ONSEEPKANS AGRICULTURAL DEVELOPMENT

The proposed development of ±250 ha of new agricultural land at Onseepkans (Northern Cape Province)

BIODIVERSITY & BOTANICAL SCAN

A biodiversity scan of areas that will be affected by the proposed development.

22 March, 2017

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INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant to BVi Engineers 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 QUALITFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of 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 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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SUMMARY - MAIN CONCLUSIONS

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SUMMARY OF POSSIBLE SIGNIFICANT BIODIVERSITY FEATURES

Having evaluated and discussed the various biodiversity aspects associated with the proposed development, the most significant biodiversity features that might be impacted identified are:

- The rocky hills and outcrops with its diverse and potentially wide range of habitats, which again results in higher potential biodiversity associated with the Eastern Gariep Rocky Desert vegetation type.
- The fact that the larger Onseepkans area falls within the Gariep Centre of endemism (primarily as a result of the diverse rocky outcrops).
- The fact that all of the sites falls within an ecological support area (ESA), while Expansion site B might also potentially impact on a critical biodiversity area (CBA) of expert importance.
- The potential impact on protected species, especially a number of *Boscia albitrunca* and *Boscia foetida* trees.
- The potential impact on fauna associated with the surrounding rocky outcrops.

However, the botanical scan suggest that it is highly unlikely that the proposed development footprint will impact on Eastern Gariep Rocky Desert vegetation, which also mean that it will not impact on the rocky hills and outcrops (with its higher potential biodiversity status). It also means that it is unlikely to have any significant impact on the Gariep Centre of endemism. However, a number of protected tree species are likely to be impacted (even though most of them are in poor condition to begin with), but with mitigation the impacts on these trees can be reduced significantly.

Taken the above into consideration it is highly unlikely that the proposed project will contribute significantly to any of the following:

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

Significance before mitigation: The impact assessment suggests that the proposed development is expected to have **Medium-high cumulative** potential impact, with the most significant aspect being the potential impact on the sensitive habitat associated with the Eastern Gariep Rocky Desert vegetation type (which is also the main reason for the area being included in the Gariep Centre of endemism) and protected species (mainly tree species) encountered within the site and to a lesser degree potential accidental veld fires.

Significance after mitigation: The site visit confirmed that it is very unlikely that the proposed development will impact on Eastern Gariep Rocky Vegetation and its potentially much more diverse biodiversity. Impacts on protected tree species can also be minimised through slight layout adjustments. The potential impact on the regional status of the vegetation type and associated biodiversity features (e.g. corridor function or special habitats) will also be minimised through the above mitigations. Apart from the potential impact on protected species no further irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the proposed agricultural development. With mitigation the potential impacts on biodiversity features can be reduced to **Low**.

RECOMMENDATION

It is expected that the upgrade will result in improved water conservation and management and will also lead to visual and environmental improvement. In addition, and probably the most significant positive of the proposed canal would be the fact that the proposed upgrade will minimise future maintenance work (and thus negate the current regular disturbance resulting from working with heavy machinery next to the Orange River).

With the available information to the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

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1. INTRODUCTION

Onseepkans is a small settlement on the banks of the Orange River in Northern Cape Province, South Africa, which also acts as a border post with Namibia for traffic between Pofadder in South Africa and Keetmanshoop in Namibia. Onseepkans was established in approximately 1916 by missionary settlers and relies almost exclusively on irrigated lands supplied with water from the Orange River. The Department of Agriculture, Land Reform and Rural Development is the process of upgrading the bulk water supply system at Onseepkans. At the same time the Department of Agriculture also proposes to unlock, stimulate and expand the agricultural potential of Onseepkans (once the bulk water system is in place) by promoting the re-establishment of crops on the existing agricultural land and also the establishment of additional agricultural land for production of high value crops **outside of the flood plain areas (away from the Orange River)**.

The primary objective of the proposed development project at Onseepkans centres on economic growth, job creation and economic empowerment, through revitalization the agricultural potential of existing agricultural land (flood plains) and the development of approximately 250 ha of new agricultural land (spread over 3 locations) into an intensive export table grape production unit.

The applicant is the Department of Agriculture, Land Reform and Rural Development. EnviroAfrica CC has been appointed as the independent environmental assessment practitioner (EAP) responsible for undertaking the relevant EIA and the Public Participation Process required in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA). Since the three proposed new development areas are still covered by natural veld a Biodiversity Scan of the proposed location was commissioned in order to evaluate the environmental impact(s) of the proposed project and to establish whether further and more in depth studies would be required.

This study focuses only on the three (3) areas that will be impacted by the proposed development of the new 250 ha of agricultural land.

1.1 TERMS OF REFERENCE

EnviroAfrica (Pty) Ltd was appointed by BVi Consulting Engineers (Upington) as the independent Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a Biodiversity and Botanical Scan of the proposed site.

PB Consult was appointed within the following terms of reference:

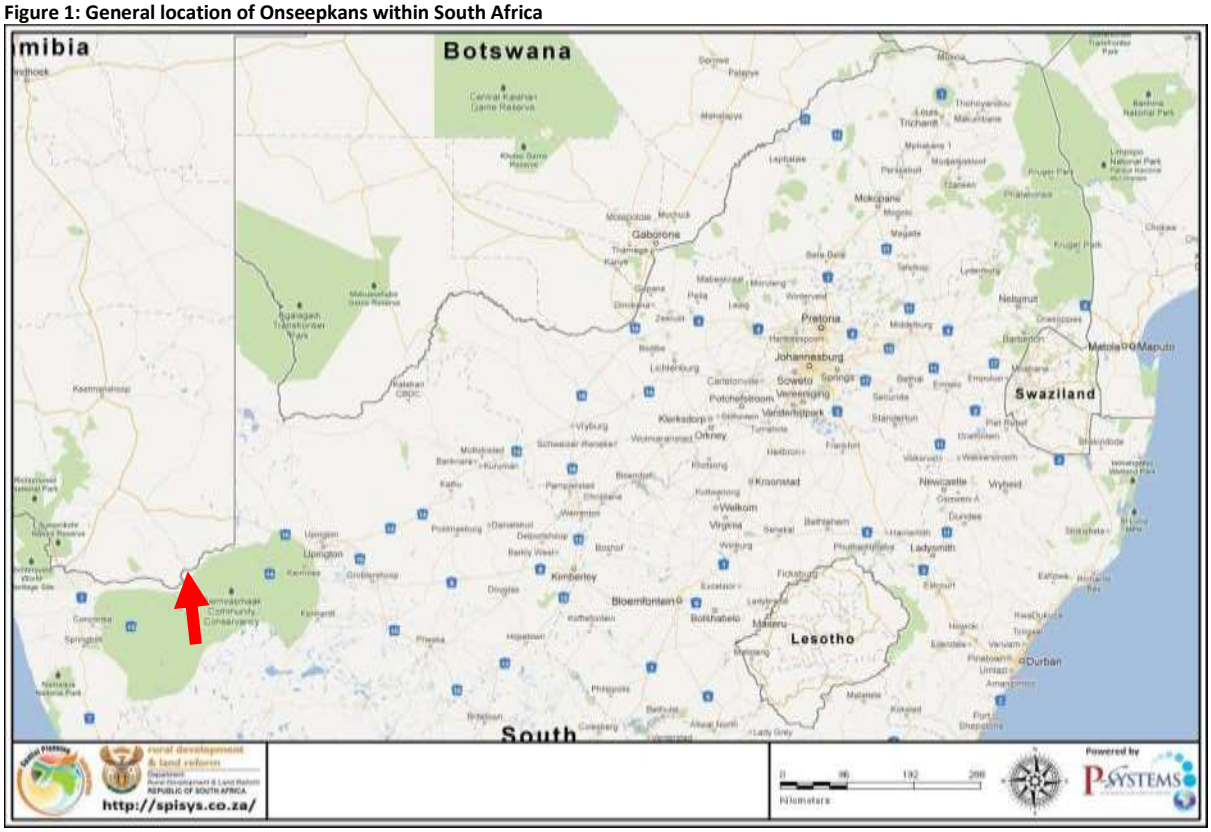
- Evaluate the proposed site in order to determine whether any significant biodiversity or botanical features will be impacted as a result of the proposed development.

- Make recommendations on impact minimisation should it be required
-
- Consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

1.2 LOCATION & LAYOUT

Onseepkans is a small settlement on the banks of the Orange River in Northern Cape Province, South Africa (Figure 1). It is a border post with Namibia for traffic between Pofadder in South Africa and Keetmanshoop in Namibia. The settlement is located within the Khai-Ma Local Municipality (Namakwa District Municipality) of the Northern Cape Province, approximately 50 km due north of Pofadder and 220 Northwest of Upington.

Figure 1: General location of Onseepkans within South Africa



The Department of Agriculture, Land Reform and Rural Development proposes invest in the revitalisation of the agricultural potential of the larger Onseepkans Settlement with the main aim of job creation, poverty relieve and social investment. This includes two aspects of development namely:

- Firstly – revitalising the agricultural potential of approximately 300 ha of **existing agricultural land** (mainly within the flood plains) (NB, which is not part of this scan).
- Secondly - The development of approximately 250 ha of additional agricultural land outside of the floodplain area (this study).

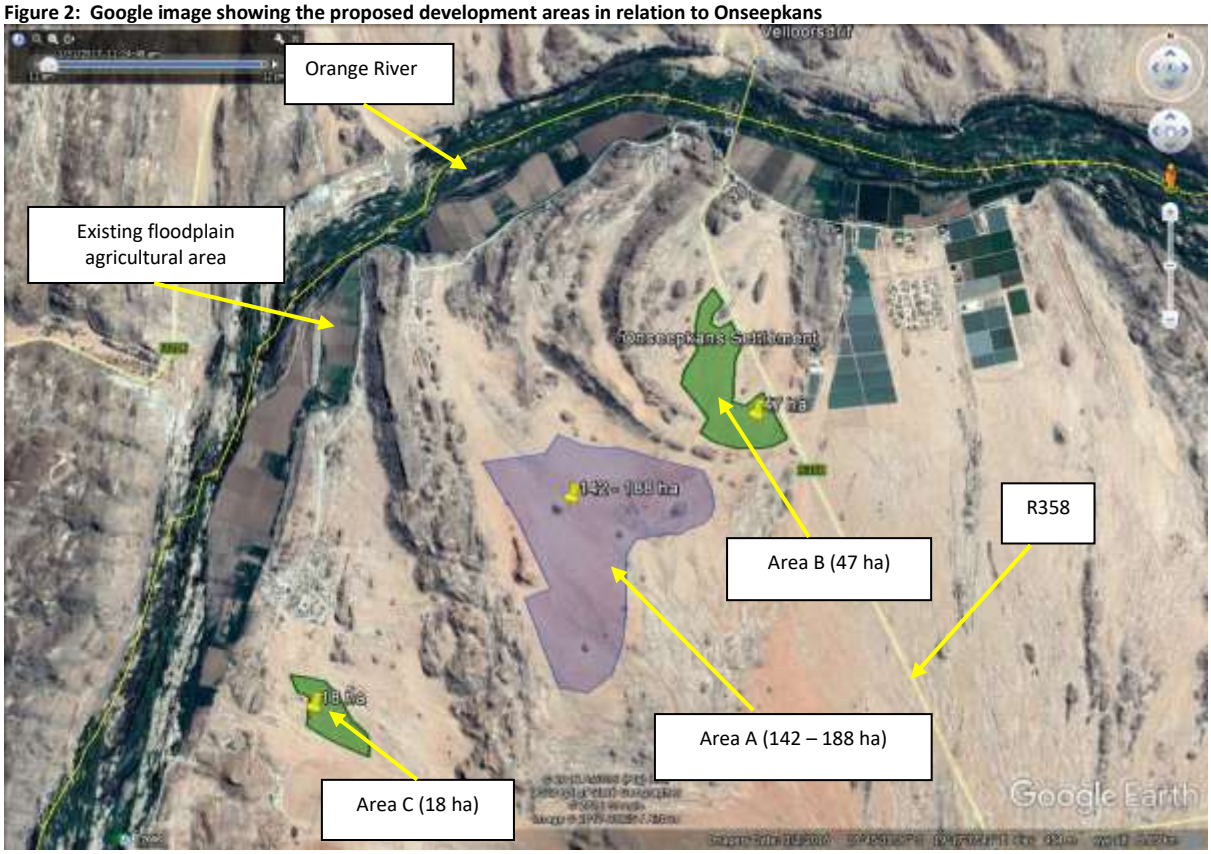
The new agricultural area will consist of three (3) areas (Figure 3), namely;

- Expansion area A (between 142 – 188 ha);
- Expansion area B (± 47 ha); and
- Expansion area C (18 ha)

Table 1: GPS coordinates for the proposed Onseepkans agri developments (using midpoints)

DESCRIPTION	Farm Name	LATITUDE AND LONGITUDE
Expansion Area A (142 – 188 ha)	Rem. Farm 88, Onseepkans	S28° 45' 58.6" E19° 17' 32.8"
Expansion Area B (47 ha)	Rem. Farm 88, Onseepkans	S28° 45' 24.0" E19° 18' 11.2"
Expansion Area C (18 ha)	Rem. Farm 88, Onseepkans	S28° 46' 47.2" E19° 16' 14.9"

Figure 2: Google image showing the proposed development areas in relation to Onseepkans



