Figure 1). The proposed development will be located on communal land, to the southwest of the main town of Paulshoek, along the lower slopes of a low mountain, near the existing bulk water infrastructure.

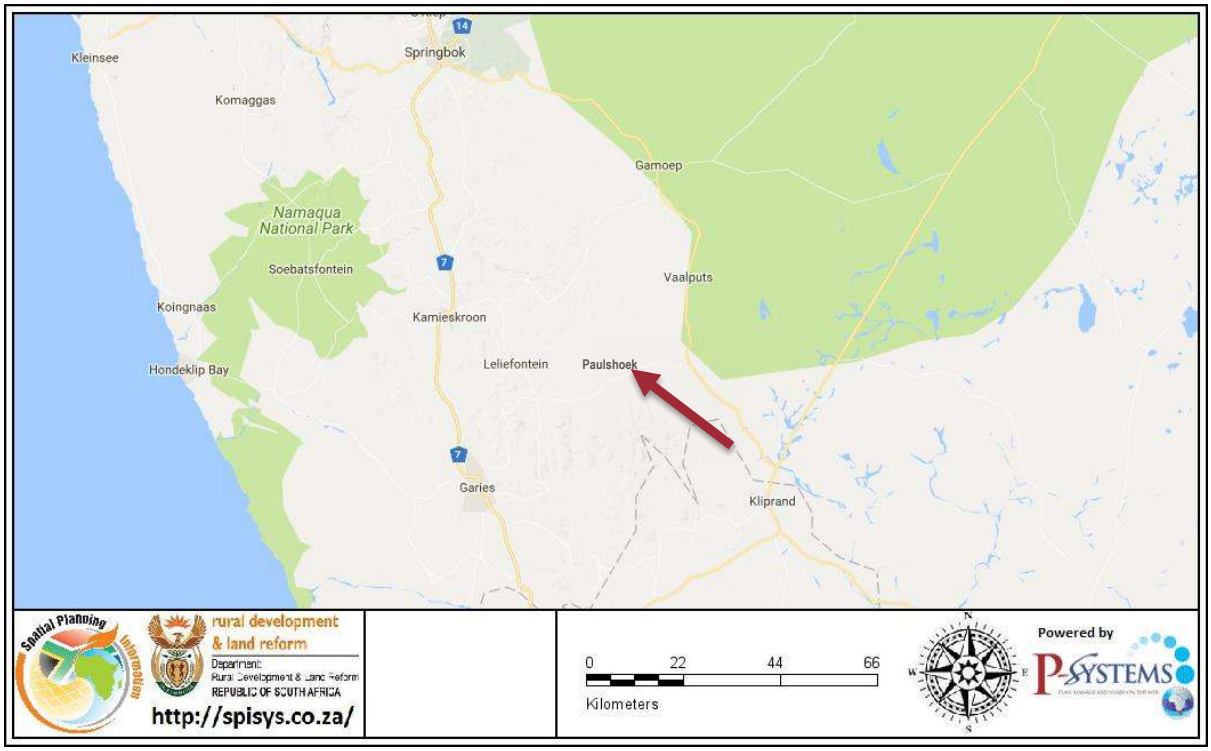

Figure 1: Location map indicating the approximate location of the property in relation to nearby towns

Figure 2: The proposed areas investigated (Site 1 & 2)

3.2. GEOLOGY AND SOILS

Paulshoek is located within the Kamiesberg mountain range, forming the spine of the Namaqualand and is commonly known as the Hardeveld and Klipkoppe. It forms a jumbled land-scape of granite domes and rounded boulders dotted over sandy plains. The Kamiesberg Mountains marks the western rim of the interior plateau, and lies mostly at altitudes of between 500 to 1 000m, but the higher peaks reach over 1 500m. It stretches for about 140 km from Garies in the south to Springbok in the north and forms a plateau between the Sandveld of the Cape West Coast in the west and the Bushmanland in the east (Twidale, 1981). It comprises mainly of a complex mix of granite and gneiss rocks that weathers into coarse sand or fine gravel. Heuweltjies, or hillocks, are a conspicuous feature of the Hardeveld. These weathered remnants of ancient termite mounds appear as circles supporting a slightly different vegetation type, usually about 10m wide (Manning, 2008).

According to the Mucina & Rutherford (2006), one potential soils type is expected in the larger area, namely those associated with Namaqualand Granite Renosterveld. The geology and soils is described as granitic gneiss of the Stalhoek Complex, the Kamieskroon Gneiss and the Nababeep Gneiss, partly overlain by quartzite and other metasediments of the Bitterfontein Formation (Bushmanland Group). The above Mokolian age rocks form level to gentle rocky slopes. The soils are sandy; yellow-brown to brown loamy sand. Land types mainly Ic, IB and Ag.

3.3. TOPOGRAPHY

The town of Paulshoek is located at an elevation of approximately 1 100 m above mean sea level. The existing reservoirs (and the proposed development areas) are located on the lower slopes of a rocky mountain, about 400 m southwest of the town of Paulshoek (Figure 2). The proposed footprint for the treatment plant and evaporation ponds is likely be located slightly further west of the reservoir on one of the two proposed areas. Both sites are located on open sandy areas on a slight (14.5%) southern slope (Figure 3). Both sites showing signs of disturbance as are to be expected so near to town. Aspect is not expected to have any significant influence on the vegetation. A small drainage line runs down the mountain and crosses the western lower corner of the proposed site two.

