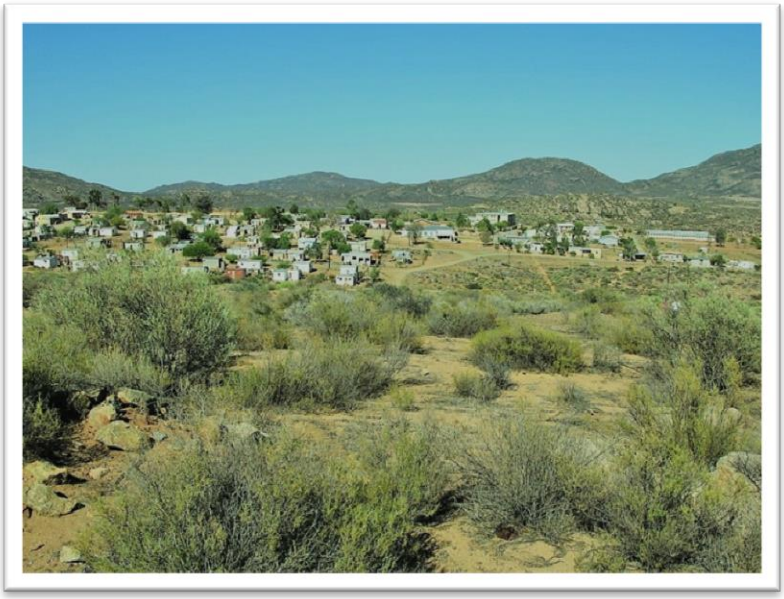
PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL SCAN

KAMIESKROON 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 Klipkoppe Shrubland:** It is considered least threatened, but it is also poorly protected and much still needs to be done to reach the conservation goal of 28%. However, the proposed site does not fall within any CBA or ESA identified within the Namakwa District Biodiversity Sector Plan (meaning, that the footprint does not fall within an area earmarked for conservation).
VEGETATION ENCOUNTERED	The proposed larger development footprint falls within the Kamieskroon urban edge and is located between two sections of the town. However, it is also located on the gentle slopes of a small koppie, which has, to a large degree, protected the footprint from the brunt of direct impacts, (normally associated with an urban area) and as a result the vegetation encountered remains in remarkable good condition.
CONSERVATION PRIORITY AREAS	According to the Namakwa District Biodiversity Sector Plan, the site is not located within a CBA or an ESA and is thus not currently earmarked for conservation in order to achieve conservation targets. Kamieskroon (and the potential footprint) is located near to, but falls outside of the Kamiesberg Centre (KBC) of endemism and the proposed development is not expected to have any direct impact on the KBC.
CONNECTIVITY	The vegetation of the larger footprint is still fairly well connected to the north, but is mostly impeded to the east and west, by urban development and to the south by intensive agriculture.
LAND-USE	The proposed development will impact on a small area potential used for grazing by the local population, but 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, 7 NCNCA protected species was encountered, of which one is considered a weedy pioneer and one is recommended for Search & Rescue. Please note that almost all of these plants are relative common species not considered rare or endangered.
WATER COURSES AND WETLANDS	No watercourses or wetlands were encountered within or near to the larger proposed development footprint.
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 and the development will not impact on any ESA or CBA and should not impact on the nearby Kamiesberg Centre of Endemism. According to the impact assessment it is considered highly unlikely that the development would have 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 will 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 consultant and has 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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Registered Professional Botanical, Environmental and Ecological Scientist

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1. INTRODUCTION

Kamieskroon is a small town located within the Namaqua District Municipal area, just off the N7, between Garies and Springbok within the Northern Cape Province. It was founded in 1924, when the Dutch Reformed Church bought the land to relocate from Bowesdorp, 8 km to the north of the current location of the town. The move was forced by a shortage of water and restricted space for the growth of the town. The town, which lies at the foothills of the Kamiesberge, is more or less in the centre of the Namaqualand (about 70 km south of Springbok) and is well known for its spring wild flowers displays.

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 Kamieskroon 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 Kamieskroon.

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 Kamieskroon BVi, proposes the establishment of a new Water Treatment Works (Desalination Plant) and evaporation ponds, placed near to the existing Bulk water storage tanks (in areas still mostly covered by indigenous 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 proposed site and its immediate surroundings in terms of the potential impact of such a development on any potential significant botanical features that might be encountered.

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 Kamieskroon is located just off the N7, between Garies and Springbok, within the Kamiesberg Local Municipality (Namakwa District Municipality) of the Northern Cape Province (Figure 1). The proposed development will be located on communal land (Remainder of Farm 154), to the south of Kamieskroon, near the existing reservoirs.