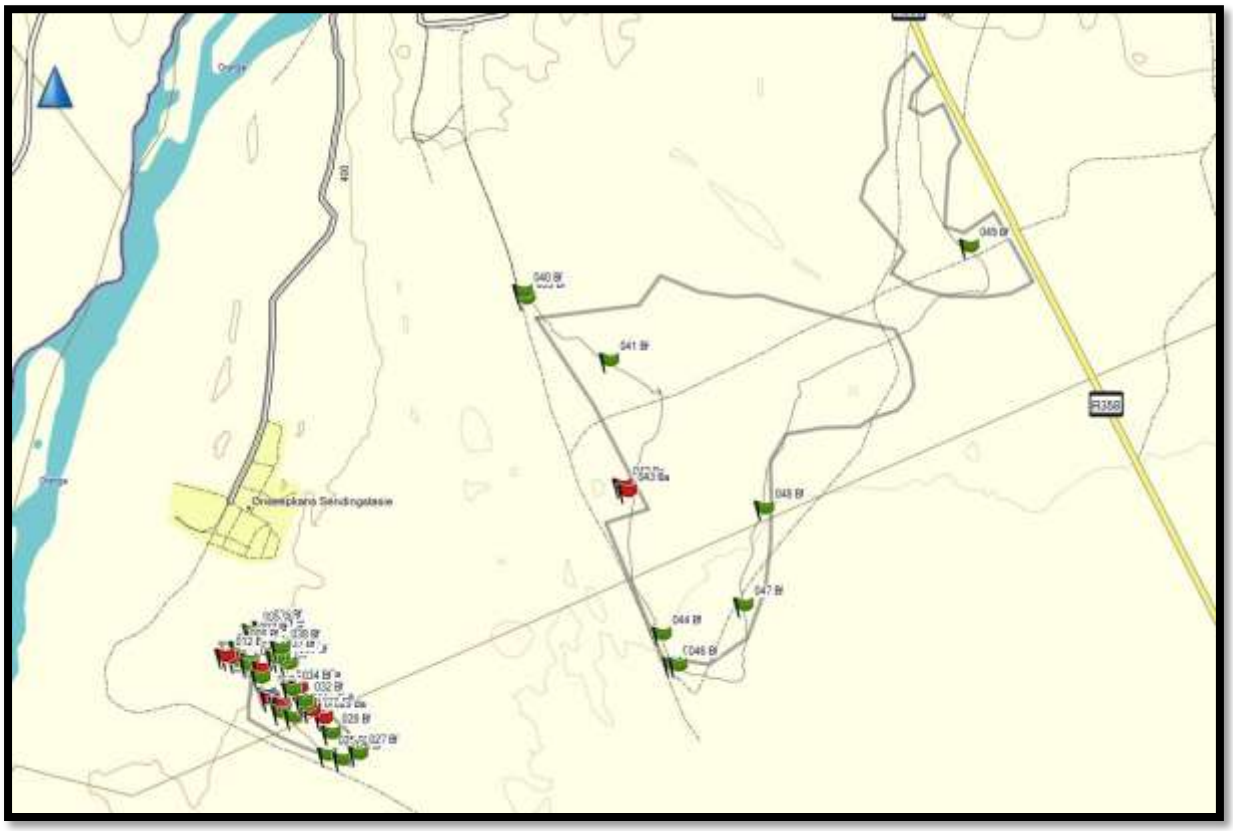
The land under consideration is owned by the municipality and does not require to be procured in the open market. From an engineering point of view, the proposed locations are preferred due to the favourable soil and specifically accessibility. The sites are also in close proximity to the source of water (Orange River).

1.3 METHODS

Desktop studies were conducted, coupled by physical site visits. The original site visit was done during November 2015 coupled with a follow-up site visit during February 2016. The site visit compromises walking the site, examining and photographing any area of interest, aiming 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).

During the site visit and desktop studies, a fairly good understanding of the environment was achieved. The timing of the site visit was reasonable in that essentially all perennial plants were identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

Figure 3: Map showing the proposed development areas and points of interest identified during the site visits



2. APPLICABLE LEGISLATION

Constitution of the Republic of South Africa (1996): of special relevance in terms of environment is section 24

Conservation of Agricultural Resources Act 43 of 1983 (CARA): supports conservation of natural agricultural resources (soil, water, plant biodiversity) by maintaining the production potential of the land and combating/preventing erosion; for example, by controlling or eradicating declared weeds and invader plants.

Hazardous Substances Act 15 of 1973: to control substances that may cause injury, ill-health, or death through their toxic, corrosive, irritant, strongly sensitizing or flammable nature, or by the generation of pressure

National Environmental Management Act 107 of 1998 (as amended): replaces the Environmental Conservation Act (ECA) and establishes principles for decision-making on matters affecting the environment, and for matters connected therewith.

- **Environmental Impact Assessment Regulations** (2014): procedures to be followed for application to conduct a listed activity.

National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA): replaces the Atmospheric Pollution Prevention Act (No. 45 of 1965).

National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA): supports conservation of plant and animal biodiversity, including the soil and water upon which it depends.

- **National list of ecosystems that are threatened and in need of protection** (GN 1002 of 9 December 2011).
- **Alien and invasive species list 2016** (GN R. 864 of 29 July 2016).

National Environmental Management: Protected Areas Act 57 of 2003 (as amended Act 31 of 2004) (NEMPAA): To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.

National Environmental Management: Waste Act 59 of 2008 (NEMWA): To reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

- **List of Waste Management Activities that have, or are likely to have a detrimental effect on the environment** (GN 718 of 3 July 2009): Identifies activities in respect of which a waste management license is required.

National Forests Act 84 of 1998 (as amended): supports sustainable forest management and the restructuring of the forestry sector.

- **List of protected tree species** (as updated)

National Heritage Resources Act 25 of 1999: supports an integrated and interactive system for the management of national heritage resources, including supports soil, water and animal and plant biodiversity.

National Veld and Forest Fire Act 101 of 1998 (NVFFA): protects soil, water and plant life through the prevention and combating of veld, forest, and mountain fires

National Water Act 36 of 1998 (NWA): promotes the protection, use, development, conservation, management, and control of water resources in a sustainable and equitable manner.

Northern Cape Nature Conservation Act 9 of 2009 (NCNCA): To provide 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.

3. DEFINITIONS & ABBREVIATIONS

3.1 DEFINITIONS

Construction: means the period of the project during which the actual works are carried out, deemed to include site establishment, site preparation, the works, maintenance period and decommissioning.

Construction site: means the area influenced and affected by the construction activities or under the control of the Contractor often referred to as "the Site".

Contaminated water: means water contaminated by the Contractor's activities, *e.g.* concrete water and runoff from plant/ personnel wash areas.

Environment: means the surroundings within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part of the combination of the above two bullets and the interrelationships between them;
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being

Environmental Aspect: any element of any construction activity, product or services that can interact with the environment.

Environmental Control Officer: a suitably qualified environmental agent responsible for overseeing the environmental aspects of the Construction phase of the EMP.

Environmental Impact: any change to the environment, whether adverse or beneficial, wholly or partially resulting from any construction activity, product or services.

No-Go Area(s): an area of such (environmental/aesthetical) importance that no person or activity are allowed within a designated boundary surrounding this area.

Owner: the owner, or dedicated person, responsible for the management of the property on which the proposed activity will be performed.

Solid waste: means all solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Precautionary principle: means the basic principle, that when in doubt or having insufficient or unreliable information on which to base a decision, to then limit activities in order to minimise any possible environmental impact.

Watercourse: in this report the author uses a very simplified classification system to define the difference between rivers, streams or a drainage lines encountered in the Northern Cape.

- River: A river is a natural watercourse with a riverbed wider than 3m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Stream: A small river or natural watercourse with a riverbed of less than 3 m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Drainage line: A very small and poorly defined watercourse, mostly on relatively flat areas, which only flows for a short period after heavy rains, usually feeding into a stream or river or dries up completely before reaching another body of water.

3.2 ABBREVIATIONS

AIP	Alien and invasive plants
AIS	Alien and invasive species
BGIS	Biodiversity Geographical Information System
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
GWC	Griqualand West Centre of endemism
IDP	Integrated development plan
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NEMA	National Environmental Management Act, Act 107 of 1998
NEMAQA	National Environmental Management Air Quality Act 39 of 2004
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEMPAA	National Environmental Management Protected Areas Act 57 of 2003
NEMWA	National Environmental Management Waste Act 59 of 2008
NFA	National Forests Act 84 of 1998
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act 101 of 1998
NWA	National Water Act 36 of 1998
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SIBIS	SANBI's Integrated Biodiversity Information System
SKEP	Succulent Karoo Ecosystem Project

4. DESCRIPTION OF ENVIRONMENT

The aim of this section is to discuss the physical features of the study area and its immediate surroundings in relation to potential significant biodiversity features that might be encountered. During the desktop study significant biodiversity features associated with the larger surroundings was identified, and were taken into account. The desktop portion of the study also informs as to the biodiversity status as classified in the National Spatial Biodiversity Assessment as well as in the recent National list of ecosystems that are threatened and in need of protection (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. It also aims to take Municipal Environmental Management Frameworks (EMF's) and Municipal Critical Biodiversity Areas (CBA's) into account where applicable.

4.1 TOPOGRAPHY

Traditionally the agricultural areas associated with Onseepkans are located within the Orange River flood plain and contained within the narrow valley between the mountains and the river which also encloses the Onseepkans Settlement. The alluvial floodplains next to the river have been developed into productive agricultural land and small holdings. The valley bottom ranges in width from less than 500 m to just over 2 km wide in places. In contrast the topography of the higher terraces (on which the proposed development will be located) is generally gentle sloping sandy plains in between rocky hills. These higher terraces appear to consist entirely of wind deposited material or alluvial material totally reworked by wind action. As a result the sandy plains have a hummocky micro relief which ranges from fair to severe in other areas. In places, the area can become rocky, possessing a "broken" topography. Elevation varies from approximately 400 m to 500 m on these sandy plains.

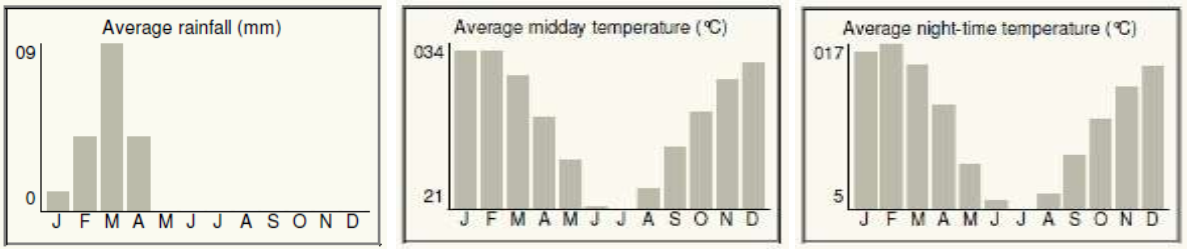
Another feature of these sandy plains is the alluvial fans frequently encountered as a result of flash floods (thunderstorm events) which drain the rocky hills onto the plains. Reaching these gentle sloping plains the power of the streams quickly dissipates and become too low to carry the sediment load, which is then dropped onto the sandy plains, resulting in the formation of these alluvial fans. Vary rarely will these drainage from the rocky hills result in the formation of a significant watercourse (e.g. connecting it to another water resource).

4.2 CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. The Onseepkans area falls within the desert biome or **hyperarid region** of fringing the western South African shoreline, Southern Angola and Namibia. The desert biome is characterised by ecological extremes and of all the biomes in SA it has the lowest amount of and the variability in rainfall. Onseepkans normally receives about 18mm of rain per year, with most rainfall occurring mainly during autumn (Figure 4). Figure 4, below (lower left) shows the average rainfall values for Onseepkans per month. It receives the lowest rainfall (0mm) in May and the highest (9mm) in March (also indicating that Onseepkans falls outside of the winter rainfall area – which is significant in terms of the

expectancy of plant species of the Mesembryanthemaceae). The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Onseepkans range from 20.7°C in July to 33.4°C in January. The region is the coldest during July when the mercury drops to 4.7°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures. (www.saexplorer.co.za).

