Report on the floristic and ecological assessment of the proposed expansion of the Augrabies graveyard, Northern Cape Province.

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1. Introduction

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition.

South Africa has a large amount of endemic species and in terms of biological diversity ranks third in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources.

South Africa contains 19 known centres of endemism. These areas contain a high number of species endemic to this specific area. Due to the limited range of most of these species many are rare, protected or endangered. The proposed graveyard is situated on the eastern border of the Gariep Centre of Endemism. Many species occurring within this centre is unique and localised to this area. Development in such centres of endemism should be done with careful investigation of the biodiversity and species composition of the area. Areas with rare, endangered or endemic species and areas with a high biodiversity should be avoided when planning a development.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

Development around cities and towns are necessary to accommodate an ever growing population. Areas along the boundaries of cities and towns are usually in a degraded state due to the impact of the large population these areas house. Though this may be the case in most situations there may still be areas that consist of sensitive habitats such as water courses, wetlands or rare vegetation types that need to be conserved. These areas may also contain endangered fauna and flora.

An ever increasing population is accompanied by an ever increasing fatality-rate. This necessitates the expansion or establishment of graveyards. These graveyards should be located in areas of low slope to prevent the erosion of graves and should also not occur near water courses where graves may be exposed by floods.

For the above reasons it is necessary to conduct a vegetation and ecological assessment of an area proposed for development.

The proposed expansion of the Augrabies graveyard is situated within the town of Augrabies and may be reached by the Angelier Street turnoff from the R359 Provincial Road (Map 1). The site is bordered on the west by an ephemeral stream and the existing graveyard and is bordered on the east by vineyards.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed development.

2. Scope and limitations

- To evaluate the present state of the vegetation and ecological functioning of the site proposed for development.
- To identify possible negative impacts that could be caused by the proposed graveyard expansion.

2.1 Vegetation

Aspects of the vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the proposed site.
- The overall status of the vegetation on site.
- Species composition with the emphasis on dominant-, rare- and endangered species.

The amount of disturbance present on the site assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

2.2 Fauna

Aspects of the fauna that will be assessed include:

- A basic survey of the fauna occurring in the region using visual observations of species as well as evidence of their occurrence in the region (burrows, excavations, animal tracks, etc.).
- The overall condition of the habitat.
- A list of species that may occur in the region (desktop study).

2.3 Limitations

Some of the bulbous species may have been overlooked. Many species have a spring/summer flowering period.
Some species may have been overlooked due to an annual cycle.
Some animal species may not have been observed as a result of their nocturnal and/or shy habits.

3. Methodology

3.1 Several literature works were used for additional information.

Vegetation:
Red Data List (Raymondo *et al.* 2009)
Vegetation types (Mucina & Rutherford 2006)
Field guides used for species identification (Adams 1976, Coates-Palgrave 2002, Court 2010, Hartmann 2001, Le Roux 2005, Roberts & Fourie 1975, Van Oudtshoorn 2004, Van Rooyen 2001, Manning 2009, Van Wyk & Van Wyk 1997).

Terrestrial fauna:
Field guides for species identification (Smithers 1986).

3.2 Survey

The site was assessed by means of transects and sample plots.

Noted species include rare and dominant species.
The broad vegetation types present on the site were determined.
The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.

Animal species were also noted as well as the probability of other species occurring on or near the site according to their distribution areas and habitat requirements.
The state of the habitat was also assessed.

3.3 Criteria used to assess sites

Several criteria were used to assess the site and determine the overall status of the environment.

Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.
Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single nich – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species can potentially be a fatal flaw.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.
Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:
Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.
Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.
Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:
Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:
Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.
Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria above were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, six different classes are described to assess the suitability of the sites to be developed. The different classes are described in the table below:

Table 1: Biodiversity sensitivity ranking

BSR	BSR general floral description	Floral score equating to BSR class
Ideal (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low. The site is ideal for the proposed development.	29 – 30
Preferred (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low. The area is preferred for the proposed development.	26 – 28
Acceptable (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low. The area is acceptable for the proposed development.	21 – 25
Not preferred (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance. The area is not preferred for the proposed development.	11 – 20
Sensitive (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high. The area is regarded as sensitive and not suitable for the proposed development.	0 - 10

4. Ecological overview of the site

4.1 Overview of ecology and vegetation types (Mucina & Ruterford 2006)

The vegetation in the area consists of Bushmanland Arid Grassland (NKb 3). The vegetation type is characterised by the dominance of white grasses (*Stipagrostis spp.*) and may contain a large degree of annual herbs after periods of high rainfall.

The topography is relatively flat and sloping slightly towards the north. The area has recently been cleared of all vegetation and the area has been levelled. This has severely degraded the area. The site is bordered to the west by the existing graveyard and the Augrabies residential settlement. The site is bordered to the east by commercial vineyards. Due to the surrounding developments the site does not form part of a natural area and this lowers the conservation value of the site (Map 1 & 2).