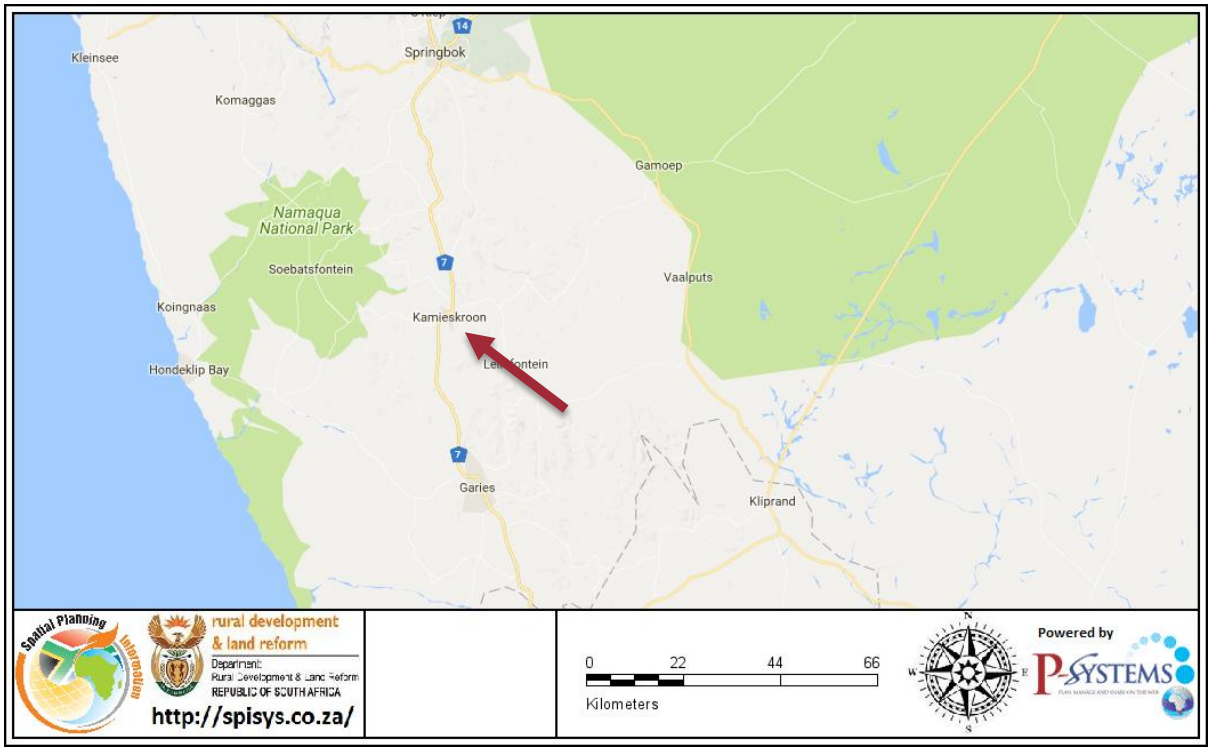

Figure 1: Location map indicating the approximate location of the property in relation to nearby towns

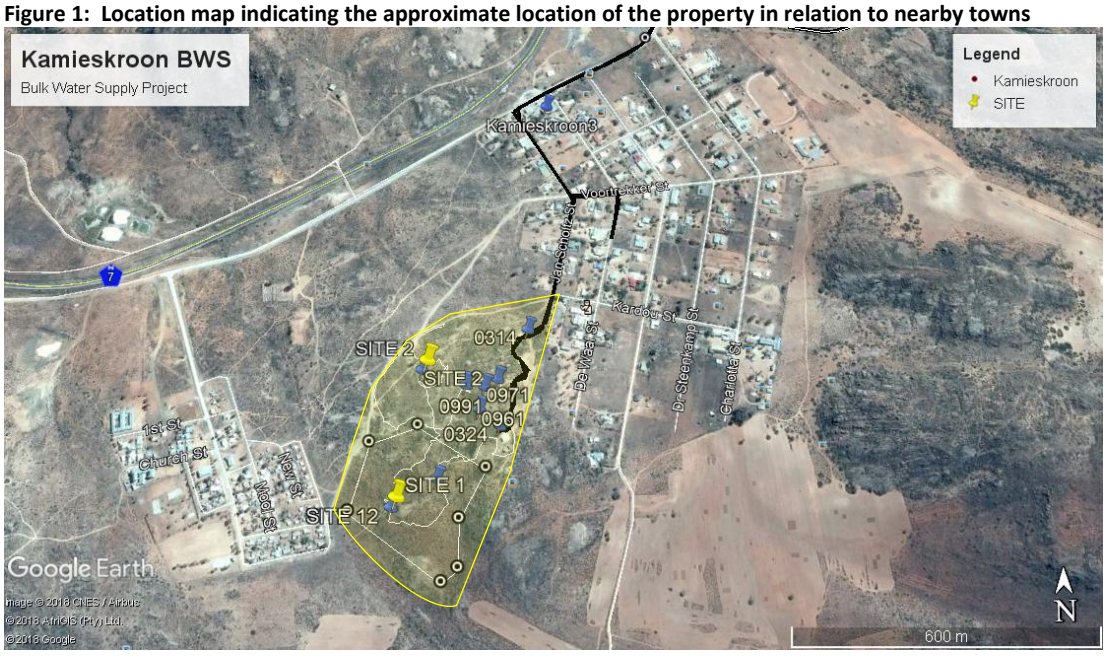

Figure 2: The proposed larger area (including Site 1 & 2) investigated

3.2. GEOLOGY AND SOILS

The Kamiesberg or Kamiesberge is a mountain range of jumbled granite inselbergs dotted over sandy plains and centred on Kamieskroon in Namaqualand in South Africa. 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 and Bushmanland in the east, with the Hardeveld of the mountainous central Kamiesberg escarpment in the midst (Twidale, 1981).