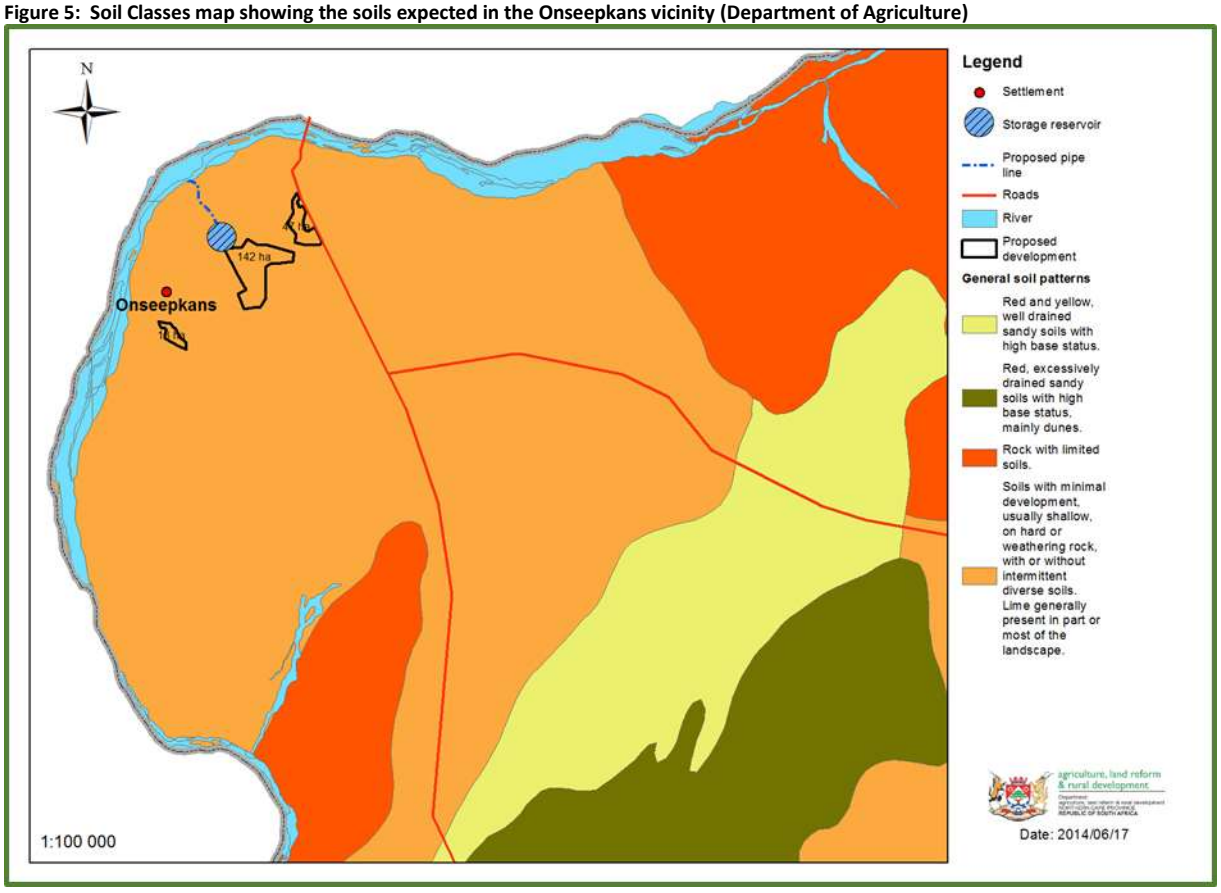
Figure 4: Average rainfall, temperature and night-time temperatures for Onseepkans Canal (www.saexplorer.co.za)



4.3 GEOLOGY & SOILS

According to Mucina and Rutherford (2006) and the SANBI Biodiversity Geographical Information System, the geology and soils of the alluvial soils next to the river are mostly recent alluvial deposits of the Orange River supporting soil forms such as Dundee and Oakleaf. The river cuts through a great variety of Precambrian metamorphic rocks (la land type). As it name suggests the flood plains are subject to floods, especially in summer, caused by high precipitation on the Highveld.

Figure 5: Soil Classes map showing the soils expected in the Onseepkans vicinity (Department of Agriculture)



According to the agricultural feasibility study done by the Department of Agriculture (July 2014), the proposed development sites lies south of the alluvial plain on gently sloping pediment slopes. This area is characterized by gneissic rock and course grained metamorphic rocks from the Little Namaqualand Suite of the O'Kiep Group. This is interspersed by sedimentary material from the Korannaland Sequence which includes conglomerates, quartzite, schists and mica. Due to the dominant soil properties, inter alia, (i) topsoil horizons (ii) clay content (iii) effective root depth (iv) dominant soil form and series, it was concluded that the soils have low to high potential for irrigated agriculture.

The area cannot be considered as prime land, because prime land is defined as the best land available, primarily from national perspective. However, this area can be defined as unique agricultural land, due to specific combinations of location, climate or soil properties that make it highly suitable for a specific crop, more especially table grapes, which is made even more suitable due the availability of sufficient volumes of high quality water for permanent irrigation.

4.4 LANDUSE AND COVER

Onseepkans lies in a hyperarid region where access to water is the main restriction on human settlement and agricultural expansion. It has implications for the types of agricultural activities that can take place, in that the most appropriate crops and the most water-efficient irrigation technologies need to be promoted. The only sustainable source of good quality irrigation water is the Orange River. The area has a hot and sunny climate with the highest solar radiation intensity in South Africa, making it also attractive for solar energy generation.

The proposed development areas will be located on communal land within the sandy plains (between the rocky hills) to the south of the main Onseepkans settlements. The sandy plains can be described as sloping plains, sharply contrasting with the surrounding rocky hills and mountains covered with sparsely vegetated natural veld, used as natural grazing by the local inhabitants of Onseepkans. However, the long term grazing capacity is very low for the Onseepkans farming area and ranges between 70 ha LSU-1 and 100 ha LSU-1 (Large Stock Unit) (Grazing map, 1993).

4.5 WETLANDS AND WATERCOURSES

Rivers maintain unique biotic resources and are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors. However, with the exception of the Orange River all the rivers in the area are non-perennial rivers.

All three of the proposed agricultural expansion areas is located on open sheet washed plains that is commonly found between the rocky hills of the Eastern Gariep desert. These plains contains the alluvial fans which developed from drainage channels emerging out of the hills (driven by flash floods during thunder storm events) and opening up on the gently sloping pediment where the power of the streams become too low and where the sediment loads are dropped (and the drainage lines dissipate onto the sandy plains).

This is the case in this instance as well. No perennial watercourses or wetlands were observed on any of the proposed sites. However, a number of smaller drainage lines have been observed (a legacy of thunderstorm events). Some of these drainage lines (e.g. at Expansion area C) is slightly more prominent and sometimes a larger shrubs or small trees (e.g. *Parkinsonia africana*, *Boscia foetida* or *Boscia albitrunca)* layer can be associated with portions of these drainage lines, but even at expansion area C the site is located to miss the most significant alluvial fans. On all three of these sites, almost invariably, these drainage lines dissipate onto the sandy plains and does not link up to any water resource (Figure 6).

Figure 6: A google image showing alluvial fans in the vicinity of Area C, draining the rocky hills to the east of the site

4.6 BROAD SCALE VEGETATION TYPES EXPECTED

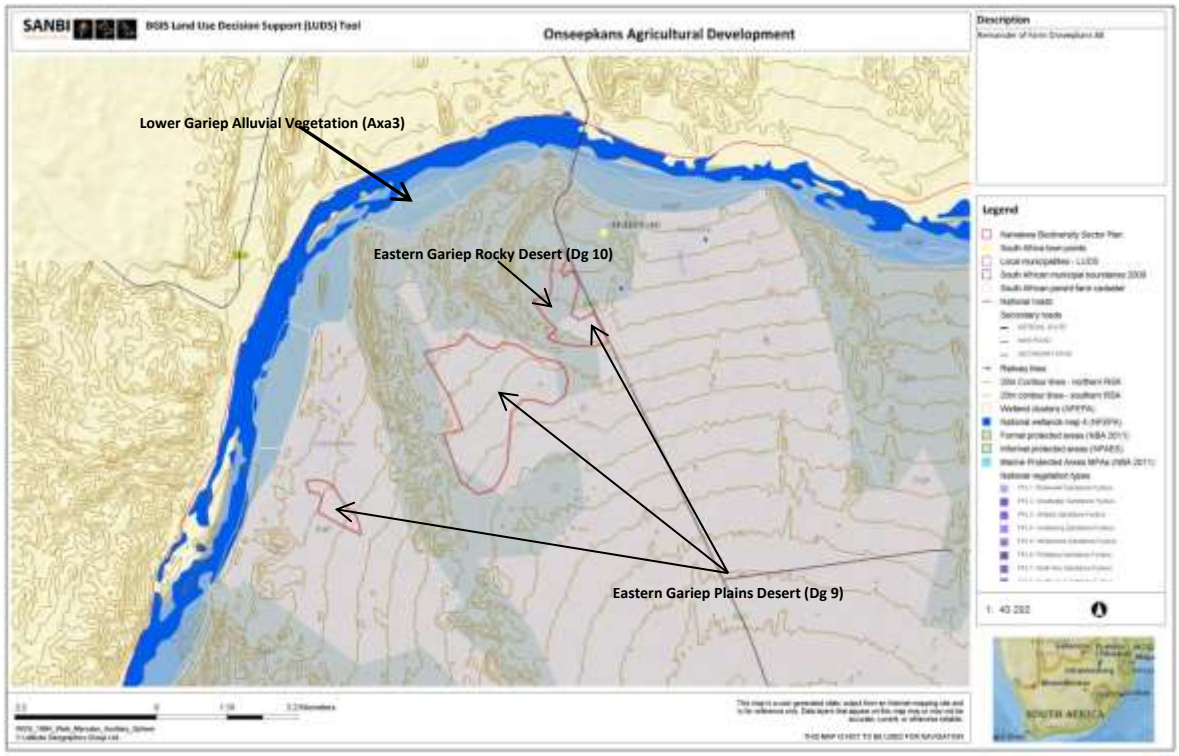
In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) only two broad vegetation types are expected to be impacted by the proposed development namely; ***Eastern Gariep Plains Desert*** and ***Eastern Gariep Rocky Desert*** (Figure 7). According to the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011) both these vegetation types are classified as "Least Threatened" (Table 2).

Table 2: Vegetation status according to the 2004 & 2011 National Spatial Biodiversity Assessment

VEGETATION TYPE	NATIONAL STATUS 2011	REMAINING (2004)	CONSERVATION TARGET	FORMALLY CONSERVED
Eastern Gariep Plains Desert	Least Threatened	Very little intact examples remains	34%	-
Eastern Gariep Rocky Desert	Least Threatened	99.7%	34%	-

It is important to note that even though both Eastern Gariep Plains Desert and Eastern Gariep Rocky Desert, has been classified as least threatened, they also both falls within the South African Desert Biome, in this case fringing on the Namibian desert. The Desert Biome is a hyperarid region of great age and one with extraordinary high diversity of organisms (including many endemics), adaptions and includes both winter- and summer rainfall areas, making it one of the most interesting hyperarid regions of the world. Compared with other desert regions, plant species richness is very high (especially the Richtersveld) and does not differ much from that of the Succulent Karoo (Mucina & Rutherford, 2006). However, not all parts of this biome are equally rich in species diversity. Plant species richness of the western Gariep Lowland Desert vegetation unit, is thought to be less rich than that of for example the Richtersveld and is described by Mucina & Rutherford (2006) as moderate. This is very likely as a result of the fact that the Richtersveld falls within a winter rainfall area (and subject to fog from the nearby Atlantic Ocean), while moving east the climate changed to a summer rainfall pattern (like at Onseepkans).

Figure 7: Vegetation map of SA, Lesotho and Swaziland (2012, beta 2)



4.6.1 Eastern Gariep Plains Desert

The vegetation type is described as occurring on sloping plains, sharply contrasting with the surrounding rocky hills and mountains. Typical wash vegetation in the breaks between the mountains to the Orange River. Grassland dominated by 'white grasses', some spinescent (*Stipagrostis* species), on much of the flats with additional shrubs and herbs in the drainage lines or on more gravelly or loamy soil next to the mountains.

According to Rutherford and Mucina (2004), important taxa include the following: Small tree: *Parkinsonia africana*. Stem- & Leaf-succulent Shrubs: *Brownanthus pseudoschlichtianus*, *Psilocaulon subnodosum*. Stem-succulent Shrub: *Euphorbia gregaria*. Leaf-succulent Shrub: *Zygophyllum microcarpum*. Other Shrubs: *Sisyndite spartea*, *Calicorema capitata*, *Galllonia crocyllis*, *Hermbstaedtia glauca*, *Monechma spartioides*, *Petalidium setosum*. Graminoids: *Stipagrostis brevifolia*, *S. ciliata*, *Schmidtia kalahariensis*, *Stipagrostis obtusa*. Perennial Herbs: *Codon royenii*, *Rogeria longiflora*. Succulent Herb: *Mesembryanthemum guerichianum*.

4.6.2 Eastern Gariep Rocky Desert

The vegetation type is described as occurring on hills and mountains (up to 650 m of relative altitude from their base), mostly with bare rock outcrops and covered with very sparse shrubby vegetation in crevices, usually separated by broad sheet-wash plains (Eastern Gariep Plains Desert).

Important Taxa (""Mainly western part, 'Mainly eastern part) Succulent Tree: Aloe dichotoma. Small Trees: *Acacia mellifera, Boscia albitrunca, B. foetida, Ehretia rigida, Euclea pseudebenus*, *Maerua gilgii*, *Pappea capensis*. Stem-& Leaf-succulent Shrubs: *Brownanthus pseudoschlichtianus*, *Ceraria fruticulosa, Psilocaulon subnodosum, Ruschia barnardii*. Stem- succulent Shrubs: *Ceraria namaquensis, Commiphora capensis, C cervifolia, C. gracilifrondosa', C namaensis, Euphorbia avasmontana, E. friedrichiae, E. gariepina, E. gregaria, E. guerichiana, E. virosa.* Leaf- succulent Shrubs: *Aloe dabenorisana, A. gariepensis, Mesembryanthemum inachabense, Prenia tetragona, Trianthema parvifolia, Tylecodon rubrovenosus, Zygophyllum decumbens, Z microcarpurn, Z. rigidum.* Other Shrubs: *Adenolobus garipensis, Antherothamnus pearsonii, Aptosimum tragacanthoides, Barleria lancifolia', B. rigida, Cadaba aphylla, Calicorema capitata, Diospyros acocksii, Dyerophytum africanum, Eriocephalus scariosus, Hermannia stricta, Justicia orchioides, Monechma mollissimum, Petalidium setosum, Rhigozum obovatum, Rhus populifolia, Sisyndite spartea.* Graminoids: *Enneapogon scaber, Schmidtia kalahariensis, Stipagrostis anomala, S. ciliata, S. obtusa*. Perennial Herbs: *Abutilon pycnodon, Chascanum garipense, Codon royenii, Rogeria longiflora, Tribulus cristatus.* Geophytic Herb: *Bowiea gariepensis*. Succulent Herb: *Mesembryanthemum guerichianum*. Annual Herbs: *Cleome angustifolia* subsp. *diamdra*, C. *foliosa* var. lutea.