Figure 3: Showing the slope of the proposed development footprint

3.4. CLIMATE

The Kamiesberg is unusual among desert areas in that although it is arid, it is characterized by relatively reliable rainfall patters, although minimal (50–400 mm/year), with frost being rare. Rain is usually accompanied by heavy dewfall and fog and more than 60% of the rain arrives between May and September. The presence of the cold Atlantic Ocean in the west not only moderates temperatures throughout Namaqualand (mean summer temperature 30°C), but also provides an additional sources of moisture in the form of coastal fog and heavy dew experienced in winter months. Bergwinds during winter can result in temperatures of up to 40 C. After a winter of adequate rainfall, springtime can bring widespread and spectacular flower shows, mainly of the Asteraceae, Brassicaceae Aizoaceae, Scrophulariaceae, Poaceae, Liliaceae and Amaryllidaceae (NDBSP, 2008).

Paulshoek is located almost in the middle of the Kamiesberg at an altitude of 1 100 m. Its climate can be described as a desert climate, with very little rain during the year. Precipitation average 115 mm per year, with most of this rainfall received in the winter months (a Mediterranean climate). It receives the lowest rainfall (3 mm) in January and the highest (18 mm) in June. January is the hottest month with average midday temperatures of 25.6°C, while July is the coldest month with average temperatures only reaching 10.7°C in February. Table 1 gives a summary of temperatures and rainfall recorded at Paulshoek (https://en.climate-data.org/location/911655/).

Table 1: Average rainfall and temperatures (https://en.climate-data.org/location/911655/)

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	25.6	25.5	23.4	18.9	14.7	11.6	10.7	12.6	15.3	18.5	21.7	23.9
Min. Temperature (°C)	16.5	16.6	14.8	10.4	6.7	3.8	2.9	4.4	6.8	9.8	12.9	14.8
Max. Temperature (°C)	34.7	34.4	32	27.4	22.7	19.4	18.6	20.8	23.9	27.3	30.6	33
Avg. Temperature (°F)	78.1	77.9	74.1	66.0	58.5	52.9	51.3	54.7	59.5	65.3	71.1	75.0
Min. Temperature (°F)	61.7	61.9	58.6	50.7	44.1	38.8	37.2	39.9	44.2	49.6	55.2	58.6
Max. Temperature (°F)	94.5	93.9	89.6	81.3	72.9	66.9	65.5	69.4	75.0	81.1	87.1	91.4
Precipitation / Rainfall	3	9	11	12	14	18	13	11	5	6	8	5

4. EVALUATION METHOD

Desktop studies together with two site visits were performed to evaluate the proposed sites in terms of potential impacts on biodiversity and to make recommendations on potential alternative sites where necessary. The site visits was conducted during May and October of 2017 (before and after winter). The timing of the site visit was reasonable in that essentially all perennial plants were identifiable, but unfortunately, many of the bulb and annual flowers were not yet visible, in flower or identifiable. As a result the possibility remains that a number of species may have been missed. However, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

The survey was conducted by walking the site (Figure 4) 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, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

Figure 4: Showing the larger area investigated (red) for the proposed development footprint. Site 1 & 2 indicates the preferred location for the new evaporation ponds.

5. THE VEGETATION

Namaqualand 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. This remarkable diversity is not distributed evenly throughout the region, but is concentrated in many local centres of endemism (NDBSP, 2008).

5.1. GENERAL FLORA & VEGETATION

According to most definitions the Namaqualand region would be classified as a desert region, which are barren for almost three-quarters of the year (summer, autumn and winter), but which can become green and covered in carpets of beautiful flowers for two to three seasons (Le Roux, 2015). According to the 2012 (beta 2) version of the Vegetation map of SA (Mucina & Rutherford, 2006) the proposed footprint is expected to fall within a vegetation type known as Namaqualand Granite Renosterveld. However, Namaqualand Blomveld is expected just to the south of the proposed footprint (Figure 5), both vegetation types classified as "Least Threatened", according to the National list of ecosystems that are threatened and in need of protection (GN 1002, 9 December 2011). It is important to note that both these vegetation types are presently poorly conserved and much still needs to be done to ensure that national conservation targets are met.

According to Mucina and Rutherford (20016), Namaqualand Granite Renosterveld is found on plateaus, low mountains and broken veld of typical granite landscapes at altitudes between 1 100–1 450 m, with its most easterly extension in the vicinity of Paulshoek. The vegetation is described as dense, 1–1.5 m tall shrublands dominated by renosterbos (*Elytropappus rhinocerotis*) and other, mainly asteraceous (*Euryops*, *Arctotis*) shrubs. Overgrazing within this vegetation increases the cover of karroo elements, while abandoned ploughed fields on the plateaus can present spectacular annual floral displays.

Namaqualand Blomveld, on the other hand is generally found 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 also low, spreading, leaf-succulents show spectacular flower displays (hence the name of the unit) in wet years

The vegetation encountered (specifically relating to the open sandy areas targeted for the proposed development) can only be described as degraded as a result of severe overgrazing and was mostly dominated by *Galenia africana* (Kraalbos), a well-known disturbance indicator. In the Kamiesberge overgrazing had an extremely negative effect on many vegetation types, especially Mountain Fynbos types, with complete destruction of natural vegetation quite common near settlements (Van Wyk & Smith, 2001). Even so the complete absence of renosterbos (*Elytropappus rhinocerotis*) together with the plant species composition encountered, led the author to believe that the larger footprint area is more likely to be associated with Namaqualand Blomveld than with Namaqualand Renosterveld.