An ephemeral stream occurs along the western boundary of the site (Map 2). Being ephemeral in nature the stream may not contain a baseflow for several years. Flooding of this stream is likely to occur only every other year. This stream still acts as a water transporting body and is regarded as a sensitive environment. The streamflow that occurs sporadically in this stream may still exercise a strong erosive power and this will also erode graves that are located within or adjacent to this stream. This stream should be excluded from the graveyard and no graves should be located within this stream or within 20 meters from this stream (Map 2).

A small drainage line is located within the eastern portion of the site. This drainage line has previously been graded and levelled. The ecological function of this drainage line has been transformed and does no longer function as a water transporting body. However, the surface water flow in this area would still be somewhat higher than the immediate surroundings. This would increase the erosion in this area. Erosion of the surface soil would gradually expose graves. To prevent this a portion of the drainage line must be excluded from the graveyard (Map 2).

The region is very arid with a very low Mean Annual Precipitation (MAP) of 124mm. Rain occurs mainly in the form of summer thunderstorms and these may periodically cause flash floods. The soils of the area are loose, freely draining soils that are easily mobilised by surface water flow. As a result the areas on the site adjacent to the drainage line and ephemeral stream would be subjected to water erosion. This must be kept in mind throughout the design of the graveyard. The implementation of erosion measures should be investigated.

Most of the vegetation on the site has been cleared and the area has been levelled. As a result the percentage vegetation cover is very low. The remaining vegetation on the site consists of several pioneer herbs and grasses. These species include *Zygophyllum simplex, Mesembryanthemum guerichianum, Psilocaulon articulatum, Osteospermum sinuata, Schmidtia kalihariensis* and *Stipagrostis uniplumis*.

Due to the clearance of the vegetation on the site the area is severely degraded. The ephemeral stream and drainage line occurring on or near the site is deemed as sensitive environments and must be excluded from the graveyard.

4.2 Overview of terrestrial mammals (actual & possible)

No rare or endangered mammals could be identified on the site.

As a result of the clearance of vegetation on the site as well as the proximity of the adjacent settlement and commercial vineyards no mammal species could be identified on the site. It is deemed highly unlikely that any species of concern would occur on or near the site.

List of some Red Data terrestrial mammals that could occur in the region:

Aardwolf	*Proteles cristatus*
Bat-Eared Fox	*Otocyon megalotis*
Striped Weasel	*Poecilogale albinucha*
Small Spotted Cat	*Felis negripes*
Antbear	*Orycteropus afer*

The likelihood that one or several of these endangered species may occur in this area is highly unlikely.

5. Site specific results

Habitat diversity and species richness:
The available habitat on the site has been severely degraded by the clearance of vegetation on the site. The adjacent ephemeral stream does contribute to habitat diversity but as a consequence of the proximity of human settlement this is not deemed an important habitat for fauna. Species diversity on the site is low.

Presence of rare and endangered species:
No species of concern could be identified on the site. Due to the clearance of vegetation as well as the impact of the surrounding human activities it is considered highly unlikely that any species of concern would occur on the site.

Ecological function:
The ecological function of the site has been transformed. The vegetation has been cleared and the area has been levelled. The portion of drainage line that occurs on the site has also been graded and levelled. In so doing the ecological function has been altered. The ecological function of the adjacent ephemeral stream and drainage line remains largely intact. Although these systems have been severely degraded they still function as water transporting bodies.

Degree of rarity/conservation value:
The vegetation type that is present on the site is regarded as being of Least Concern and it is not rare. The vegetation on the site has been cleared. The site is also located adjacent to the existing graveyard and settlement as well as commercial vineyards. These impacts on the site deem it to have a low conservation value. However, the adjacent ephemeral stream and drainage line, although degraded, remain sensitive areas and the conservation value of these areas is considered to be high.

Percentage ground cover:
Due to the previous removal of the vegetation on the site the percentage ground cover is low.

Vegetation structure:
The vegetation structure consists of a grass and herb layer that has been severely degraded and altered.

Infestation with exotic weeds and invader plants:
No exotic species could be identified on the site. Due to the aridity of this area it is not susceptible to infestation by exotics. Care should be taken not to introduce the exotic Mesquite Tree (*Prosopis glandulosa*) as a shade tree in the graveyard as this species readily forms infestations in this region.

Degree of grazing/browsing impact:
Grazing by domestic stock is relatively low.

Signs of erosion:
Though erosion is present on the site this is considered moderate. Some erosion is present near the adjacent ephemeral stream. This is caused by water erosion coupled with the arid climate and loose soils. This should be kept in mind in the design of the graveyard.