Endemic Taxa Small Tree: *Ozoroa namaquensis*. Leaf-succulent Dwarf Shrub: *Tylecodon sulphureus*.

4.7 VEGETATION ENCOUNTERED

Expansion area A & C are expected to be located within the Eastern Gariep Plains Desert vegetation type, while expansion area B overlaps both Eastern Gariep Plains Desert and Eastern Gariep Rocky Desert vegetation types (Refer to Figure 7). However, the vegetation encountered on all three sites was very similar, with the only marked difference the number of larger shrub and tree species encountered on Area C (probably as a result of the being located s more defined drainage lines in the vicinity of the site) and higher grassy content on Expansion area B. All three sites were located on typical sheet washed plains and it is very likely that the expectance of Eastern Gariep Rocky Desert vegetation on Expansion area 3 is more the result of the scale of mapping than there actually being Eastern Gariep Rocky Desert vegetation on site.

In general all of these sites were covered by a very sparse (>10% cover) low shrubland or grassy shrubland. Larger shrubs and small trees were also occasionally encountered on the plains (e.g. *Boscia foetida, Senegalia mellifera* and *Euphorbia gregaria*), but more often than not larger shrubs and small trees were associated with alluvial fans and dry drainage lines. Species like *Parkinsonia africana* and *Adenolobus garipensis* are almost exclusively found in association with these dry drainage lines.

None of the sites are fenced and all the sites showed signs of over grazing. Palatable shrubs are heavily grazed and the veld dominated by less palatable species such as *Aptosimum spinescens*, *Euphorbia species*, *Petalidium setosum* and *Sisyndite spartea*. Grass densities are low and mostly with a low basal cover, dominated by less palatable species like *Schmidtia kalahariensis*. More palatable grasses such as *Stipagrostis ciliata* and *Stipagrostis obtusa* were scarce and if encountered grazed to ground level. The presence of invasive alien species like *Prosopis* spp. (even though low in numbers) also raises concern.

Frequent droughts and high rainfall variability are considered the primary drivers in this desert ecosystem. As a result the long term carrying capacity for this vegetation type is very low (because of the variability of rainfall the availability of forage will also be highly irregular). It also means that the vegetation can be quite sensitive to degradation (e.g. changes in plant species composition) as a result of overutilization or mismanagement, which is often the case on communal land, where water points are few, livestock loads are high and grazing management is not coordinated (no systems in place to allow resting periods for grazing areas).

4.7.1 Vegetation: Expansion area A

Expansion Area A is by far the largest (142 – 188 ha) of the three sites and is located within the open sandy plains south of the Viljoensdraai Settlement (Refer to Figure 3). The site can be described as an open sheet washed plain covered by a very sparse grassy and shrub layer (Photo 1). The shrub layer of the proposed expansion area A (Photo 1) was dominated by scattered individuals of *Lycium cinereum* with *Petalidium setosum*, *Euphorbia gregaria* and *Euphorbia gariepina* also relatively common. Grasses were common but mostly unpalatable varieties like *Schmidtia kalahariensis* and *Stipagrostis* species and was mostly heavily

grazed with a low basal cover. Other shrubs included *Acanthopsis* cf. *disperma*, *Aptosimum spinescens*, *Chascanum garipense*, *Codon royenii* and *Kissenia capensis* (near rocky outcrops) and *Sisyndite spartea*.

Photo 1: Very sparse vegetation dominated by *Lycium cinereum* encountered at expansion area A

Figure 8: Google image showing area A with *Boscia foetida* (Bf) and *Boscia albitrunca* (Ba) locations marked

Apart from a few scattered *Parkinsonia africana* (near ephemeral drainage lines or alluvial fans) two ***Boscia albitrunca*** trees were encountered (Refer to Waypoint 042 & 043 in Figure 8) near the site, both beautiful mature trees (2 m and 3.5 m in height respectively). However, both these trees are outside of the proposed

footprint, at the base of a rocky hill and there should be no reason to disturbed these trees and they should be protected. Eight ***Boscia foetida*** ranging from large shrubs to small trees in size were also observed within or near the site, of which only 4 falls within the proposed footprint. However, apart from the small tree (marked with waypoint 041 in Figure 8) the remaining three (waypoint 044, 047 & 048) are near to the boundaries of the proposed sites and although none of them are particularly spectacular trees (1.8 – 2m in height) it should be possible to preserve at least some of these trees (Figure 8) if not all.

4.7.2 Vegetation: Expansion area B

Expansion Area B is the second largest site (48 ha) and is located next to the R358 main entrance to Onseepkans (Figure 3). The vegetation encountered was very similar to that described for expansion area A, although it showed a slightly denser grassy layer (Photo 2) and *Lycium cinereum* was replaced by *Senegalia mellifera* (Swarthaak) and *Euphorbia gregaria* as the dominant shrub layer. *Adenolobus garipensis* was also encountered on this site.

Photo 2: Open sandy plains with the large *Euphorbia gregaria* in the foreground encountered at Expansion area B

Only one *Boscia foetida* (approximately 2m in height and in average condition) was encountered within the proposed footprint (marked by waypoint 049 in Figure 9).

Even though the vegetation map (Refer to Figure 7) indicates that the northern portion of this site overlaps Eastern Gariep Rocky Desert vegetation, the site visit **does not support this**. This is significant, since the Eastern Gariep Rocky Desert is more likely to contain red-listed plant species. In fact, the rocky desert vegetation type was encountered just north of the proposed footprint (but still well outside and unlikely to be impacted) in which the red-listed species *Commiphora capensis* was quite common (Refer to the Orange area in Figure 9, marking the observed boundary between rocky and plains desert). However, since the rocky desert vegetation type is associated with rocky outcrops and rocky sheets, it is highly unlikely to be impacted by the proposed development.

Figure 9: Google image showing area B with the *Boscia foetida* (Bf) location marked

4.7.3 Vegetation: Expansion area C

Expansion area C is the smallest of the proposed sites (18 ha) and located further to the west and directly east of the main Mission settlement at Onseepkans.

Photo 3: *Sisyndite spartea* dominated veld encountered at expansion area C

The shrub layer is noticeably denser than found on the other two sites, but still dominated by unpalatable species such as *Sisyndite spartea*, *Euphorbia garipense*, *Euphorbia gregaria, Tetraena decumbens* and *Petalidium setosum* (Photo 3). In terms of botanical significance, this site was regarded as the most sensitive of the three sites, purely because of the relative high number of *Boscia foetida* and *Boscia albitrunca* individuals within and near the site (which is probably the result of the number of alluvial fans in the vicinity of the site – ephemeral drainage lines).

Other species encountered includes the shrubs: *Acanthopsis* cf. *disperma*, *Adenolobus garipensis*, *Aptosimum spinescens, Blepharis mitrata, Calicorema capitata, Chascanum garipense, Codon royenii, Lycium cinereum, Parkinsonia capensis* and *Senegalia mellifera*. The number of individuals of the alien invasive plant *Prosopis* species was worrying.

Figure 10: Google image showing area C with *Boscia foetida* (Bf) and *Boscia albitrunca* (Ba) locations marked

Photo 4: *Lycium cinereum* (Area A) in seed

However, importantly, twenty six (26) *Boscia foetida* and 11 *Boscia albitrunca* trees/shrubs were observed within or in close proximity to the proposed development footprint (Refer to Figure 10). Of the 26 *Boscia foetida* only 15 falls within the proposed footprint (likely to be impacted), most of which were small or scruffy plants in poor condition. However, three of the plants (marked with waypoint 035, 036 and 038 in Figure 10) was described as mature trees in relative

good condition (located near an ephemeral drainage line and also near to the boundary of the proposed site). If possible the footprint should be adjusted to exclude these 3 *Boscia foetida* trees.

Of the 11 *Boscia albitrunca* (Sheppard's trees) individuals only one (waypoint 012) falls outside of the proposed footprint, while one (waypoint 11) should be easy to avoid. The remainder are squarely within the site. However, none of these trees are really in good condition, in fact, six of them (refer to waypoint 015 and 018 – 022) are scruffy small trees in poor condition (all of them less than 1.8 m in height), while another three (refer to waypoint 029, 030 and 033), were described as in medium condition with only one (029) reaching 2 m in height.

4.8 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.

Table 3: List of species encountered within the sites (excluding grass species)

SPECIES NAME	FAMILY	Protected species	Legal requirement(s)
Acanthopsis disperma	ACANTHACEAE		
Adenolobus garipensis	FABACEAE		
Aptosimum spinescens	SCROPHULARIACEAE		
Blepharis mitrata	ACANTHACEAE		
Boscia albitrunca	CAPPARACEAE	Protected in term of the **NFA** and all Boscia species protected in terms of Schedule 2 of NCNCA	Apply for a tree permit in terms of the NFA as well as a Flora permit in terms of the NCNCA for all individuals to be removed.
Boscia foetida	CAPPARACEAE	Protected in terms of Schedule 2 of NCNCA	Apply for a Flora permit in terms of the NCNCA for all individuals to be removed.
Calicorema capitata	AMARANTHACEAE		
Chascanum garipense	VERBENACEAE		
Codon royenii	BORAGINACEAE		
Euphorbia gariepina	EUPHORBIACEAE		
Euphorbia gregaria	EUPHORBIACEAE		
Kissenia capensis	LOASACEAE		
Lycium cinereum	SOLANANEACEAE		
Mesembryanthemum guerichianum	AIZOACEAE	All Aizoaceae protected in terms of the Schedule 2 of NCNCA. But please note that this plant is a typical pioneer species indicating disturbance and not vulnerable in itself.	Apply for a Flora permit in terms of the NCNCA for all individuals to be removed.
Monsonia parvifolia	GERANIACEAE		
Ornithoglossum vulgare	COLCHICACEAE		
Petalidium setosum	ACANTHACEAE		
Prosopis species	FABACEAE	**Category 2 in terms of CARA;**	

SPECIES NAME	FAMILY	Protected species	Legal requirement(s)
		Category 3 in terms of NEMBA	
Rogeria longiflora	PEDALIACEAE		
Schmidtia kalahariensis	POACEAE		
Senegalia mellifera (=Acacia mellifera)	FABACEAE		
Sisyndite spartea	ZYGOPHYLLACEAE		
Stipagrostis ciliata	POACEAE		
Stipagrostis namaquensis	POACEAE		
Stipagrostis obtusa	POACEAE		
Tetraena decumbens (=Zygophyllum decumbens)	ZYGOPHYLLACEAE		

4.9 RED DATA 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).

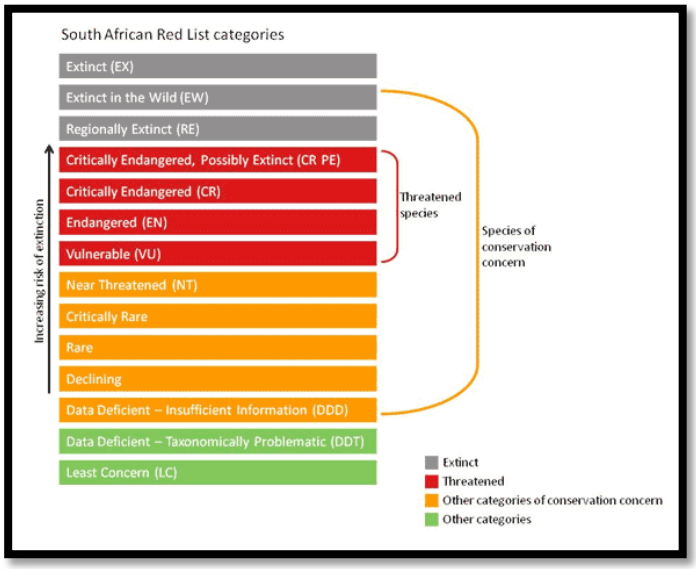
In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- 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*" (as updated).
- 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).

4.9.1 Red list of South African 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). The South African red list categories are given in **Figure 11**.

Figure 11: South African red list categories (SANBI, 2015)



The definitions used for the national Red List categories are described in **Table 4** underneath. Categories marked with [N] are non-IUCN, national Red List categories for species not in danger of extinction, but considered of conservation concern. The IUCN equivalent of these categories is Least Concern (LC) (SANBI, 2015).