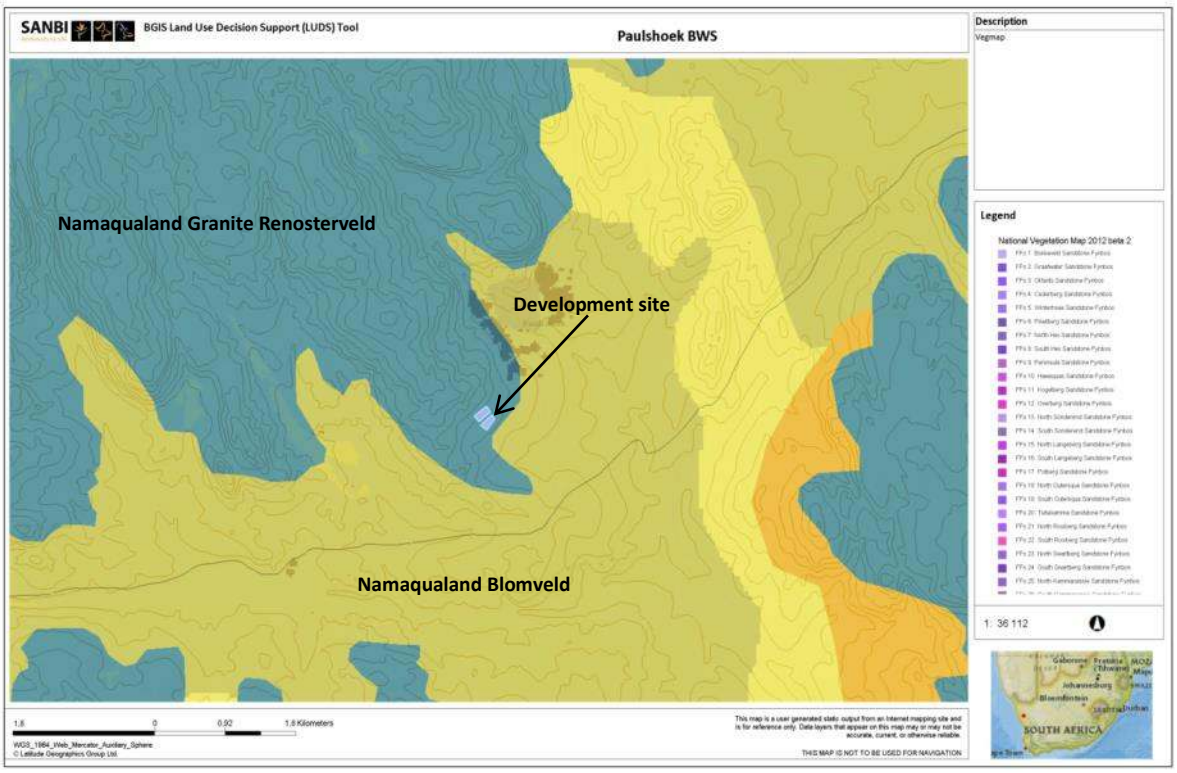

Figure 5: Vegetation map of South Africa (2012 beta 2 version), showing the larger area and expected vegetation

5.2. 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.

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).

The 2016 Northern Cape Critical Biodiversity Areas (NCCBA) gives both aquatic and terrestrial Critical Biodiversity Areas (CBAs) and ecological support areas for the Northern Cape. According to the NCCBA, the proposed development falls within an ecological support area (ESA) (Refer to 6).

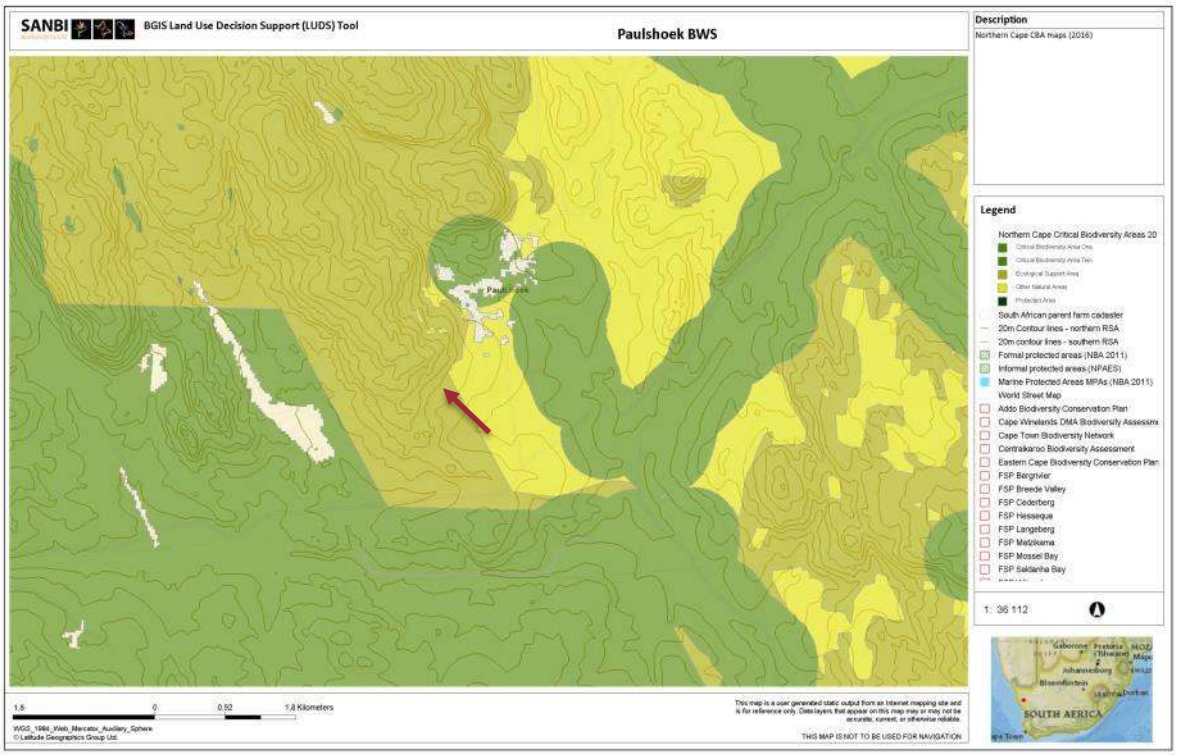

Figure 6: The Northern Cape Critical Biodiversity Areas (2016) showing proposed development footprint, with site one overlapping a T2 Terrestrial biodiversity site (green)