Terrestrial animals:
Due to the previous clearance of the vegetation on the site as well as the proximity of the site to the existing graveyard, settlement and commercial vineyards it is considered highly unlikely that any species of concern would occur on or near the site.

Table 2: Biodiversity Sensitivity Rating for the proposed graveyard expansion.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness	3		
Presence of rare and endangered species	3		
Ecological function	3		
Uniqueness/conservation value	3		
Vegetation condition			
Percentage ground cover	3		
Vegetation structure	3		
Infestation with exotic weeds and invader plants or encroachers			1
Degree of grazing/browsing impact		2	
Signs of erosion		2	
Terrestrial animal characteristics			
Presence of rare and endangered species	3		
Sub total	21	4	1
Total		26	

6. Biodiversity sensitivity rating (BSR) interpretation

Table 3: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Augrabies graveyard expansion	26	Preferred	4

7. Discussion and conclusions

The site has been rated as being Preferred for the proposed development.

The vegetation on the site has been severely degraded due to the previous removal of the vegetation. The site is also bordered by the existing graveyard, residential settlement and commercial vineyards. For these reasons the area does not have a high conservation value. Furthermore, the site does not form part of a natural area and this further lowers the conservation value of the site.

A small ephemeral stream occurs to the west of the site. This stream has been severely degraded by the adjacent settlement. However, this stream still functions as a water transporting body and is regarded as sensitive. The stream should be excluded from the graveyard and a buffer zone of 20 meters from this stream should be respected (Map 2). The banks of this stream are susceptible to erosion and should be monitored periodically to ascertain if erosion has occurred. Progressive erosion of the stream banks will eventually lead to the erosion of the graves on the site. A buffer zone of 20 meters from the stream banks may prevent erosion in this area. The implementation of erosion measures along this stream should be investigated.

A small drainage line is situated in the eastern portion of the site. A large portion of this drainage line has been graded and levelled. The portion of the drainage line that is intact should be excluded from the development (Map 2). This will prevent erosion of this part of the graveyard and will also prevent further degradation of the drainage line.

The area contains no visible exotic species. The region has a low susceptibility to exotic infestation due to the arid climate. However, the Mesquite Tree (*Prosopis glandulosa*) is adapted to this environment and causes infestation problems in many areas. This tree should not be used as a shade tree in the graveyard.

Several trees indigenous to the region may be considered as shade trees within the graveyard. This will contribute to a peaceful sense of place and will provide shade to visitors. These trees will also aid in stabilisation of the soil. Trees that should be considered include *Acacia erioloba* (Camel Thorn)*, A. melifera* (Black Thorn), *Searsia lancea* (Karree) and *Parkinsonia africana* (Greenhair Tree).

The expansion of the proposed graveyard on this site would have a relatively low impact on the environment as long as the adjacent ephemeral stream and drainage line is excluded from the development.

8. Recommendations

- The adjacent ephemeral stream to the west of the site should be excluded from the layout (Map 2).
- A buffer zone of 20 meters should be respected from this ephemeral stream (Map 2).
- The drainage line in the eastern portion of the site should be excluded from the development (Map 2).

- The area should be monitored for signs of erosion. Should any erosion occur prevention measures should be put in place.

- The implementation of erosion measures along the ephemeral stream should be investigated.

- The use of the Mesquite Tree (*Prosopis glandulosa*) as a shade tree should not be permitted.

- The use of indigenous shade trees should be investigated. This will also aid in stabilisation of the soil.

- No animals may be captured, hunted or harmed in any way during construction or operation of the facility.

9. References

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Annexure A: Maps and Site photos

Locality of the proposed expansion of the Augrabies graveyard.

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9 Barnes Street
Bloemfontein
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Legend:
- R359 Provincial Road
- Angelier Street
- Proposed graveyard
- Orange River
- Existing graveyard

Map Information

Spheroid: WGS 84
Topo Cadastre Sheet: T2820CB

0 145 290 435
Scale (m)