According to the Mucina & Rutherford (2006), only one major soil type is expected in the study area associated with the Namaqualand Klipkoppe Shrubland (rocky outcrops). The soils 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 are described as yellow-brown to brown loamy sand, 0.15 – 0.6 m deep.

3.3. TOPOGRAPHY

The town of Kamieskroon is located at an elevation of approximately 800 m above mean sea level. The existing reservoirs are located on a domed hill to the south of Kamieskroon. The proposed footprint for the treatment plant and evaporation ponds is likely be located to the west or south west of these reservoirs on a gentle slope of between 20 – 30%. Along this slope elevation varies only slightly between 790 and 750 m and aspect therefore is not expected to have any significant influence on the vegetation. No water courses or wetlands were observed on the site or in its near vicinity (within a 100 m).

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).

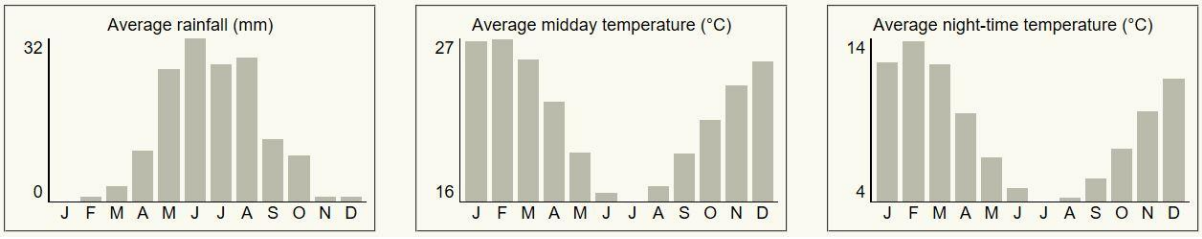

Table 1: Average rainfall and temperatures (www.saexplorer.co.za)

Kamieskroon normally receives about 150 mm of rain per year and because it receives most of its rainfall during winter it has a Mediterranean climate. The chart below (lower left) shows the average rainfall values for Kamieskroon per month. It receives the lowest rainfall (0 mm) in January and the highest (32 mm) in June. Average midday temperatures for Kamieskroon range from 16°C in July to 26.9°C in February. The region is the coldest during July with temperatures of 4.3°C on average during the night (www.saexplorer.co.za/south-africa/climate).

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, because of a relative dry spell, many of the bulb and annual flowers were not 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 through the site (Refer to Figure 3) 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 3: Showing the larger area investigated (yellow paths) for the proposed development footprint

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 falls within a vegetation type known as Namaqualand Klipkoppe Shrubland (Refer to Figure 4), a vegetation type classified as "Least Threatened", according to the National list of ecosystems that are threatened and in need of protection (GN 1002, 9 December 2011). However, at present only some 6% of a targeted 28% is statutorily conserved in Namaqua National Park (incl. former WWF Skilpad Wild Flower Reserve), Goegab Nature Reserve, and a small portion in the Moedverloren Nature Reserve.

The vegetation is largely without alien invader species and very little has been transformed by agriculture (because of the steep rocky habitats), but old mine spoils (mainly copper) are a disturbing view in some localities. Erosion is moderate (35%), very low (35%) or low (30%). Namaqualand Klipkoppe Shrubland is found both in the Western and Northern Cape Provinces in the Central and north-central regions of the Namaqualand spanning Steinkopf in the north and Nuwerus in the south at altitudes varying between 120 – 1 260 m (Mucina & Rutherford, 2006).