Table 4: Definitions of the South African national red list categories (SANBI, 2015)

Extinct (EX): A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
Extinct in the Wild (EW): A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
Regionally Extinct (RE): A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
Critically Endangered, Possibly Extinct (CR PE): Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
Critically Endangered (CR): A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
Endangered (EN): A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
Vulnerable (VU): A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
Near Threatened (NT): A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
[N]**Critically**" Rare A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
[N]**Rare**: A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows: ➢ Restricted range: Extent of Occurrence (EOO) <500 km2, OR ➢ Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km2, OR ➢ Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR ➢ Small global population: Less than 10 000 mature individuals.
[N]**Declining**: A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
Least Concern: A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the

above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
Data Deficient - Insufficient Information (DDD): A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Data Deficient - Taxonomically Problematic (DDT): A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
Not Evaluated (NE): A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

Within the Eastern Gariep Plains Desert vegetation type, 3 red list plants may be expected namely (www.redlist.sanbi.org):

- *Aloidendron dichotomum,* (Masson) Klopper & Gideon.F.Sm. (Status: ***Vulnerable***);
- *Conophytum devium* G.D.Rowley subsp. *stiriferum,* S.A.Hammer & Barnhill (Status: ***Rare***);
- *Othonna graveolens*, O.Hoffm. (Status: ***Least Concern***).

Within the Eastern Gariep Rocky Desert vegetation type a number of red listed species can be expected namely (www.redlist.sanbi.org):

- *Aloidendron dichotomum*, (Masson) Klopper & Gideon.F.Sm. (***Vulnerable***)
- *Aloidendron ramosissimum*, (Pillans) Klopper & Gideon.F.Sm. (***Vulnerable***);
- *Anginon jaarsveldii*, B.L.Burtt. (***Endangered***);
- *Brunsvigia gariepensis,* Snijman. (***Endangered***);
- *Bulbine ophiophylla*, G.Will. (***Endangered***);
- *Commiphora capensis*, (Sond.) Engl. (***Least Concern***);
- *Conophytum devium*, G.D.Rowley subsp. *stiriferum* S.A.Hammer & Barnhill (***Rare***);
- *Conophytum fuller*, L.Bolus. (Status: ***Least Concern***);
- *Conophytum limpidum,* S.A.Hammer (***Near Threatened***);
- *Conophytum marginatum,* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer. (***Rare***);
- *Euphorbia phylloclada,* Boiss. (***Least Concern***);
- *Jatropha orangeana*, Dinter ex P.G.Mey. (***Least Concern***);
- *Lithops dinteri* Schwantes subsp. *frederici* (D.T.Cole) D.T.Cole (***Vulnerable***);
- *Lithops dorotheae* Nel (***Endangered***);
- *Lithops olivacea* L.Bolus (***Vulnerable***);
- *Othonna graveolens* O.Hoffm. (***Least Concern***); and
- *Tritonia marlothii* M.P.de Vos subsp. *marlothii*. (***Vulnerable***).

No red-listed plant species were encountered within the proposed development footprints. However, *Commiphora capensis* is quite common in the rocky outcrops surrounding these sites. Since development within these rocky areas is not feasible, it is highly unlikely that any of these plants will be impacted.

4.9.2 NEM: BA Protected 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 within the proposed development footprint.

4.9.3 NFA Protected 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).

- ***Boscia albitrunca***: Thirteen (13) of these trees protected in terms of the NFA was observed within or near the proposed footprints (Refer to Appendix A for locations and recommendations).

4.9.4 NCNCA protected 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.

- ***Boscia foetida***: Thirty five (35) of these trees protected in terms of the NFA were observed within or near the proposed footprints (Refer to Appendix B for locations and recommendations).

4.10 GARIEP CENTRE OF ENDEMISM

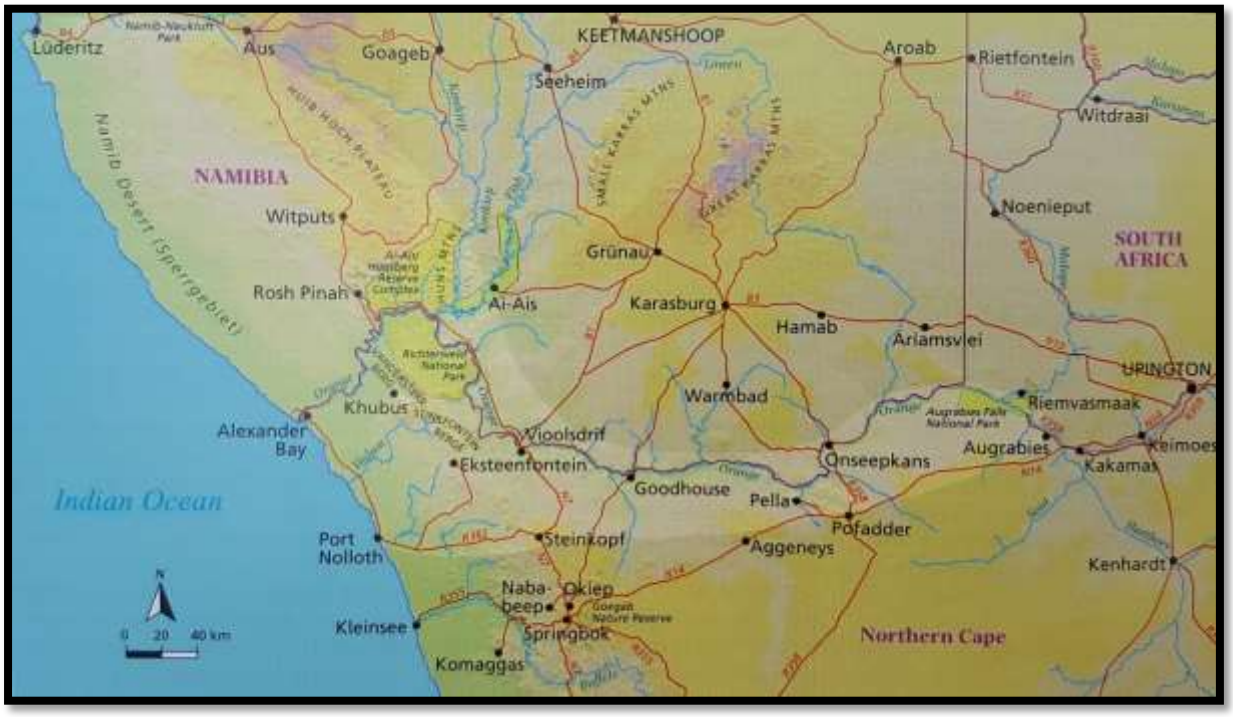
"Gariep" is the Khoekhoe name for the Orange River, which means the "Great River". The lower Orange River cuts right through the core of the Gariep Centre of endemism (GC) and also forms the international border between South Africa and Namibia (Refer to Figure 12). The GC, with the Richtersveld as its core is part of the Succulent Karoo Region and is considered a region of high floristic endemism. It is located in the north-western corner of the Northern Cape and the adjacent south-western corner of Namibia (Van Wyk & Smith, 2001). Van Wyk & Smith (2001) describes the GC as more or less L-shaped and within South Africa it is bounded by Port Nolloth (and north to include the Richtersveld), Steinkopf, Pofadder and on the Augrabies Falls to the south and east and by the Orange River in the north (note that it also extends into Namibia).

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

Vegetation within the GC is mainly xerophytic semi-desert shrubland with a predominance of succulents. However, succulents are less prominent towards the east (as it moves out of the winter rainfall zone into the summer rainfall zone). Vegetation is intimately related to the geomorphology, geology and climate of the

region. Trees and shrubs are very rare and mostly confined to rocky mountainous areas, dry watercourses, springs and banks of the Orange River. Within the Richtersveld and Port Nolloth area, most the rare and endangered plant species are concentrated on the higher mountain ranges and other high lying areas.

Figure 12: The Gariep Centre (highlighted) with the Richtersveld as its core (taken from Van Wyk & Smith, 2001)



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

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

allowed for the capture of some tropical floristic elements in the GC. Variability in annual rainfall within winter rainfall deserts is also much lower (again favouring the development of succulents).

- The right taxa, at the right place, at the right time (especially concerning the Mesembryanthemaceae).
- The rapid population turn-over associated with perennial shrubs (mainly Mesembryanthemaceae) within the GC would have minimised competitive interaction and would have been conducive to rapid speciation and diversification of especially perennial taxa.

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

In summary: The **Gariep Centre has the richest variety of succulents on earth** of which a **high percentage are endemic or near endemic.** A soft, but regular and therefore effective rainfall is mainly responsible for this abundance of plant life. Many of the endemic plants are limited to small areas, mostly on mountains where the rainfall is higher and habitat diversity is greatest. The proposed development is located within the Gariep Centre of endemism, but is not expected to have a significant impact on endemic plant species as the development will be located on the sheet washed plains and will not impact on the rocky hills (which are more likely to be associated with endemic species). No red listed species were observed within the proposed footprints (Refer to Table 3 and Section 4.9).

4.11 FINE-SCALE MAPPING (CBA'S)

In terms of the National Environment Management Act (NEMA) 107 of 1998, all organs of state are obligated to take biodiversity considerations into account and to ensure decisions are informed by the most up to date information. NEMA also states that, although the environment is a functional area of concurrent national and provincial legislative competence, all spheres of government and all organs of state must co-operate with, consult and support one another. The Namakwa District Biodiversity Sector Plan (NDBSP) with its associated Terrestrial Critical Biodiversity Areas (CBA's) maps was created with three main land-use planning and decision-making avenues in mind:

- Reactive decision-making, such as environmental impact assessment (EIA) agricultural land-use decisions, water-use licensing and other development control decisions through the Land Use Planning Ordinance (LUPO) or other land-use legislation,
- Proactive forward planning, such as Integrated Development Plans (IDP's), Spatial Development Frameworks (SDF's) & Zoning Schemes, and
- Proactive conservation, such as stewardship, land acquisition & easements.

The importance of these functions is described within the NDBSP (2008) Sector plan as follows:

Terrestrial (or land) ecosystems provide valuable ecosystem services that contribute to human well-being. For example they can provide:

- buffers against natural hazards such as fire and floods

- carbon sequestration (storage), important for reducing the impacts of climate change
- regulation of water supply grazing for wild animals and livestock
- natural spaces for recreation &tourism
- the air we breathe
- spiritual, ritual and ceremonies
- horticultural & wild flower industries
- natural heritage
- food, fibre and medicinal plants

Rivers are central to human welfare and economic development. They provide:

- water for agricultural, industrial and domestic uses
- flood attenuation and regulation
- food and medicinal plants
- transport and/or purification of biodegradable wastes
- tourism, recreational and cultural use
- enhanced property values

Ecological corridors provide valuable ecosystem services that are often impossible or very costly to replicate or offset. For example they:

- Support the migration (movement) and long-term survival of plant and animal species and their ecological processes (e.g. fire, pollination, seed dispersal), in response to global climate change.
- Are important areas for storing carbon to reduce the impacts of global climate change.
- are important areas for regulating water supply (e.g. filtering and storing drinking water, keeping excess nutrients out of wetlands and rivers, ensuring a high water yield from mountain catchments).
- Supply good quality water from mountain catchment areas, both surface and groundwater.
- The supply of water quality and quantity is not only for human consumption but for ensuring the survival of downstream estuaries, wetlands (vleis) and streams (which in turn provide us with other ecosystem services).
- Are of important scenic value, contributing to tourism and the 'sense of place'.

4.11.1 Biodiversity categories for land-use planning

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 table underneath gives the framework for linking spatial planning categories (CBA's) to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives (as used within the NDM, 2008).

Table 5: Linking CBA categories to land management objectives within the Namaqualand District Municipality

CBA CATEGORY	LAND MANAGEMENT OBJECTIVE
PA & CBA 1	*Natural landscapes*: • Ecosystems and species fully intact and undisturbed • These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. • These are landscape that are at or past their limits of acceptable change
CBA 2	*Near-natural landscapes*: • Ecosystems and species largely intact and undisturbed. • Areas with intermediate irreplaceability or some flexibility in terms of area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising our ability to achieve targets. • These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESA)	*Functional landscapes*: • Ecosystems moderately to significantly disturb but still able to maintain basic functionality. • Individual species or other biodiversity indicators may be severely disturbed or reduced. • These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA and Transformed	*Production landscapes*: • Manage land to optimize sustainable utilization of natural.

* **PA** = Protected Areas, **ESA** = Ecological Support Area, **ONA** = Other Natural Areas

4.11.2 Critical biodiversity areas encountered

According to the Namakwa District Biodiversity Sector Plan (NDBSP) and its associated Terrestrial Critical Biodiversity Areas (CBA's) maps (Refer to Figure 13) all three sites are located within Ecological Support Areas (ESA) and might even overlap onto Critical Biodiversity Areas (CBA).

The ecological support areas in this case aim to maintain terrestrial migration corridors. Ideally the proposed agricultural sites should have been placed outside of these CBA areas. However, this will mean that establishment and operational cost will be much higher and the sites located away from the Onseepkans settlements and away from the only source of water, making the development less viable. In addition the proximity of the Onseepkans Settlement means that the migration corridors associated with the proposed site is likely already impacted to a degree. It should this be preferable to place such development areas nearer to

existing settlements (which is more likely to already be degraded as a result of human settlement and communal grazing) than on land which might be less impacted.

Figure 13: The Namakwa District Biodiversity Sector plan showing CBA area in relation to the proposed development areas

The critical biodiversity areas, in this case, aims to protect expert important terrestrial areas. At Onseepkans these expert important terrestrial areas are associated with the rocky outcrops of the Eastern Gariep Rocky Desert vegetation type which is the potential habitat to a great number of known endemic plant species. According to Figure 13, the proposed Expansion area B is likely to overlap such rocky desert vegetation. However, the botanical scan does not support this (refer to section 4.7.2 of this report). As a result it is considered highly unlikely that the proposed development, will in actual fact, have any significant impact on the proposed CBA areas in the vicinity of Onseepkans.