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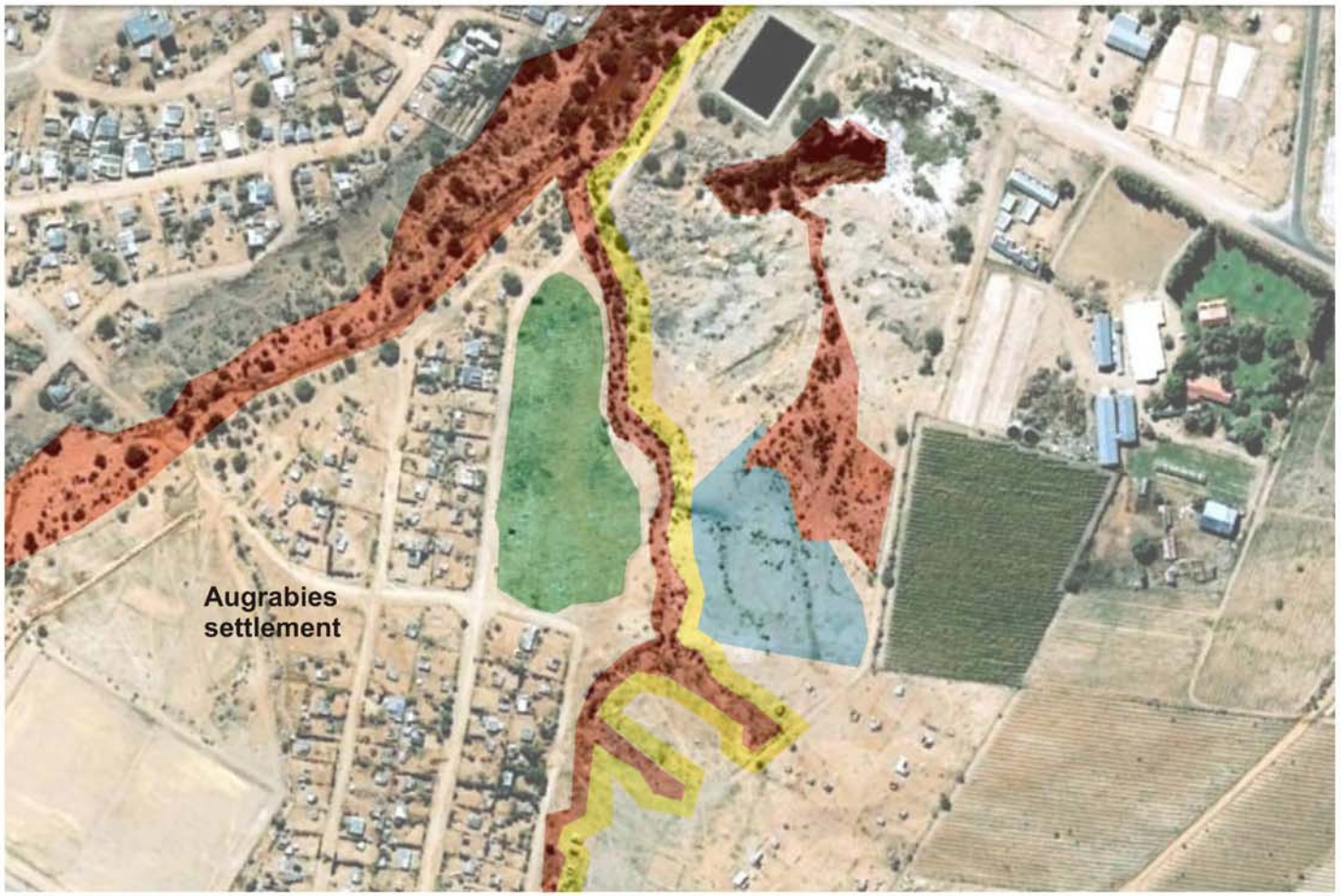
Map 1: The location of the proposed expansion of the Augrabies graveyard. The existing graveyard is also indicated. The R359 Provincial Road and Angelier Street giving access to the site is also indicated. The Orange River is located to the north of the site. Note the high abundance of ephemeral streams and drainage lines in the area.

Layout of the proposed expansion of the Augrabies graveyard.



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Legend:

- Existing graveyard
- Proposed graveyard
- Ephemeral stream and drainage lines
- 20m buffer zone

Map Information

Spheroid: WGS 84
Topo Cadastre Sheet: T2820CB

0 54 108 162
Scale (m)

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Map 2: The approximate layout of the proposed expansion of the Augrabies graveyard. The existing graveyard is also indicated. Note also the existing commercial vineyards to the east of the site. The ephemeral stream and drainage lines are indicated in red. A buffer zone of 20 meters is indicated along the ephemeral stream.

Figure 1: Panorama of the site as seen from the west towards the north east. The absence of vegetation on the site is clearly visible. The vineyards are situated in the background. A portion of the drainage line is indicated in blue.

Figure 2: Panorama of the site as seen from the west towards the south of the site. The absence of vegetation on the site is clearly visible. The Augrabies residential settlement is visible in the background.

Figure 3: The ephemeral stream located along the western boundary of the site. Degradation of this stream is clearly visible. However, the stream functions as a water transporting body and is sensitive to water erosion. Therefore it should be excluded from the development.

Figure 4: The ephemeral stream located along the western boundary of the site. Degradation of this stream is clearly visible as well as moderate erosion along the banks. However, the stream functions as a water transporting body and is sensitive to water erosion. Therefore it should be excluded from the development.