5.3. KAMIESBERG CENTRE OF ENDEMISM

The Kamiesberg centre (KBC) of endemism is named after the Kamiesberg mountain range, just east of Kamieskroon and comprises the entire Kamiesberg Mountain Range (Refer to Figure 7). The vegetation of the Kamiesberg Mountains (especially the high-altitude regions of the Kamiesberg) show remarkable resemblance with that of the Cape Fynbos Region and it is generally regarded as an outlier of the Cape Floristic Region (Van Wyk & Smith, 2001). The KBC is recognized as one of several areas of high endemism within the Succulent Karoo Region, which is one of the globally important sites of plant diversity and endemism recognized by the WWF and one of the world's 25 hotspots (Mittermeier *et. al.* 2000; in Van Wyk & Smith, 2001).

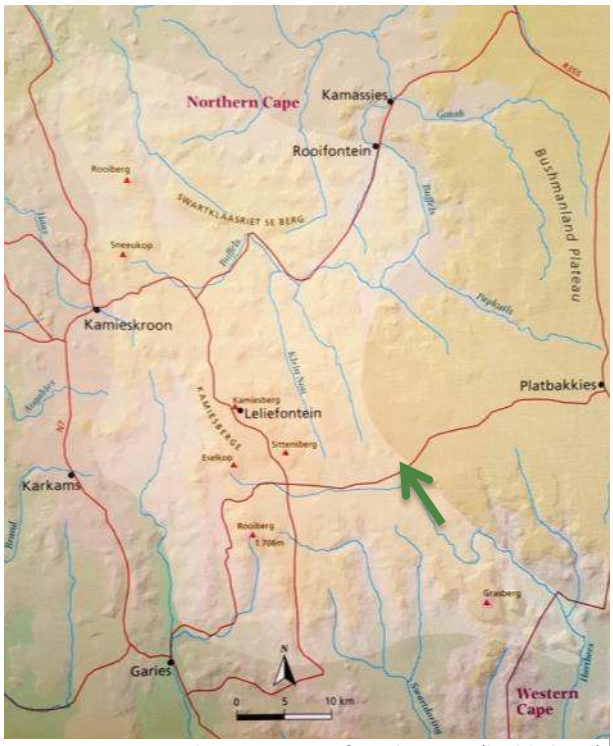

Figure 7: Kamiesberg Centre of endemism (highlighted), taken from Van Wyk & Smith (2001)

The KBC extents from near Garies in the south, to the basin of the Buffels River in the north (about 60km north). Eastwards the region gradually merges, through a series of lower ridges, into the Bushmanland Plateau (not a distinct boundary). The Kamiesberg itself forms the western edge of the extensive interior plateau of the subcontinent and comprises the highest region in the Namaqualand (Van Wyk & Smith, 2001).

Much of the KBC is a broken plateau with an elevation above 1 200 m and is characterized by massive granite domes among granite hills and sandy plains. It receives winter rain of which at least 80% falls between April and September. Because of its higher altitude, the Kamiesberge have a notably higher precipitation (averaging about 400 mm per annum) and lower temperatures than surrounding areas (with typical annual rainfall of between 100 – 200 mm) (Van Wyk & Smith, 2001).

Most of the KBC endemics are confined to the Fynbos and Renosterveld. According to Hilton-Taylor (1996) (in Van Wyk & Smith, 2001), about 79 endemic plant species can be found within the Kamiesberg range, with the Family Iridaceae, particularly well represented. Succulent endemism is surprisingly low, especially taken into account that it is surrounded by Succulent Karoo Vegetation. The KBC is the only centre of endemism where, apart from one exception, all the known succulent endemics belong to one family (Mesembryanthemaceae). The affinity of the high-altitude flora of the KBC clearly lies with the Cape Floristic Region (CFR), all three of the characteristic families of the CFR (Restionaceae, Ericaceae and Proteaceae) present in the KBC, as well as several genera that have their present centres of diversity in the Cape (Van Wyk & Smith, 2001).

Much of the KBC is communal land, used mainly for stock farming. By 1938 it was already noted that the vegetation in many parts of the Kamiesberg had been degraded as a result of severe overgrazing by sheep, goats and donkeys. Since then the vegetation had deteriorated further, which was compounded by farmers implementing short interval burns in order to improve grazing. This had an extremely negative effect, especially on the Mountain Fynbos, with complete destruction of natural vegetation quite common around settlements in the region. As a result the KBC is regarded as having among the highest conservation priorities of all centres of endemism in the Succulent Karoo (Van Wyk & Smith, 2001).

Paulshoek is located on the eastern boundary of the Kamiesberg Centre. However, because the KBC is mainly associated with the Fynbos and Renosterveld which is found at higher altitudes it is highly unlikely that the proposed development will have any significant impact on the KBC.