4.12 FAUNA AND AVI-FAUNA

Animal species found in the Desert biomes associated with the Nama-, and Succulent Karoo is adapted to withstand the harsh, arid climate, while some species associated with the denser vegetation bordering the Orange River. This vast desert area was once the home of plentiful and diverse nomadic herbivores together with a great number of bird-, lizard- and snake species. However, more than 200 years of livestock grazing together with wild game hunting has left its mark on this dry sparse desert landscape. In an area, where the carrying capacity of the veld is already very low (70 – 100 ha per larger stock unit), the long term impact of stock grazing (often overgrazing), with their much narrower grazing habits (range of palatable plant species), as opposed to game, had very likely irreversibly impacted on plant species composition as well. As a result large game was almost totally displaced by sheep and goat farmers and herders in in this part of the Northern

Cape. This in turn has affected the food chain and ultimately the density of tertiary predators, particularly mammals and larger birds of prey. Smaller predators and scavengers such as jackal and caracal suffered the same lot and were almost totally eradicated by farmers in fear of their livestock. The use of wire snares and hunting dogs added to the impact on the remaining mammal species such as rabbit and mongooses, which are extremely vulnerable to such hunting methods

This holds very true for the larger Onseepkans settlement. Livestock grazing mostly by sheep and goats have left its impact on the immediate surroundings. All areas easily reachable within the Onseepkans communal lands show signs of the impact of long-term livestock farming. Almost all larger ungulates had been displaced together with nearly all smaller game. Thus, although natural fauna and avi-fauna are still present, it is expected that it would be limited to avi-fauna, insects and reptile's species albeit slightly changed in composition as a result of the changed food chain (loss of game). Because of the long-term impact of human settlement on the larger areas and especially because of the close proximity of the proposed development areas to the Onseepkans settlement no comprehensive faunal survey was conducted or deemed necessary. The numbers of species given below reflects the potential range of species from literature, but because of the location, the nature and the relative small scale of the proposed development it is not expected that the development can or will pose any significant impact on any specific fauna or avi-fauna species.

However, it is a known fact that many animal and bird species associate with large *Acacia erioloba* as well as *Boscia albitrunca* trees and the removal of mature trees of these species will have an impact on such wildlife (even though very localised).

4.12.1 Mammals

The site falls within the distribution range of approximately 50 mammal species indicating moderate diversity. Some of the most well-known species still to be expected within the larger communal land includes the Yellow mongoose (*Cynictis penicillata*), scrub hares (*Lepus saxatilis*), South African ground squirrels (*Xerus inauris*), Aardvark (*Orycteropus afer*), Dassie (*Petromus typicus*), Chacma Baboons (*Papio hamadryas*), Velvet Monkey (*Cercopithecus pygerythrus*), Porcupines (*Hysterix africaeaustralis*) and Batt-eared Foxes (*Octocyon megalotis*). Since human activity in the area is medium-high and it is highly unlikely that a fair representation of these mammals will be found on the property. As result the potential impact on mammal species is deemed negligible.

4.12.2 Reptiles

The site falls within the distribution range of approximately 30 reptile species, indicating low diversity. The rocky outcrops surrounding the proposed development areas is much more likely to provide suitable habitat for a much wider range of reptile species than the open sandy plains. Thus although a small number of snakes of snakes, lizards and geckos might be encountered on the open sandy plains (none of which was observed during the site visit), by far the majority of reptile species will be associated with the surrounding rocky hills.

As a result is considered highly unlikely that the proposed development will impact on any significant number of reptile species. As such, the impact on reptiles should be negligible.

4.12.3 Amphibians

The site falls within the distribution range of approximately 10 amphibian species. However, no suitable breeding places were observed on the proposed site and it is highly unlikely that the proposed development will have any significant impact on amphibian species. In addition, most amphibians require perennial water and will thus not be affected at all.

4.12.4 Avi-fauna

The site falls within the distribution range of approximately 200 bird species known from the broad area. But because of the medium-high human activity and the location of the site (open sandy plains away from the Orange River) it is not expected that a fair representation of these species will be encountered on site or its immediate vicinity. However, larger indigenous trees can provide suitable habitat for a number of animal species, including avi-fauna, and it remains important that all larger indigenous trees must be protected wherever possible in order to minimise the possible impact (although localised). Thus apart from the potential impact on mature trees the proposed activity is not expected to have a significant impact on avi-fauna.

4.13 Alien and invasive plant (AIP) species

Alien and invasive plant (AIP) species were introduced into South Africa more than 1 000 years ago *via* trading routes from other countries in southern Africa (Alberts & Moolman, 2013). Since the arrival of settlers from Europe these numbers have increased dramatically. At present, AIPs are encountered on large portions of land in South Africa (10 million hectares) and it is reportedly consuming nearly 330 million cubic meters of water annually, or 7% of the annual run-off. But what is really scary is that this water consumption levels are increasing rapidly and could reach 50% of the mean annual run-off in the not too distant future (Alberts & Moolman, 2013). The aggressive behaviour of the AIPs in their unnatural habitat is a direct threat to the vast wealth of biodiversity in South Africa. South Africa is a relatively small country that comprises only 2% of the total surface of the Earth, but it contains 10% of the plant species, 7% of the vertebrates, and is home to three biodiversity hotspots.

In South Africa, there are currently three pieces of national legislation that relate to the control of Alien and Invasive Species (AIS) namely:

- Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), administered by the Department of Agriculture, forestry and Fisheries.
- List of weeds and invader plants declared in terms of Regulations 15 and 16 (as Amended, March 2001) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) administered by the Department of Agriculture, Forestry and Fisheries (DAFF);

- Alien and invasive species list 2016 (GN R. 864 of 29 July 2016) promulgated in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management, Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), administered by the Department of Environmental Affairs (DEA).

4.13.1 Fertilizer, farm feeds, agricultural remedies and stock remedies act

According to Government Notice No. 13424 dated 26 July 1992, it is an offence to "acquire, dispose, sell or use an agricultural or stock remedy for a purpose or in a manner other than that specified on the label on a container thereof or on such a container". Contractors using herbicides need to have a valid Pest Control Operators License (limited weeds controller) according to the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947).

4.13.2 Conservation of Agricultural Resources Act (CARA)

The **CARA** sets out the regulations (amended March 2001) regarding the control of weeds and invasive plants and provides a list of declared plants. The amended regulations make provision for four groups of invader plants. The first three groups consist of undesirable alien plants and are covered by Regulation 15, namely:

- **Category 1** declared weeds (Section 15A of the amended act) are prohibited plants that will no longer be tolerated on land or on water surfaces, neither in rural or urban areas. These plants may no longer be planted or propagated, and all trade in their seeds, cuttings or other propagative material is prohibited. Plants included in this category because their harmfulness outweighs any useful properties or purpose they may have.
- **Category 2** declared plant invaders (Section 15B of the amended act) are plants with a proven potential of becoming invasive, but which nevertheless have certain beneficial properties that warrant their continued presence in certain circumstances. May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- **Category 3** declared plant invaders (Section 15C of the amended act) are undesirable because they have the proven potential of becoming invasive, but most of them are nevertheless popular ornamentals or shade trees that will take a long time to replace. May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, provided they are not within 30 metres of the 1:50 year flood line of a river, stream, lake or other type of inland water body. The "executive officer" can impose further conditions on Category 3 plants already in existence, which might include removing them if the situation demands it.
- **Bush encroachers**, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

4.13.3 National Environmental Management: Biodiversity Act (NEM:BA)

NEMBA aims to provide the framework, norms, and standards for the conservation, sustainable use, and equitable benefit-sharing of South Africa's biological resources. The purpose of NEMBA as it relates to Alien and Invasive Species (AIS) is to prevent the unauthorised introduction and spread of such species to ecosystems and habitats where they do not naturally occur; manage and control such species to prevent or minimise harm to the environment and to biodiversity in particular; and to eradicate alien invasive species

from ecosystems and habitats where they may harm such ecosystems or habitats. The Regulations on Alien and Invasive Species, referred to as the "**AIS Regulations"** combine invasive species already listed in the CARA, with two new lists relating to invasive species and prohibited species.

The AIS Regulations list 4 different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa, namely:

- **Category 1a:** invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. These species need to be controlled on your property, and officials from the Department of Environmental Affairs must be allowed access to monitor or assist with control.
- **Category 1b**: invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management programme.
- **Category 2**: These are invasive species that can remain in your garden, but only with a permit, which is granted under very few circumstances.
- **Category 3:** These are invasive species that can remain in your garden. However, you cannot propagate or sell these species and must control them in your garden. In riparian zones or wetlands all Category 3 plants become Category 1b plants.

4.13.4 Northern Cape Nature Conservation Act (NCNCA)

Although provinces have a mandate to implement and enforce national legislation (such as CARA or NEM:BA), provincial authorities can also add further to legislation in the form of provincial ordinances, whereby each province can further prohibit certain species should the authorities feel that a species poses a potential risk or threat to the province's ecosystems or biodiversity.

In the Northern Cape Schedule 6 of the Northern Cape Nature Conservation Act, Act 9 of 2009 list additional invasive species that must be controlled. Schedule 6 list includes all species listed as weeds in CARA as well as an additional 36 species (none of which has been observed during this study). *Please note that all species categorized as Category 1 plants in terms of CARA are automatically listed in terms of the NCNCA.*

4.13.5 Alien & invasive plants encountered

The riparian zone associated with the nearby Orange River is heavily infested with alien invasive species, with *Prosopis* species especially prominent. Away from the river the climate is much harsher and water much less freely available. As a result the number of alien species encountered away from the river corridor reduces dramatically. However, a number of *Prosopis* trees were observed within the various footprints (especially Expansion area C) most likely the result of its seeds being distributed by livestock (the seed pot of the Prosopis

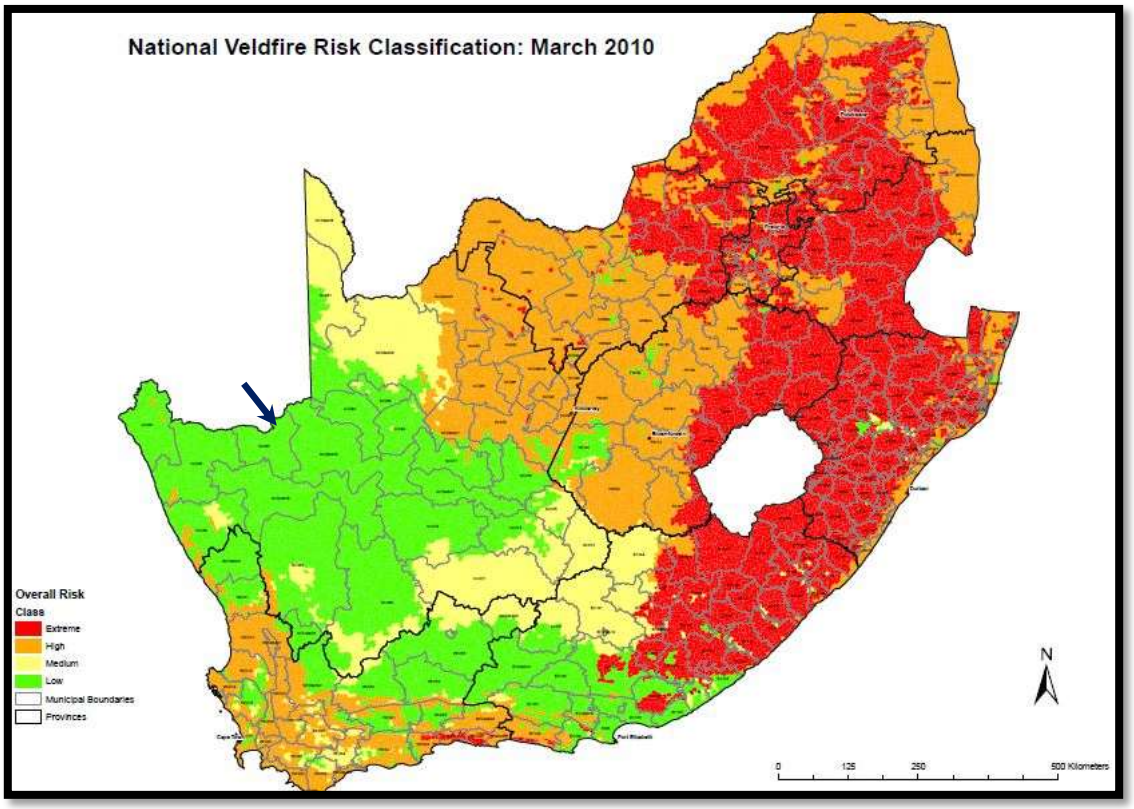
tree being a sough after fodder). Although their numbers are not high at present, it is important that these plants are removed where-ever they are observed. Removal methods should be based on that used by the Working for Water Program (Bold, 2007) and or the CapeNature alien control guideline (Martens *et. al.,* 2003). Prosopis is listed as an alien invasive plant in terms of both CARA and NEMBA (Refer to Table 3).

In this case all *Prosopis* individuals should be removed from the footprint and its immediate vicinity.