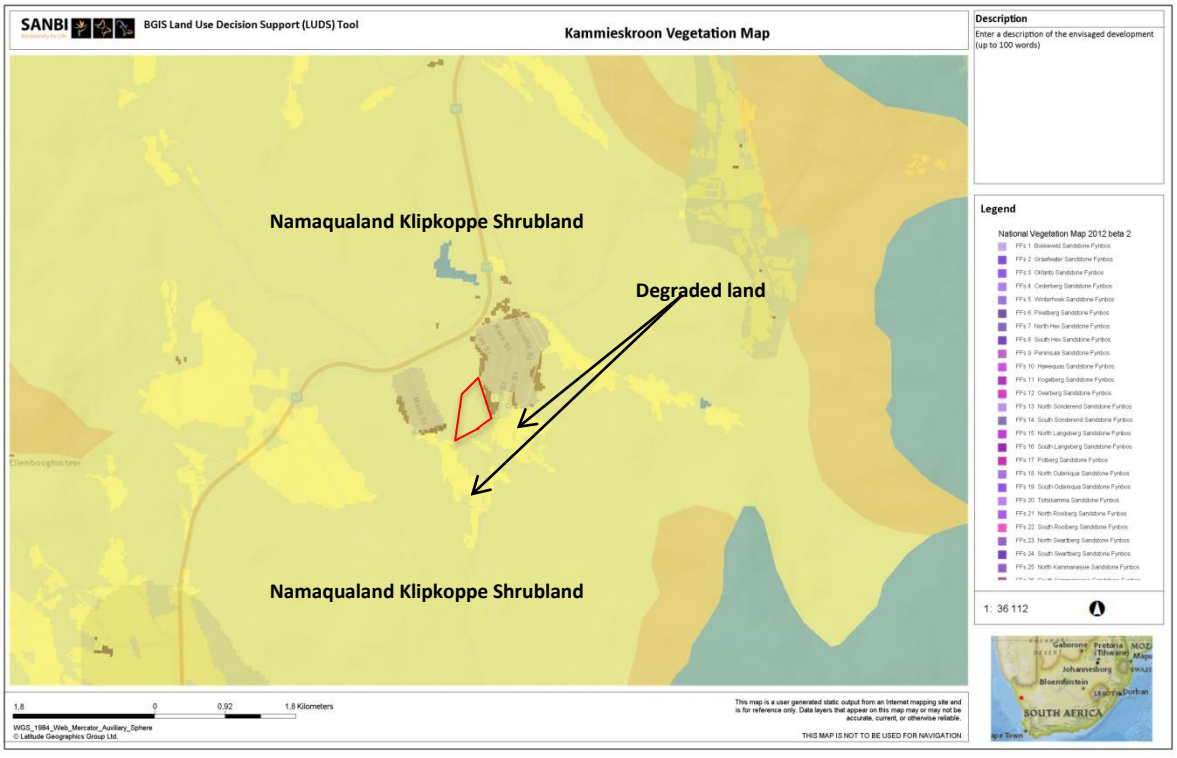

Figure 4: Vegetation map of South Africa (2012 beta 2 version), showing the larger study area

The landscape features dramatic huge granite and gneiss domes, smooth glacis and also disintegrating boulder koppies, which supports an open shrubland up to 1 m tall, dominated by shrubs of dwarf to medium stature and with ericoid or succulent leaves. Scattered kokerboom trees (*Aloidendron dichotomum*) can be found mostly on north-facing slopes. Flat or gently 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) consists of 1–3 m tall shrubs with non-succulent leaves and canopy cover reaching 40–100%.

5.2. CRITICAL BIODIVERSITY AREAS MAPS

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.

The use of CBA's in the NDM follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008):

- **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 Namakwa District Biodiversity Sector Plan (NDBSP) 2008, gives both aquatic and terrestrial Critical Biodiversity Areas (CBAs) and ecological support areas for the Namakwa District Municipality. According to the

NDBSP, the proposed development **will not impact** (does not fall within) on any ecological support area or any critical biodiversity area (Refer to Figure 5).

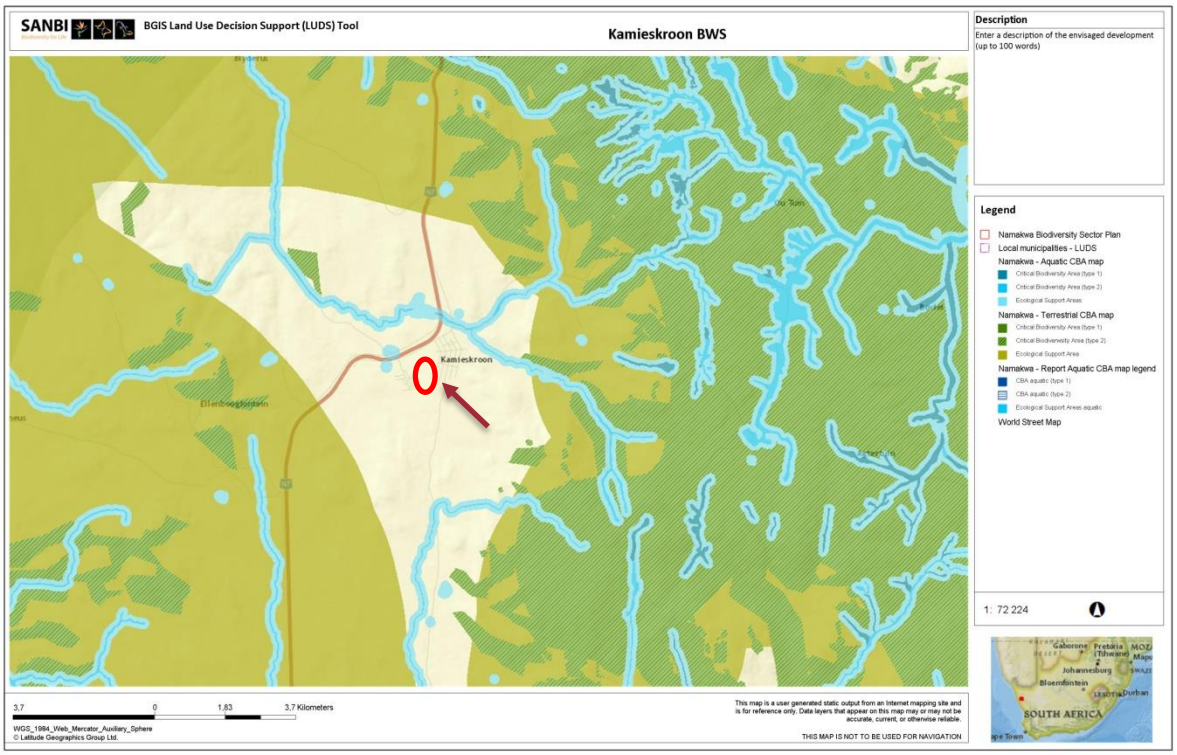

Figure 5: The Namakwa District Biodiversity Sector Plan (2008) indicating the location of the development (red)