5.4. VEGETATION ENCOUNTERED

According to the 2012 (beta 2) version of the Vegetation map of SA (Mucina & Rutherford, 2006) the proposed footprint is expected to fall within a vegetation type known as Namaqualand Granite Renosterveld. The vegetation encountered (specifically relating to the open sandy areas targeted for the proposed development) can be described as degraded as a result of severe overgrazing and was mostly dominated by *Galenia africana* (Kraalbos), a well-known disturbance indicator. In the Kamiesberge overgrazing had an extremely negative effect on many vegetation types, especially Mountain Fynbos types, with complete destruction of natural vegetation quite common near settlements (Van Wyk & Smith, 2001). Even so the complete absence of renosterbos (*Elytropappus rhinocerotis*) together with the plant species composition encountered, led the author to believe that the larger footprint area is more likely to be associated with Namaqualand Blomveld than with Namaqualand Granite Renosterveld.

The main and by far the largest impact will be associated with the establishment of the new evaporation ponds located within an area that supports a degraded form of Namaqualand Blomveld vegetation. These evaporation ponds are expected to cover an area of 0.5-1 ha. Pipeline routes will link the evaporation ponds to the existing pump station, located just east of the proposed evaporation ponds. Potentially the pump station infrastructure will be enlarged in order to upgrade the system or even to house the new treatment plant (desalination plant).

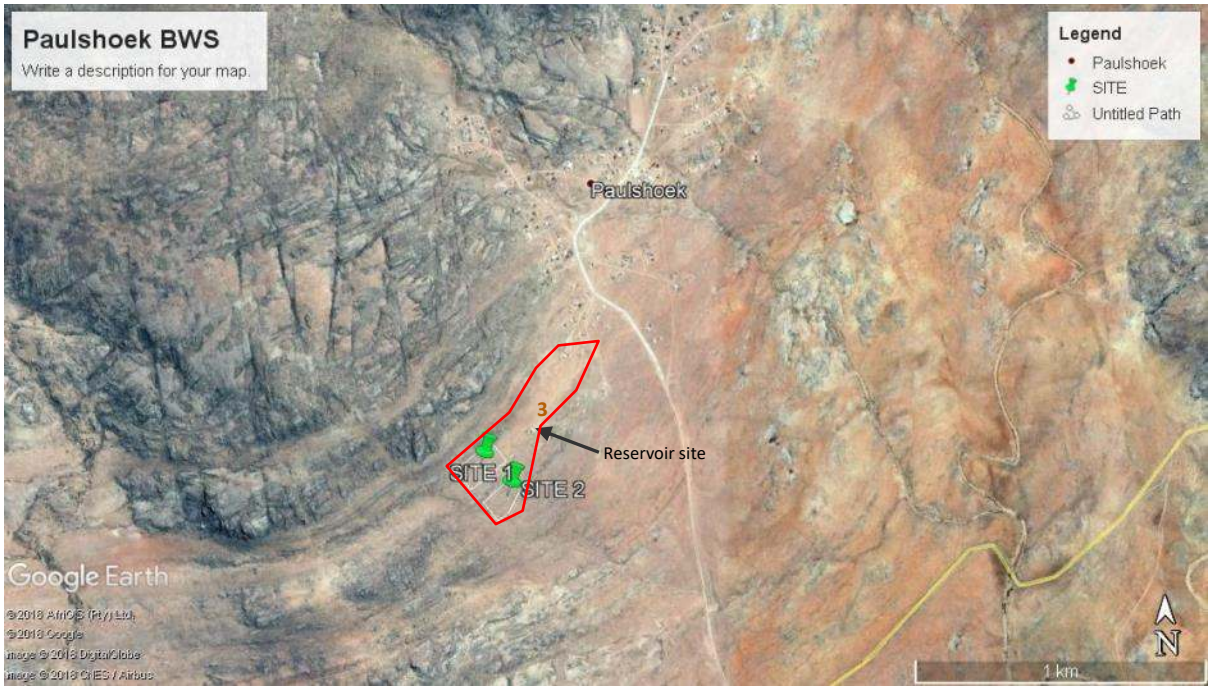

Figure 8: Google image showing the larger footprint (red), the proposed sites (green) and the existing reservoir site

Communities in the Kamiesberg are in general very poor and livestock grazing offers one of the few ways of sustainable income. Paulshoek is no exception and is located on communal land, used mainly for livestock grazing (goats, sheep and donkeys). Because of the arid nature of the region the carrying capacity of the veld is very low, and much of the Kamiesberg had been degraded as a result of severe overgrazing. In some areas this is further compounded by farmers implementing short interval burns in order to improve grazing, which had an extremely negative effect, especially on the Mountain Fynbos. Complete destruction of natural vegetation is quite common around settlements in the region. The vegetation in the immediate vicinity of Paulshoek (including the proposed footprint) also shows signs of overgrazing and veld in a poor condition, but not as severe as in some other instances. The two areas proposed for the new evaporation ponds are both within degraded Namaqualand Blomveld, with only hardy and mostly unpalatable shrubs remaining (Photo 1).

Photo 1: Looking from Site 1 (Figure 8) east towards the existing reservoirs with *Galenia africana*, *Eriocephalus* cf. *microphyllus* and *Lycium cinereum* prominent.

5.4.1. Vegetation site 1

The proposed Site 1 is located on almost level open sandy patch running east –west along the lower slopes of the low rocky hill to its north (Photo 1 & 2). The vegetation can be described as a sparse dwarf shrubland, representing a degraded form of Namaqualand Blomveld dominated by *Galenia africana* and *Eriocephalus* cf. *microphyllus* with *Lycium cinereum* and *Hermannia trifurca* also common. Vegetation cover was relatively low, usually between 20-40% and normally showed two stratums. The top stratum (about 60 cm in height) was dominated by the four species mentioned above, while the lower stratum reached about 20 cm in height. In general the site can be described as degraded with only hardy unpalatable shrubs left.