4.14 VELD FIRE RISK

The revised veldfire risk classification (Forsyth, 2010) in terms of the National Veld and Forest Fire Act 101 of 1998 was promulgated in March 2010.

Figure 14: South African National Veldfire Risk Classification (March 2010)



The purpose of the revised fire risk classification is to serve as a national framework for implementing the National Veld and Forest Fire Act, and to provide a basis for setting priorities for veldfire management interventions such as the promotion of and support to Fire Protection Associations. In the fire-ecology types and municipalities with High to Extreme fire risk, comprehensive risk management strategies are needed.

Onseepkans Canal is situated in an area supporting desert vegetation, which has been classified with a **low fire risk classification**. Although, the fire risk is low it is still important that during construction and operation the site must adhere to all the requirements of the local Fire Protection Association (FPA) if applicable, or must adhere to responsible fire prevention and control measures.

4.15 SENSITIVE HABITATS

Apart from the Orange River and its important riparian zone (which will not be impacted by the proposed development) **all rocky hills and koppies** in the vicinity of the proposed development footprint, **must be considered sensitive habitats**.

These rocky outcrops are characteristically diverse in aspect, slope and geology all resulting in a wide range of habitat in terms of protection, soil type, temperature and moisture, which again results in higher potential biodiversity. Within the Gariep Centre of endemism, they provide important habitat for a great number of plant species, many of which are endemic (e.g. the red-listed Nama corkwood, *Commiphora capensis*, was commonly observed in the surrounding rocky outcrops. They also provide important habitat for smaller mammals (e.g. Dassie, which was frequently observed), reptile species and birds. A wide variety of bird groups utilize ridges, koppies and hills for feeding, roosting and breeding, including some owls, falcons, nightjars, swifts, swallows, martins, larks, chats, thrushes, cisticolas, pipits, shrikes, starlings, sunbirds, firefinches, waxbills, buntings, canaries, eagles and even vultures. They also provide important habitat for sensitive species such as bats and the eastern rock elephant shrew. The variable microclimate may favour a vast array of invertebrate communities and generally supports a higher number of insects (both in number and species) than the surrounding plains.

Protection of these rocky outcrops (especially in the Northern Cape) will contribute significantly to the conservation of biodiversity in this area as well as in the Northern Cape.

5. IMPACT ASSESSMENT METHOD

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

5.1 DETERMINING SIGNIFICANCE

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

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

5.1.1 Criteria used

***Conservation value*:** Conservation value refers to the intrinsic value of an attribute (e.g. an ecosystem, a vegetation type, a natural feature or a species) or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species (Refer to Table 6 for categories used).

Table 6: Categories used for evaluating conservation status

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

Likelihood refers to the probability of the specific impact occurring as a result of the proposed activity (Refer to Table 7, for categories used).

Table 7: Categories used for evaluating likelihood

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

Duration refers to the length in time during which the activity is expected to impact on the environment (Refer to Table 8).

Table 8: Categories used for evaluating duration

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

Extent refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur (Refer to Table 9).

Table 9: Categories used for evaluating extent

EXTENT	
Site (1)	Under normal circumstances the impact will be contained within the construction footprint.
Property (2)	Under normal circumstances the impact might extent outside of the construction site (e.g. within a 2 km radius), but will not affect surrounding properties.
Surrounding properties (3)	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).
Regional (4)	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.
Provincial (5)	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 (Refer to Table 10).

Table 10: Categories used for evaluating severity

SEVERITY	
Low (1)	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.
Medium/low (2)	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium (3)	It is expected that 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.
Medium/high (4)	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.
High (5)	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

5.2 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 11. Mitigation options are evaluated and comparison is then made (using the same method) of potential significance before mitigation and potential significance after mitigation (to advise the EAP).

Table 11: 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 are un-mitigatable and usually result in very severe effects, beyond site boundaries, national or international.

6. IMPACT ASSESSMENT

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development. As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), with emphasis on:

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

Table 12 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 12: Significant rating of impacts associated with the proposed development (including the No-Go option)

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig.	Short discussion
Geology & soils	The proposed development will have a direct impact on 200 - 250 ha of soils associated with Eastern Gariep Plains Desert vegetation (already degraded as a result of past and present grazing practices). According to the South African vegetation map it might also impact on Eastern Gariep Rocky Desert (considered a sensitive habitat in terms of potential flora and fauna which is also the main reason this area is included in the Gariep Centre of Endemism. These rocky hills are considered of much higher biodiversity significance than the sandy plains in-between (Refer to Section 4.15). No other sensitive habitats were observed (e.g. termite mounts or true quartz patches).							
	Without mitigation	4	4	5	1	4	56	Potential impact on the sensitive rocky hills and its associated biodiversity.
	With mitigation	1	1	5	1	1	8	The site visit indicates that the proposed development will not impact on these rocky hills. Mitigation: All rocky outcrops must be considered sensitive environmental features to be regarded as No-Go areas.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig.	Short discussion
Landuse and cover	The proposed development will impact on areas currently used for livestock grazing by local farmers. However, the carrying capacity of the land is very low and the size of the development footprint relatively small (in terms of the available communal land). In addition the socio-economic benefit of the proposed development might be huge (and will very likely benefit these farmers as well). Still these farmers will have to buy in to the proposed development.							
	Without mitigation	2	4	5	1	3	26	Taking away grazing rights without consultation or compensation.
	With mitigation	1	1	3	1	1	6	Ensuring that farmers with grazing rights are compensated or included in the benefits of the proposed development.
Vegetation type	The development footprint is relatively small in terms of remaining vegetation types, both of which is classified as Least Threatened. Eastern Gariep Rocky Desert has a much higher biodiversity value ant the protection of rocky hills on which it is located will contribute significantly to the conservation of biodiversity within the Gariep Centre of endemism.							
	Without mitigation	4	4	5	1	4	56	Potential impact on the sensitive Eastern Gariep Rocky Desert vegetation type and its associated biodiversity.
	With mitigation	1	1	5	1	1	8	The site visit indicates that the proposed development will not impact on this vegetation type. Mitigation: Regard all rocky outcrops as sensitive environmental features to be regarded as No-Go areas.
Conservation priority areas and connectivity	Expansion area B, might potentially impact a CBA regarded as of "expert important terrestrial areas". In addition all of the proposed sites are located within an ESA for maintaining terrestrial migration corridors.							
	Without mitigation	4	4	5	1	4	56	Potential permanent impacts on a CBA regarded as very sensitive (within the Gariep Centre of Endemism) and an ESA.
	With mitigation	2	1	5	1	1	16	The site visit shows that the proposed sites will not impact on the rocky hills at which the CBA aims it protection. The ESA is also already significantly degraded and in close proximity to the Onseepkans Settlement.
Watercourses and wetlands	Alluvial fans and small drainage lines are present on the various sites, but no significant watercourse will be impacted. However, stormwater management will have to be part of the development criteria.							
	Without mitigation	2	1	5	1	3	20	No stormwater management.
	With mitigation	2	1	5	1	1	16	With stormwater management.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig.	Short discussion
Flora	No red-listed species was encountered within the proposed sites (although one listed plant species was observed within the surrounding rocky hills). However, a number of protected species were encountered.							
	Without mitigation	3	4	5	1	3	39	Development with no mitigation or regard for protected species.
	With mitigation	2	3	5	1	2	22	Implementing the recommendations regarding to protected trees given in Appendix A & B and regarding all mature indigenous trees as sensitive and to be protected wherever possible.
Fauna	It is considered unlikely that the proposed footprint will impact significantly on the conservation of any fauna species or its habitat.							
	Without mitigation	2	3	5	1	2	22	Construction without regard for the protection of fauna.
	With mitigation	2	2	2	1	1	12	During construction personnel must be made aware of potential impacts on fauna and trained in appropriate measures for their protection.
Avi-fauna	It is considered unlikely that the proposed footprint will impact significantly on any single species.							
	Without mitigation	2	2	5	1	2	20	Construction without regard for the protection of avi-fauna and its habitat (e.g. larger indigenous trees).
	With mitigation	1	1	2	1	1	5	Mitigation - minimise footprint and impact on protected trees.
Alien and invasive plant species	A number of Prosopis trees were observed. They have to potential to spread significantly when in proximity to water or if removed incorrectly. The incorrect use of herbicides might also impact on the surrounding vegetation.							
	Without mitigation	3	3	4	2	4	39	Incorrect control methods or incorrect use of herbicides.
	With mitigation	3	1	2	1	1	15	Alien invasive plant control must be done in accordance with an approved method statement based on the Working for Water or CapeNature guidelines for AIP control.
Veld fire risk	The risk of veld fires is low, but they can be potentially dangerous during times when the grass layer is significant.							
	Without mitigation	3	3	4	3	3	39	Uncontrolled fires can have a severe impact on vegetation and fauna.
	With mitigation	3	1	2	1	1	15	Fire prevention and control measures must be implemented during construction and operation.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig.	Short discussion
Cumulative impacts	Cumulative impacts refer to the sum of all impacts associated with the proposed development. In this case it was measured in terms of its potential impact on the vegetation types, the importance of the Gariep Centre of endemism and potential impact on red-listed species and protected species.							
	Without mitigation	4	4	5	3	4	64	Development without mitigation as proposed throughout this document.
	With mitigation	3	3	5	1	2	33	Development with mitigation as proposed in this document.
The "No-Go" option	The No-Go option refers to no development being allowed. In this case the No-Go option means the "status quo" will be maintained and no additional permanent impacts will result on vegetation or associated biodiversity. However, it was also taken into account that the site itself is not pristine condition and the purpose of the development is socio-economic benefit.							
	Without mitigation	2	1	4	1	1	14	No development, but also no socio-economic gain.
	With mitigation						0	The positive gain from the associated socio-economic upliftment is likely to be significant.

Significance before mitigation: The impact assessment suggests that the proposed development is expected to have **Medium-high cumulative** potential impact, with the most significant aspect being the potential impact on the sensitive habitat associated with the Eastern Gariep Rocky Desert vegetation type (which is also the main reason for the area being included in the Gariep Centre of endemism) and protected species (mainly tree species) encountered within the site and to a lesser degree potential accidental veld fires.

Significance after mitigation: The site visit confirmed that it is very unlikely that the proposed development will impact on Eastern Gariep Rocky Vegetation and its potentially much more diverse biodiversity. Impacts on protected tree species can also be minimised through slight layout adjustments. The potential impact on the regional status of the vegetation type and associated biodiversity features (e.g. corridor function or special habitats) will also be minimised through the above mitigations. Apart from the potential impact on protected species no further irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the proposed agricultural development. With mitigation the potential impacts on biodiversity features can be reduced to **Low**.

The NO-GO option: The "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" on the site. On the other hand the socio-economic benefits may be significant.

7. DISCUSSION & RECOMMENDATIONS

Having evaluated and discussed the various biodiversity aspects associated with the proposed development, the most significant biodiversity features that might be impacted identified are:

- The rocky hills and outcrops with its diverse and potentially wide range of habitats, which again results in higher potential biodiversity associated with the Eastern Gariep Rocky Desert vegetation type.
- The fact that the larger Onseepkans area falls within the Gariep Centre of endemism (primarily as a result of the diverse rocky outcrops).
- The fact that all of the sites falls within an ecological support area (ESA), while Expansion site B might also potentially impact on a critical biodiversity area (CBA) of expert importance.
- The potential impact on protected species, especially a number of *Boscia albitrunca* and *Boscia foetida* trees.
- The potential impact on fauna associated with the surrounding rocky outcrops.

However, the botanical scan suggest that it is highly unlikely that the proposed development footprint will impact on Eastern Gariep Rocky Desert vegetation, which also mean that it will not impact on the rocky hills and outcrops (with its higher potential biodiversity status). It also means that it is unlikely to have any significant impact on the Gariep Centre of endemism. However, a number of protected tree species are likely to be impacted (even though most of them are in poor condition to begin with), but with mitigation the impacts on these trees can be reduced significantly.

Taken the above into consideration it is highly unlikely that the proposed project will contribute significantly to any of the following:

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

Lastly it is felt that good environmental planning and control during construction (the appointment of a suitably qualified ECO and the implementation of an approved EMP) and good rehabilitation after construction could significantly reduce environmental impact.

With the available information to the author's disposal it is recommended that project be approved, provided that mitigation is adequately addressed.

8. MITIGATION MEASURES

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP).
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and ensure that the recommendation made in this study is implemented.
- Rocky outcrops and hills must be identified as sensitive habitats and regarded as no-go areas.
- The possibility of slight adjustments to the proposed footprint must be investigated in order to accommodate the recommendations made in Appendix A & B with regard to impact minimisation on the protected *Boscia* trees.
- The necessary Tree and Flora permits must be obtained for the removal or damage to any protected plant species that might be impacted as a result of the proposed development.
- All other mature indigenous trees must be regarded as sensitive biodiversity features and efforts must be made to protect such trees wherever they are encountered.
- During construction personnel must be made aware of potential impacts on fauna and trained in appropriate measures for their protection.
- Ensuring that farmers with grazing rights are compensated or included in the benefits of the proposed development.
- All alien invasive plant species within the proposed footprints and within 50m of these footprints must be eradicated as part of the construction phase. Regular follow-up control must be part of the maintenance management plan.
- Alien invasive plant control must be done in accordance with an approved method statement based on the Working for Water or CapeNature guidelines for AIP control.
- Stormwater management must be part of the development layout in order to accommodate flash floods from the surrounding rocky hills (erosion prevention).
- Fire prevention and control measures must be implemented during construction and operation.
- All areas outside of the final footprint that were disturbed as a result of the proposed development must be rehabilitated as part of the construction phase.