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 6). 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). 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

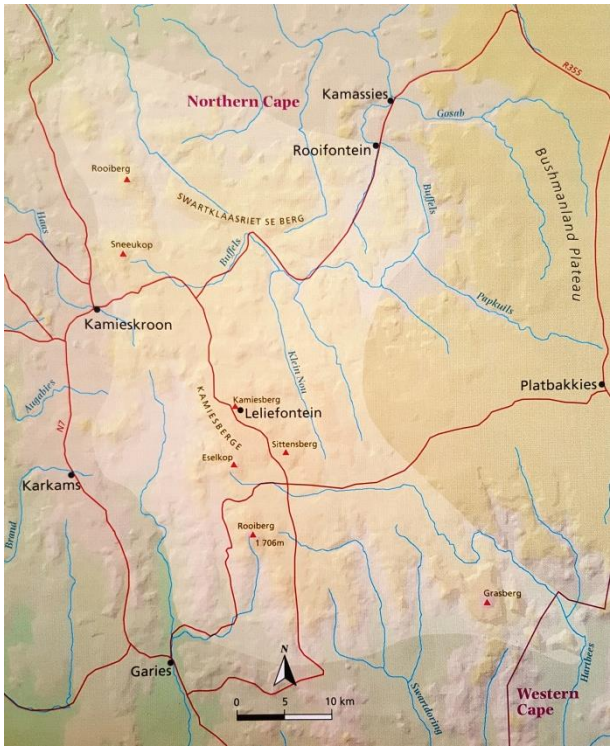

Figure 6: Kamiesberg Centre of endemism (highlighted), taken from Van Wyk & Smith (2001)

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).

Kamieskroon and the proposed location of the proposed development falls just west of the Kamiesberg Centre and is not expected to have any direct impact on the specific centre of endemism.

5.4. VEGETATION ENCOUNTERED

The study site is located between two portions of the Town of Kamieskroon (Refer to Figure 2) and within Municipal land generally associated as being part of the larger footprint of the town. As a result it was expected that the site would be in poor condition (botanically speaking) as a result of urban activities together with informal grazing practices. Although this was true for the northern part of the study area, with its numerous footpaths, the southern portion of the study area was still in relative good shape (although some of the open areas does show signs of previous impacts). Unfortunately, at the time of the site visit many of the bulb and annual plants were not in flower or identifiable, and as a result it is likely that a number of species may have been missed. However, the author is confident that a fairly good understanding of the vegetation and its status was obtained.

The study area showed typical Namaqualand Klipkoppe Shrubland located on the western slopes of a rocky outcrop, characterized by boulders and domes, slowly being weathered into course sand. A few open sandy areas were also encountered in between the rocks and domes (Photo 1 & 2). Typically the vegetation showed structural and species composition differences between the rocky and sandy areas.

The sandy patches was normally were covered by a medium high (0.5 – 0.8 m) shrub layer dominated by *Galenia africana*, *Leipoldtia schultzei* and one of the *Rushia* species (likely *Rushia* cf. *muelleri*). Vegetation cover ranged from 40% to 60%, but was normally more towards the 60% range (Photo 1). Other species that was also encountered in the sandy patches and also in between the rocky outcrops included: *Asparagus capensis*, *Ballota africana*, *Cheiridopsis denticulata, Didelta spinosa, Eriocephalus microphyllus, Euphorbia mauritanica, Euphorbia rhombifolia, Hermannia amoena, Limonium sinuatum, Lycium cinereum, Manochlamys*

albicans, Melianthus pectinatus, Montinia caryophyllacea, Peliostomum virgatum, Pteronia species*, Searsia horrida, Searsia undulata Thesium lineatum* and *Tylecodon wallichii.*

Photo 1: Typical veld encountered on sandy patches in-betweens rocky outcrops. Note dense stands of *Leipoldtia schultzei* intermingled with *Galenia africana.*

In the larger footprint there were also a number of areas showing definite signs of disturbance (Photo 2). The reasons for these disturbances were not easy to detect but is most likely due to fire coupled with continual grazing. Because of the aridness of the area, disturbances will take a long time to correct. Once the vegetation has been opened (for example by fire), these sites is likely to be more attractive to livestock, especially after rains when grasses will tend to dominate these patches. As a result these patches will be subject to continual heavier grazing pressure, which means that as long as grazing pressure remains, it is unlikely to rehabilitate without intervention. On the other hands these open patches are also the same sites that might be covered by extended carpets of bright orange, yellow or white annual flowers, the same flowers that has become such signature feature of the Namaqualand and that are fuelling the tourist industry.

Photo 2: A typical disturbed sandy patch as was also frequently encountered within the larger study area. In these sites the vegetation cover drops significantly and was almost always dominated by the pioneer species, *Galenia africana,* or Kraalbos as it is commonly known.