Photo 2: Looking from Site 1 (Figure 8) south onto the lower lying areas and onto the proposed Site 2.

Other species encountered at Site 1 includes; *Aptosimum spinescens*, *Asparagus capensis*, *Crassula brevifolia* and *Crassula cotyledonis* (both plants normally associated with rocky outcrops along the edges of the site), the low growing form of the shrub *Searsia undulata*, a heavily grazed *Osteospermum* species and *Tylecodon wallichii* (usually also only encountered within the rocky outcrops to the south and east of the site). The very low species diversity is most probably the result of the impact of constant overgrazing. It is very likely that the site will support a number of geophytes and annual plants that were not visible at the time of the study, but they should only emphasise the degraded status of the veld.

Photo 3: *Crassula cotyledonis* encountered within rocky outcrops in the vicinity of Site 1 and Site 2.

5.4.2. Vegetation site 2

The proposed Site 2 is located lower down the slope on another open sandy area (disturbed footprint). The slope of site 2 is more pronounced than that of Site 1 and the vegetation cover is slightly denser and in better shape than Site 1. *Euphorbia mauritanica* now characterise the natural veld surrounding the open sandy patch, rather than *Galenia africana* and *Eriocephalus* cf. *microphyllus*. However, the species encountered is still more consistent with Namaqualand Blomveld than with Namaqualand Granite Renosterveld (Photo 4 & 5). Please note that there is a small seasonal drainage line running through the site along its western lower corner (Figure 3).

Photo 4: Looking over Site 2 from north to south (down-hill). Note disturbance footprint in front with more natural vegetation surrounding the site.

The open disturbed sandy patch (in which the proposed site 2 is located) is surrounded by a denser natural veld (and more rocky) with two stratums present. The top stratum (60 – 80 cm in height) is dominated by *Euphorbia mauritanica* (Photo 6) but with *Galenia africana*, *Eriocephalus* cf. *microphyllus, Lycium cinereum* and *Hermannia trifurca* also common. Vegetation cover was generally higher (between 40 – 60%), but as can be seen from the species above consists mostly of hardy unpalatable species. Other species encountered includes; *Aptosimum spinescens*, *Crassula brevifolia*, *C. cotyledonis*, *Lasiopogon micropoides*, *Osteospermum* species and *Tylecodon wallichii*.

Photo 5: Looking from south to north (uphill) from the Site 2. Note the slightly denser natural vegetation away from the disturbance footprint with *Euphorbia mauritanica* prominent in the background.

Photo 6: *Euphorbia mauritanica* encountered along the lower slopes of the hill near Paulshoek. The plant is reputed to be poisonous and only Steenbok and Klipspringer are known to eat the plant (Le Roux, 2015)

5.4.3. Potential areas for development

Figure 8 shows the larger area that was investigated for this study as well as the two proposed sites considered by the engineers for the location of the new infrastructure, namely Site 1 and Site 2. From the site visit it was clear that both sites overlaps already disturbed footprints located in a disturbed form of Namaqualand Blomveld (the result of continual overgrazing over a very long period of time). At present only very hardy unpalatable species remains at both sites.

From a botanical point of view, both sites overlaps disturbed open sandy areas, that can be described as degraded. Although both sites can be considered for development, Site 2 is floristically in slightly better shape (slightly less disturbed) than Site 1 and it overlaps a small seasonal drainage line (in its south-western corner) which will add to its potential significance. In both cases the development footprint should stay within the already disturbed sandy footprints, and away from the small drainage line.

Site 1 should be the preferred site, with Site 2 as an alternative. Please note that during the site visit the author also identified a **further potential option immediately to the east of the existing reservoir site** (Refer to point 3 in Figure 8), which can also be considered (as it also shows the same disturbance footprint as encountered at Site 1).

5.5. FLORA ENCOUNTERED

Please note that this study never intended to be full botanical assessment. However, a scan of significant species was done during the site visit, and even though the author does not claim that all species encountered were identified, all efforts were made to do just that. It is also expected that because of the timing of the site visit a number of spring annuals would have been missed some of whom might be protected in terms of the Northern Cape Nature Conservation Act (NCNCA), Act, 9 of 2009 (especially referring to species of the Aizoaceae family).

Table 2: List of species encountered within or near the proposed footprint

No.	Species name	FAMILY	Status NFA, NCNCA	SA Red list status (V 2015/1)	Alien & invader species (AIS)
1.	*Aptosimum spinescens*	SCROPHULARIACEAE		LC	
2.	*Asparagus capensis*	ASPARAGACEAE		LC	
3.	*Crassula brevifolia*	CRASSULACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
4.	*Crassula cotyledonis*	CRASSULACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
5.	*Eriocephalus microphyllus*	ASTERACEAE		LC	
6.	*Euphorbia mauritanica*	EUPHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
7.	*Galenia africana*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
8.	*Hermannia trifurca*	MALVACEAE		LC	
9.	*Lasiopogon micropoides*	ASTERACEAE		LC	
10.	*Lycium cinereum*	SOLANACEAE		LC	
11.	*Osteospermum* species	ASTERACEAE			
12.	*Searsia undulata*	ANACARDIACEAE		LC	
13.	*Tylecodon wallichii*	CRASSULACEAE	Protected in terms of schedule 2 of the NCNCA	LC	

5.6. 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).

5.6.1. 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 during the site visit.