9. REFERENCES

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

Alberts, R. & Moolman, J. 2013. Protecting ecosystems by way of biological control: Cursory reflection on the main regulatory instruments for biological control agents, present and future.

Alias, D. & Milton S. 2003. A collation and overview of research information on Boscia albitrunca (shepherd's tree) and identification of relevant research gaps to inform protection of the species. Research report done for the Department of Water affairs and Forestry. 18 August 2003.

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.

Bold, T. 2007. Management treatments summary guide for terrestrial alien and invasive plants. www.dwaf.gov.za/wfw.

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.

Forsyth, G.G., FJ Kruger, F.J., & Le Maitre, D.C. 2010. National veldfire risk assessment: analysis of exposure of social, economic and environmental assets to veldfire hazards in South Africa. CSIR Report No: CSIR/NRE/ECO/ER/2010/0023/C. March 2010.

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

Martens, C., Waller, L. & Delahunt, K. 2003. Alien plant control. An operational guideline for land managers. 2nd Draft. November 2003. Produced by the Conservation Stewardship Programme. Western Cape Nature Conservation Board (CapeNature).

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. 2012. Red List of South African Plants version 2017.1. Downloaded from www.redlist.sanbi.org.

SANBI. 2015. Statistics: Red List of South African Plants version 2015.1. Downloaded from Redlist.sanbi.org on 2016/07/27.

Van der Merwe, H., Van Rooyen, M.W. & Van Rooyen, N. 2008a. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. Part 1: Fynbos Biome related vegetation. Koedoe Vol. 50(1): 61-76

Van der Merwe, H., Van Rooyen, M.W. & Van Rooyen, N. 2008b. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. Part 2: Succulent Karoo Biome related vegetation. Koedoe Vol. 50(1): 160-183.

Van Rooyen, M.W., Van Rooyen, N.; Bothma, J. du P. & Van Den Berg, H. M. 2008. Landscapes in the Kalahari Gemsbok National Park, South Africa. Koedoe [online]. 2008, vol.50, n.1, pp. 99-112. ISSN 0075-6458.

Van Rooyen, N., Bezuidenhout, H. & De Kock, E. 2001. Flowering plants of the Kalahari dunes. Ekotrust cc.

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

APPENDIX A: BOSCIA ALBITRUNCA LOCATIONS & RECOMMENDATIONS

NO.	LOCATION & WAYPOINT NO.	COMMENTS	RECOMENDATIONS
1.	S28° 46' 40.9" E19° 16' 04.6" Waypoint 011 Ba (Area C)	**Just inside footprint:** Small tree (±1.2m) in poor condition.	**Protect if possible, through a small footprint adjustment.**
2.	S28° 46' 40.6" E19° 16' 03.7" Waypoint 012 Ba (Area C)	**Outside footprint**: Medium sized tree (±1.8m) in average condition.	**Protect**.
3.	S28° 46' 42.7" E19° 16' 10.3" Waypoint 015 Ba (Area C)	**Inside footprint:** Small tree (±1.2m) in poor condition, well inside the footprint.	Apply for a NFA permit if tree needs to be removed.
4.	S28° 46' 47.7" E19° 16' 11.6" Waypoint 018 Ba (Area C)	**Inside footprint:** Small tree (±1.6 m) in poor condition.	Apply for a NFA permit if tree needs to be removed.
5.	S28° 46' 48.1" E19° 16' 12.0" Waypoint 019 Ba (Area C)	**Inside footprint:** Medium tree (±1.8 m) grazed and in poor condition.	Apply for a NFA permit if tree needs to be removed.
6.	S28° 46' 48.8" E19° 16' 13.5" Waypoint 020 Ba (Area C)	**Inside footprint:** Small tree (±1.5 m) grazed and in poor condition.	Apply for a NFA permit if tree needs to be removed.
7.	S28° 46' 48.7" E19° 16' 14.2" Waypoint 021 Ba (Area C)	**Inside footprint:** Small tree (±1.5 m) grazed and in poor condition.	Apply for a NFA permit if tree needs to be removed.
8.	S28° 46' 49.0" E19° 16' 14.1" Waypoint 022 Ba (Area C)	**Inside footprint:** Small tree (±0.5 m) grazed and in poor condition.	Apply for a NFA permit if tree needs to be removed.
9.	S28° 46' 51.2" E19° 16' 21.7" Waypoint 029 Ba (Area C)	**Inside footprint**: Medium large tree (±2 m) grazed but in average condition.	Apply for a NFA permit if tree needs to be removed.
10.	S28° 46' 50.0" E19° 16' 19.4" Waypoint 030 Ba (Area C)	**Inside footprint:** Small tree (±1.5 m) grazed and in poor condition.	Apply for a NFA permit if tree needs to be removed.
11.	S28° 46' 46.1" E19° 16' 17.0" Waypoint 033 Ba (Area C)	**Inside footprint:** Small tree (±1.6 m) grazed but in average condition.	Apply for a NFA permit if tree needs to be removed.
12.	S28° 46' 11.3" E19° 17' 16.2" Waypoint 042 Ba (Area A)	**Outside footprint:** Beautiful mature tree (±3.5 m) in good condition.	**Protect**.
13.	S28° 46' 12.3" E19° 17' 17.1" Waypoint 043 Ba (Area A)	**Outside footprint:** Medium tree (±2 m) in good condition.	**Protect**.

APPENDIX B: BOSCIA FOETIDA LOCATIONS & RECOMMENDATIONS

NO.	LOCATION & WAYPOINT NO.	COMMENTS	RECOMENDATIONS
1.	S28° 46' 38.4" E19° 16' 10.2" Waypoint 001 Bf (Area C)	**Outside footprint**. Large individual (2m) grazed but in average condition.	**Protect**
2.	S28° 46' 38.1" E19° 16' 10.9" Waypoint 002 Bf (Area C)	**Outside footprint**. Medium large tree (1.8m) grazed but in average condition.	**Protect**.
3.	S28° 46' 36.7" E19° 16' 11.2" Waypoint 003 Bf (Area C)	**Outside footprint**. Medium large tree (1.7m) grazed and poor condition.	**Protect**.
4.	S28° 46' 35.9" E19° 16' 10.6" Waypoint 004 Bf (Area C)	**Outside footprint**. Medium tree (1.6m) grazed and poor condition.	**Protect**.
5.	S28° 46' 36.4" E19° 16' 08.6" Waypoint 005 Bf (Area C)	**Outside footprint**. Medium large tree (1.6m) grazed and poor condition.	**Protect**.
6.	S28° 46' 37.3" E19° 16' 09.0" Waypoint 006 Bf (Area C)	**Outside footprint**. Large tree (2m) grazed and poor condition.	**Protect**.
7.	S28° 46' 38.1" E19° 16' 08.0" Waypoint 007 Bf (Area C)	**Outside footprint**. Medium tree (1.5m) grazed and poor condition.	**Protect**.
8.	S28° 46' 39.3" E19° 16' 06.3" Waypoint 008 Bf (Area C)	**Inside footprint**. Medium small tree (1.3m) grazed and poor condition	Apply for a NCNCA permit if tree needs to be removed.
9.	S28° 46' 40.7" E19° 16' 05.7" Waypoint 009 Bf (Area C)	**Inside footprint**. Medium tree (1.5m) grazed and poor condition	Apply for a NCNCA permit if tree needs to be removed.
10.	S28° 46' 41.3" E19° 16' 05.9" Waypoint 010 Bf (Area C)	**Inside footprint**. Medium tree (1.6m) grazed and in average to poor condition.	Apply for a NCNCA permit if tree needs to be removed.
11.	S28° 46' 41.3" E19° 16' 08.3" Waypoint 013 Bf (Area C)	**Inside footprint**. Large tree (2.1m) grazed and in average to poor condition.	Apply for a NCNCA permit if tree needs to be removed.
12.	S28° 46' 42.2" E19° 16' 08.2" Waypoint 014 Bf (Area C)	**Inside footprint**. Small shrub (1.3m) grazed and in poor condition.	Apply for a NCNCA permit if tree needs to be removed.
13.	S28° 46' 44.3" E19° 16' 10.2" Waypoint 016 Bf (Area C)	**Inside footprint**. Small tree (1.1m) grazed and in poor condition.	Apply for a NCNCA permit if tree needs to be removed.
14.	S28° 46' 50.2" E19° 16' 14.0" Waypoint 023 Bf (Area C)	**Inside footprint**. Small shrub (1m) grazed and in poor condition.	Apply for a NCNCA permit if tree needs to be removed.
15.	S28° 46' 51.1" E19° 16' 16.1" Waypoint 024 Bf (Area C)	**Inside footprint**. Large tree (2m) grazed and in average to poor condition.	Apply for a NCNCA permit if tree needs to be removed.
16.	S28° 46' 57.5" E19° 16' 22.3" Waypoint 025 Bf (Area C)	**Outside footprint**. Medium tree (1.5m) grazed and in poor condition.	**Protect**.
17.	S28° 46' 58.3" E19° 16' 25.0" Waypoint 026 Bf (Area C)	**Outside footprint**. Medium small tree (1.3m) grazed and in poor condition.	**Protect**.
18.	S28° 46' 57.4" E19° 16' 28.0" Waypoint 027 Bf (Area C)	**Outside footprint**. Small tree (1.2m) grazed and in poor condition.	**Protect**.
19.	S28° 46' 53.8" E19° 16' 23.0" Waypoint 028 Bf (Area C)	**Inside footprint**. Medium tree (1.6m) grazed and in poor condition.	Apply for a NCNCA permit if tree needs to be removed.
20.	S28° 46' 49.0" E19° 16' 18.6" Waypoint 031 Bf (Area C)	**Inside footprint**. Small shrub (1.2m) grazed and in poor condition.	Apply for a NCNCA permit if tree needs to be removed.
21.	S28° 46' 48.3" E19° 16' 18.1" Waypoint 032 Bf (Area C)	**Inside footprint**. Large tree (2.2m) grazed but in average condition.	**Protect if possible**: Apply for a NCNCA permit if tree needs to be removed.
22.	S28° 46' 46.4" E19° 16' 15.9" Waypoint 034 Bf (Area C)	**Inside footprint**. Medium tree (1.5m) grazed and in poor condition.	Apply for a NCNCA permit if tree needs to be removed.
23.	S28° 46' 41.8" E19° 16' 15.1" Waypoint 035 Bf (Area C)	**Inside footprint**. Mature tree (2.3m) grazed but in good condition.	**Protect if possible, through a small footprint adjustment**.
24.	S28° 46' 41.3" E19° 16' 13.8" Waypoint 036 Bf (Area C)	**Inside footprint**. Mature tree (2.3m) grazed but in good condition.	**Protect if possible (small footprint adjustment)**.

NO.	LOCATION & WAYPOINT NO.	COMMENTS	RECOMENDATIONS
25.	S28° 46' 40.9" E19° 16' 13.0" Waypoint 037 Bf (Area C)	**Inside footprint**. Medium large tree (1.8m) grazed and in poor condition.	**Protect if possible (small footprint adjustment)**.
26.	S28° 46' 39.3" E19° 16' 13.8" Waypoint 038 Bf (Area C)	**Outside footprint**. Mature tree (2.5m) grazed but good condition.	**Protect**.
27.	S28° 45' 39.0" E19° 16' 58.6" Waypoint 039 Bf (Area A)	**Outside footprint**. Medium tree (1.5m) grazed and in poor condition.	**Protect**.
28.	S28° 45' 38.0" E19° 16' 58.0" Waypoint 040 Bf (Area A)	**Outside footprint**. Small shrub (1.3m) grazed and in poor condition.	**Protect**.
29.	S28° 45' 49.8" E19° 17' 13.8" Waypoint 041 Bf (Area A)	**Inside footprint**. Large individual (2m) grazed but in good condition	Protect if possible. Apply for a NCNCA permit if tree needs to be removed.
30.	S28° 46' 36.8" E19° 17' 23.4" Waypoint 044 Bf (Area A)	**Just inside footprint**. Mature tree (2m) grazed but in good condition.	**Protect if possible (small footprint adjustment).**
31.	S28° 46' 42.0" E19° 17' 25.4" Waypoint 045 Bf (Area A)	**Outside footprint**. Mature tree (2.2m) grazed but in good condition.	**Protect**.
32.	S28° 46' 42.2" E19° 17' 26.3" Waypoint 046 Bf (Area A)	**Outside footprint**. Beautiful mature tree (3.2m) grazed but in good condition.	**Protect**.
33.	S28° 46' 31.8" E19° 17' 38.4" Waypoint 047Bf (Area A)	**Just inside footprint**. Medium large tree (1.8m) grazed but in average condition.	**Protect if possible (small footprint adjustment).**
34.	S28° 46' 15.2" E19° 17' 42.1" Waypoint 048 Bf (Area A)	**Just inside footprint**. Large tree (2m) grazed but in average condition.	**Protect if possible (small footprint adjustment).**
35.	S28° 45' 30.3" E19° 18' 19.5" Waypoint 049 Bf (Area B)	**Inside footprint**. Large individual (2m) grazed but in average condition.	Apply for a NCNCA permit if tree needs to be removed.