Between larger boulders and at the foot of rocky sheets (where run-off water will collect) fringe vegetation were encountered, which supported a taller (1-2m high) shrub layer with non-succulent leaves and a denser canopy cover reaching 80 – 90% (Picture 3 & 4). Species commonly found within this fringe layer includes: *Calobota sericea, Euclea tomentosa, Montinia caryophyllacea, Ozoroa dispar, Searsia horrida* and *Searsia undulata.*

Photo 3: One of the rocky sheets encountered throughout the larger site. Note the fringe vegetation along the bottom edges of the rocky sheet.

Photo 4: A further photo showing a rocky sheet and boulders within the larger footprint.

Photo 5: Shows the area, identified as the proposed development Site 1. Unfortunately, as can be seen in this photo (and Figure 6), the proposed Site 1 overlaps one of the rocky patches. However, just above the Proposed Site 1 a much better suited area within a disturbed sandy patch was encountered (Refer to Waypoint 0952 in Figure 6 and Photo 6 underneath).

Figure 7: Google image indicating areas of higher disturbance (orange) that may be better suited for development and rocky patches (white). The orange patches has been marked from 1 to 3, where 1 should be the first choice and 3 the last from a botanical perspective (1 being the most disturbed and 3 the least).

Photo 6: A sandy open area, just slightly uphill from Site 1 (Refer to waypoint 0952 in Figure 6), which might be better suited than the proposed Site 1. Site 1 is overlaps a very rocky area and the vegetation are also in much better state.

Photo 7: The proposed Site 2 (Refer to Figure 6 for its location). The area overlaps a relative disturbed area, but is also very near to the most frequently used footpaths between the two portions of Kamieskroon.

Photo 8: During the site visit a further site (Marked with a Red 1, on Figure 6) was observed by the author. This area is already quite disturbed and was used at some time for the illegal dumping of building rubble. If large enough this area might also be considered as a potential development site.

5.4.1. Potential areas for development

Figure 6 shows the larger area that was considered by the engineers for the proposed development footprint. It also indicates two areas considered by the engineers for potential placement of the infrastructure, namely Site 1 and Site 2 (marked with yellow pincushions in Figure 6). During the site visit the whole of the area was walked, noting areas of larger disturbance and areas that are in a more natural state or undisturbed. As mentioned, the overall condition of the veld was better than expected, but a number of open sandy areas was also observed, which in general was much more disturbed and with a much lower vegetation cover (although it is still likely to support annual herbs and bulbs).

Purely from a botanical viewpoint, these disturbed areas were considered better suited for the proposed development in order to minimize the impacts on more pristine vegetation. Three such areas were identified (Refer to the orange areas in Figure 6), marked in red from 1 to 3. Of these areas, site 1 (Photo 8) is the most disturbed and should be considered as a first choice for development. However, this site is also squeezed in between rocky areas, which might make it difficult to fit the entire infrastructure.

Should Option 1 not be suitable, option 2 should be considered, with option 3 as the last option (being in best condition of the three, and also surrounded by vegetation in very good condition.

Please note that a few alien invasive plants were also observed, namely a number of smaller *Prosopis* trees as well as few larger *Eucalyptus* trees (e.g. Photo 7).

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 on the proposed footprint and its immediate surroundings

No.	Species name	FAMILY	Status NFA, NCNCA	SA Red list status (V 2015/1)	Alien & invader species (AIS)
1.	*Asparagus capensis*	ASPARAGACEAE		LC	
2.	*Ballota africana*	ASTERACEAE		LC	
3.	*Calobota sericea*	FABACEAE		LC	
4.	*Cheiridopsis denticulata*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
5.	*Didelta spinosa*	ASTERACEAE		LC	
6.	*Eriocephalus microphyllus*	ASTERACEAE		LC	
7.	*Eucalyptus* species	MYRTACEAE		Alien plant	**CARA Cat. 2 invader NEMBA Not listed in Nama Karoo**
8.	*Euclea tomentosa*	EBEMACEAE		LC	
9.	*Euphorbia mauritanica*	EUPHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
10.	*Euphorbia rhombifolia*	EUHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
11.	*Galenia africana*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	