5.6.2. 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 species protected in terms of NEM: BA** was encountered.

5.6.3. 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 (GN 908 of 21 November 2014).

- **No species protected in terms of the NFA** was observed within the proposed footprint.

5.6.4. 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 (Table 3) protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 3: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	I
1.	*Crassula brevifolia* **Schedule 2 protected**	All species in the family Crassulaceae protected by default. Occasional in rocky outcrops between Site 1 & 2.	**Search & rescue**: Unlikely to be impacted, but individuals within footprint to be transplanted to surrounding area.
2.	*Crassula cotyledonis* **Schedule 2 protected**	All species in the family Crassulaceae protected by default. Occasionally in rocky outcrops between Site 1 & 2.	**Search & rescue**: Unlikely to be impacted, but individuals within footprint to be transplanted to surrounding area.
3.	*Euphorbia mauritanica* **Schedule 2 protected**	All species in the genus *Euphorbia* protected by default. Locally common.	Larger *Euphorbia* transplant poorly. Species protection through topsoil conservation.
4.	*Galenia africana* **Schedule 2 protected**	All species in the family Aizoaceae protected by default. This plant is weedy a disturbance indicator.	No special measures needed, this is a weedy pioneer species.
5.	*Tylecodon wallichii* **Schedule 2 protected**	All species in the family Crassulaceae protected by default. Occasional.	Search & rescue and further protection through topsoil conservation.

6. 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

6.1. 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 4).

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

Table 4: 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.

ASPECT / CRITERIA	LOW (1)	MEDIUM/LOW (2)	MEDIUM (3)	MEDIUM/HIGH (4)	HIGH (5)
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.

6.2. 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 5.

Table 5: 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.

7. 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 taken into account.

Namaqualand Blomveld is part of the Succulent-Karoo Biome, which has been compared to a desert harbouring a range of succulent plants beyond compare. It has a bulb flora richer than any other arid region and produces spectacular displays of annual flowers after good rains. Rainfall predictability sets it apart from other deserts and is commonly accepted as the main reason for the abundance of leaf succulents (which with their shallow root system is not well adapted to prolonged drought), bulbs and spring flowers.

Unfortunately, only a small percentage (approximately 6%) of this vegetation type is statutorily protected (Mucina *et. al*., 2006). It is also believed that within the larger Succulent Karoo Biome, the protected area system does not adequately incorporate key ecological components and evolutionary biodiversity drivers like riverine and sand movement corridors, quartz patches, edaphic interfaces, climatic and upland-lowland gradients.

Land use is primarily focused on agriculture, with livestock grazing the dominant land use. Before widespread human settlement indigenous antelope would have migrated across the landscape, no doubt having an overall positive influence on biodiversity. However, fences, permanent watering points and high domestic stock densities led to degradation, loss of vegetation, loss of seed bank and a negative influence on soil quality (Mucina *et. al*., 2006).

The proposed development is expected to result in the permanent transformation of approximately 0.5 - 1 ha of degraded Namaqualand Blomveld.

7.1. CONSERVATION VALUE

The larger development footprint falls within the Paulshoek settlement and show all the signs of being degraded as a result of overgrazing over a long period of time. Because of overgrazing and poor fire management regimes, complete destruction of natural vegetation is quite common around settlements in the region.

Vegetation status: Namaqualand Blomveld is considered least threatened, but it is also poorly protected and much still needs to be done to reach the conservation target of 28%. Since vegetation at Site 2 is in better shape, Site 1 or even Site 3 (proposed in Figure 8) will be better options for development, although Site 2 can remain an option.

CBA or ESA: According to the Northern Cape Critical Biodiversity Areas (2016), the site is located within the edge of an ESA (ecological support area) identified as a terrestrial migration corridor. Moving the site slightly to the east (e.g. to area 3, marked in Figure 8) will move the footprint out of the ESA. However, it is unlikely that it will make a significant difference whether the site remains were it is, or is moved east, as there is already urban settlement just to the south of Site 1, which also impacts on the ESA. In addition the proposed footprint is very small.

Connectivity: The vegetation of the larger footprint is still well connected to the north, west and south, but is slightly compromised to the east, where it meets urban development.

Centres of endemism: Paulshoek is located on the eastern boundary of the Kamiesberg Centre. However, because the KBC is mainly associated with the Fynbos elements at higher altitudes it is highly unlikely that the proposed development will have any significant impact on the KBC.

Other: Apart from the small seasonal drainage line encountered near Site 2, no other significant geographical features such as wetlands, true quarts patches or heuweltjies were observed in or near to the larger footprint area.

7.2. IMPACT EVALUATION

Table 6 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 6: Significant rating of impacts associated with the proposed development (including the No-Go option)