No.	Species name	FAMILY	Status NFA, NCNCA	SA Red list status (V 2015/1)	Alien & invader species (AIS)
12.	*Hermannia amoena*	MALVACEAE		LC	
13.	*Leipoldtia schultzei*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
14.	*Limonium sinuatum*	PLUMBAINACEAE		Alien plant	Naturalised species
15.	*Lycium cinereum*	SOLANACEAE		LC	
16.	*Manochlamys albicans*	AMARANTHACEAE		LC	
17.	*Melianthus pectinatus*	MELIANTHACEAE		LC	
18.	*Massonia depressa*	HYACINTHACEAE		LC	
19.	*Montinia caryophyllacea*	MONTINIACEAE		LC	
20.	*Ozoroa dispar*	ANACARDIACEAE		LC	
21.	*Prosopis glandulosa*	FABACEAE		Alien plant	**CARA Cat. 2 invader** **NEMBA Cat. 3 AIP (in Northern Cape)**
22.	*Pteronia species*	ASTERACEAE		LC	
23.	*Peliostomum virgatum*	SCROPHULARIACEAE		LC	
24.	*Ruschia* cf. *muelleri*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
25.	*Searsia horrida*	ANACARDIACEAE		LC	
26.	*Searsia undulata*	ANACARDIACEAE		LC	
27.	*Senecio* cf. *cardaminifolius*	ASTERACEAE		LC	
28.	*Thesium lineatum*	SANTALACEAE		LC	
29.	*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 (Refer to **Error! Reference source not found.**) 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	RECOMENDATIONS
1.	*Cheiridopsis denticulata* **Schedule 2 protected**	All species in the family Aizoaceae protected by default. Locally common.	Species protection through topsoil conservation.
2.	*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.
3.	*Euphorbia rhombifolia* **Schedule 2 protected**	All species in the genus *Euphorbia* protected by default. Only observed occasionally.	Larger *Euphorbia* transplant poorly. Species protection through topsoil conservation.
4.	*Galenia africana* **Schedule 2 protected**	All species in the family Aizoaceae protected by default. Plant a common weedy species.	This is a pioneer species, common in the Namaqualand. Protection through topsoil conservation.

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
5.	*Leipoldtia schultzei* **Schedule 2 protected**	All species in the family *Aizoaceae* protected by default. Locally common.	Species protection through topsoil conservation.
6.	*Ruschia* cf. *muelleri* **Schedule 2 protected**	All species in the family Aizoaceae protected by default. Locally common.	Species protection through topsoil conservation.
7.	*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 he 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 Klipkoppe Shrubland is part of the Succulent-Karoo Biome (Mucina *et al*., 2006). The Succulent Karoo is strongly influence by winter rainfall and fog and 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. The 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 in 90% of the region. Before widespread human settlement indigenous antelope would have migrated across the landscape in search of grazing, no doubt having an overall positive influence on biodiversity. However, fences, permanent watering points and high domestic stock densities almost certainly led to degradation, loss of vegetation cover, 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 2-3 ha of natural vegetation on the side slopes of a small koppie, within the urban edge of Kamieskroon.

7.1. CONSERVATION VALUE

The proposed larger development footprint falls within the Kamieskroon urban edge and is located between two sections of the town. However, it is also located on the gentle slopes of a small koppie, which has, to a large degree, protected the footprint from the brunt of direct impacts, (normally associated with an urban area) and as a result the vegetation encountered remains in remarkable good condition.

Vegetation status: Namaqualand Klipkoppe Shrubland is considered least threatened, but it is also poorly protected and much still needs to be done to reach the conservation goal of 28%. However, the proposed site does not fall within any CBA or ESA identified within the Namakwa District Biodiversity Sector Plan (meaning, that the footprint does not fall within an area earmarked for conservation).

CBA or ESA: According to the Namakwa District Biodiversity Sector Plan, the site is not located within a CBA or an ESA and is thus not currently earmarked for conservation in order to achieve conservation targets.

Connectivity: The vegetation of the larger footprint is still fairly well connected to the north, but is mostly impeded to the east and west, by urban development and to the south by intensive agriculture.

Centres of endemism: Kamieskroon (and the potential footprint) is located near to, but falls outside of the Kamiesberg Centre (KBC) of endemism and will not have any direct impact on the KBC.

Other: The site visit showed no other significant geographical features such as watercourses, wetlands, true quarts patches or heuweltjies within the proposed footprint.

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")	2	1	2	1	1	10	2	1	2	1	1	10	No special features encountered. The impact on geology and soils is expected to be very low. No mitigation required.
Land use and cover.	Possible impact on socio-economic activities as a result of the physical footprint or associated activities.	1	3	3	1	1	8	1	2	2	1	1	6	The proposed development will impact on a small area potential used for grazing by the local population, but the loss of grazing should be barely perceptible within the larger property.
Vegetation status	Possible loss of vulnerable or endangered vegetation and associated habitat.	2	1	2	1	1	10	2	1	2	1	1	10	Namaqualand Klipkoppe Shrubland is considered least threatened, but it is also poorly protected and much still needs to be done to reach the conservation goal of 28%. However, the proposed site does not fall within any CBA or ESA identified within the Namakwa District Biodiversity Sector Plan (meaning, that the footprint does not fall within an area earmarked for conservation).
Conservation priority areas	Possible impact on Protected areas, CBA, ESA or centres of endemism.	2	1	1	1	1	8	2	1	1	1	1	8	According to the Namakwa District Biodiversity Sector Plan, the site is not located within a CBA or an ESA and is thus not currently earmarked for conservation in order to achieve conservation targets. Kamieskroon (and the potential footprint) is located near to, but falls outside of the Kamiesberg Centre (KBC) of endemism and will not have any direct impact on the KBC.
Connectivity	Possible loss of identified terrestrial and aquatic critical biodiversity areas, ecological support areas or ecological corridors.	2	2	2	1	1	12	2	1	1	1	1	8	The vegetation of the larger footprint is still fairly well connected to the north, but is mostly impeded to the east and west, by urban development and to the south by intensive agriculture.
Watercourses and wetlands	Possible impact on natural water resources and its associated ecosystem.	0					0	0					0	Not applicable
Flora	Potential impact on threatened or protected plant species.	3	3	4	2	2	33	3	2	2	1	2	21	No, NEM:BA, NFA protected or red-listed plant species were observed. However, 7 NCNCA protected species was encountered, of which one is considered a weedy pioneer and one is recommended for Search & Rescue. Please note that almost all of these plants are relative common species not considered rare or endangered.
Invasive alien	Possible alien infestation as	1	2	4	2	2	10	1	1	1	1	1	4	Alien infestation very low, but both species are listed in terms of

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig. before Mit.	CV	Lik	Dur	Ext	Sev	Sig. after Mit.	Short discussion
species	a result of activities.													National legislation and must be eradicated.
Veld fire	The risk of veld fires as a result of the proposed activities.	2	3	4	3	3	26	2	2	2	2	3	18	Veld fire risk is considered high and must be addressed appropriately through the construction EMP.
Accumulative	Accumulative impact associated with the proposed activity.	3	3	4	3	3	39	3	2	2	2	3	27	The overall impact is considered to be relatively low, because of the small size, but good environmental control during construction is imperative.
No-Go alternative	Potential environmental impact associated with the no-go alternative.	2	3	4	2	2	22	2	**Mitigation not applicable.**					The above impacts will not occur, and the status quo will remain (livestock grazing as the main land use).

According to the impact assessment given in Table 6 above, it is clear that the accumulated impact, even before mitigation, is regarded as Medium Low. It is also expected that through mitigation the cumulative can be reduced to Low. The most significant aspects of the proposed development are regarded as the potential impact on NCNCA protected plant species and the risk of potential veld fires (and its subsequent impact on veld and flora).

Taken the above into consideration it is 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.

The following impact minimisation recommendations should also be considered as part of the construction phase:

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- 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 and requirements of the any competent authority.
- Purely from a botanical viewpoint, the disturbed areas identified in Figure 6 should be first consideration for the placement of the proposed infrastructure in order to minimize the impacts on more pristine vegetation. Three such areas were identified (Refer to the orange areas in Figure 6), marked in red from 1 to 3. Of these areas, site 1 (Photo 8) is the most disturbed and should be considered as a first choice for development. However, this site is also squeezed in between rocky areas, which might make it difficult to fit the entire infrastructure. Should Option 1 not be suitable, option 2 should be considered, with option 3 as the last option (being surrounded by vegetation in very good condition.
- 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.
- 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 alien plants must be removed from within the construction footprint and immediate surroundings.
- 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.

9. REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Mem. Bot. Surv. .S. Afr*. No. 28: 1-192.

Anon, 2008. Guideline regarding the determination of bioregions and the preparation and publication of Bioregional Plans. April 2008. Government Notice No. 291 of 16 March 2009.

De Villiers C.C., Driver, A., Brownlie, S., Clark, B., Day, E.G., Euston-Brown, D.I.W., Helme, N.A., Holmes, P.M., Job, N. & Rebelo, A.B. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

DEAT, 2002. Impact significance. Integrated Environmental Management, Information series 5. Department of Environmental Affairs and Tourism (DEAT). Pretoria.

Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria

Driver, A., Maze, K., Rouget, M., Lombard, A.T., Nel, J.L., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. 2005. National spatial biodiversity assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia, 17. South African National Biodiversity Institute, Pretoria.

Edwards, R. 2011. Environmental impact assessment method. Unpublished report for SiVest (Pty) Ltd. Environmental division. 9 May 2011.

Le Roux, A. 2015. Wild flowers of Namaqualand. A botanical society guide. Fourth revised edition. Struik Nature. Cape Town.

Low, A.B. & Rebelo, A.(T.)G. (eds.) 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Manning, J. 2008. Namaqualand Eco Guide. Briza Publications. Pretoria

Mucina, L. & Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Mucina, L., Jürgens, N., Le Roux, A., Rutherford, M.C., Schmiedel, U., Esler, K.J., Powrie, L.W., Desmet, P.G., and Milton, S.J. 2006. Succulent Karoo Biome. In Mucina, L. & Rutherford, M.C. 2006. (eds.) The Vegetation of South Africa. Lesotho & Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria. Pp. 221 – 299

NDBSP. 2008. Namakwa District Biodiversity Sector Plan. A report compiled for the Namaqualand District Municipality in order to ensure that biodiversity information can be accessed and utilized by local municipalities within the Namakwa District Municipality (NDM) to inform land use planning and development as well as decision making processes within the NDM.

Rouget, M., Reyers, B., Jonas, Z., Desmet, P., Driver, A., Maze, K., Egoh, B. & Cowling, R.M. 2004. South Africa National Spatial Biodiversity Assessment 2004: Technical report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.

SANBI. 2006. South African National Botanical Institute: Biodiversity GIS Home. http://bgis.sanbi.org (as updated).

SANBI. 2015. Statistics: Red List of South African Plants version (as updated). Downloaded from Redlist.sanbi.org on 2017/06/15.

Van Wyk, A.E., & Smith, G.F. 2001. Regions of floristic endemism in South Africa. A review with emphasis on succulents. Umdaus press. Hatfield.