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig. before Mit.	CV	Lik	Dur	Ext	Sev	Sig. after Mit.	Short discussion
Geology & soils	Possible impact on special habitats (e.g. true quartz or "heuweltjies")	1	1	2	1	1	5	1	1	2	1	1	5	The higher hills to the north is likely to support Fynbos type vegetation which is associated with the Kamiesberg Centre of Endemism, but no special features were encountered at either site. The impact on geology and soils is expected to be very low. No mitigation required as long as the impact remains within the disturbed footprints of Site 1, 2 or even proposed Site 3.
Land use and cover.	Possible impact on socio-economic activities as a result of the physical footprint or associated activities.	1	2	3	1	1	7	1	2	3	1	1	7	The proposed development will impact on a small area (with degraded vegetation) used for grazing by the local population, but because of the low carrying capacity and the small size of the development, the loss of grazing should be barely perceptible within the larger property.
Vegetation status	Possible loss of vulnerable or endangered vegetation and associated habitat.	3	3	3	1	1	24	3	1	2	1	1	15	Namaqualand Blomveld is considered least threatened, but is poorly protected. The Blomveld in this case is already degraded. However, the proposed sites fall within an ESA.
Conservation priority areas	Possible impact on Protected areas, CBA, ESA or centres of endemism.	3	3	3	1	1	24	3	1	2	1	1	15	According to the Northern Cape Critical Biodiversity Areas (2016), the site is located within the edge of an ESA (ecological support area) identified as a terrestrial migration corridor. Moving the site slightly to the east (e.g. to area 3, marked in Figure 8) will move the footprint out of the ESA. However, it is unlikely that it will make a significant difference whether the site remains were it is, or is moved east, as there is already urban settlement just to the south of Site 1, which also impacts on the ESA. In addition the proposed footprint is very small. Paulshoek is located on the eastern boundary of the Kamiesberg Centre. However, because the KBC is mainly associated with the Fynbos elements at higher altitudes it is highly unlikely that the proposed development will have any significant impact on the KBC.
Connectivity	Possible loss of identified terrestrial and aquatic critical biodiversity areas, ecological support areas or ecological corridors.	3	3	3	1	1	24	3	1	2	1	1	15	The vegetation of the larger footprint is still well connected to the north, west and south, but is slightly compromised to the east, where it meets urban development.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig. before Mit.	CV	Lik	Dur	Ext	Sev	Sig. after Mit.	Short discussion
Watercourses and wetlands	Possible impact on natural water resources and its associated ecosystem.	2	3	4	1	2	20	2	1	2	1	1	10	Potential impact on a small seasonal stream at Site 2. However, with proper planning the impact can be easily negated.
Flora	Potential impact on threatened or protected plant species.	3	3	3	1	2	27	3	2	2	1	1	18	No, NEMBA, NFA protected or red-listed plant species were observed. However, 5 NCNCA protected species was encountered, of which one is considered a weedy pioneer and three is recommended for Search & Rescue. Please note that none of these species are considered rare or endangered.
Invasive alien species	Possible alien infestation as a result of activities.													None observed
Veld fire	The risk of veld fires as a result of the proposed activities.	2	1	1	2	1	10	2	1	1	1	1	8	Veld fire risk is considered low, but must be addressed appropriately through the construction EMP.
Accumulative	Accumulative impact associated with the proposed activity.	3	3	4	2	2	33	3	2	2	2	1	21	The overall impact is considered to be relatively low, because of the small size, but good environmental control during construction can still lead to minimisation of impacts.
No-Go alternative	Potential environmental impact associated with the no-go alternative.	3	1	1	1	1	12	3	**Mitigation not applicable.**					The above impacts will not occur, and the status quo will remain (livestock grazing as the main land use). In this case livestock grazing has already degraded the veld significantly.

According to the impact assessment given in Table 6 above, it is clear that the accumulated impact, even before mitigation, is regarded as Low, but can still be further reduced through responsible management and mitigation. The most significant potential aspects identified are the potential impact on the vegetation, conservation priority areas, connectivity and flora because of the fact that the sites fall within an Ecological Support Area as well as potentially within the Kamiesberg Centre of Endemism and 5 Northern Cape Nature Conservation Act, protected species were observed. However, it was also determined that the impacts on these features are regarded as relatively low and most in almost all cases it can be further reduced through responsible management and mitigation, which should include the following:

- ensuring that the infrastructure is placed within the already disturbed footprints, preferably at Site 1 or 3, but also 2 if needed;
- ensuring that there is no impact on the small seasonal drainage line by avoiding this feature;
- implementing the impact minimisation strategies described in Table 3, with regard to NCNCA protected plant species.

With the correct mitigation it is considered highly unlikely that the proposed development will contributed 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.

8. RECOMMENDATIONS

Having evaluated the proposed site and its immediate surroundings, it is unlikely that the proposed development will lead to any significant impact on the botanical features as a result of its placement as long as the following impact minimisation recommendations are implemented.

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must include these recommendations.
- 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.
- Site 1 should be the preferred site, with Site 2 as an alternative. Please note that during the site visit the author also identified a further potential option immediately to the east of the existing reservoir site (Refer to point 3 in Figure 8), which can also be considered (as it also shows the same disturbance footprint as encountered at Site 1).
- Impacts on the small drainage line near the south-western corner of Site 2 should be avoided as it should be easy to fit the proposed evaporation ponds within the disturbed footprint without impacting on this feature.
- An application must be made to DENC for a flora permit in terms of the NCNCA with regards to impacts on species protected in terms of the act.
- Search & rescue operation must be implemented for individual plants that might be impacted as recommended in Table 3 (Page 21).
- Access must be limited to routes approved by the ECO.
- Before any work is done the site and access routes must be clearly demarcated (with the aim at minimal width/smallest footprint). The demarcation must include the total footprint necessary to execute the work, but must aim at minimum disturbance.
- Lay-down areas or construction sites must be located within already disturbed areas or areas of low ecological value (e.g. near the existing reservoir site) and must be pre-approved by the ECO.
- Indiscriminate clearing of any area outside of the construction footprint must be avoided.
- All areas impacted as a result of construction must be rehabilitated on completion of the project.
    - This includes the removal of all excavated material, spoil and rocks, all construction related material and all waste material.
    - It also included replacing the topsoil back on top of the excavation as well as shaping the area to represent the original shape of the environment.
- 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.
    - All rubble and rubbish should be collected and removed from the site to a suitable registered waste disposal site.

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