PRELIMINARY ECOLOGICAL ASSESSMENT FOR THE PROPOSED EXPANSION OF THE BEZUIDENHOUT VALLEY CLINIC & PARKING AREA; GAUTENG PROVINCE

Compiled for: Royal HaskoningDHV by:

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Declaration of Independence

I Clayton Cook declare that I have been appointed as an independent consulting ecologist with no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2014. I have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. Remuneration for our services by the proponent is not linked to approval by any decision-making authority responsible for authorising this development.

Mr. C. L. Cook 6th of December 2017

1. BACKGROUND INFORMATION

The City of Johannesburg, in line with the EIA Regulations, appointed Royal HaskoningDHV as the independent consultant to undertake the Environmental Authorization (BA) for the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area within the adjacent parkland. Access to the new expanded clinic would be via a proposed new bridge over the canalized section of the Jukskei River. Royal HaskoningDHV has appointed Mr C. L. Cook to undertake an ecological habitat assessment as well as faunal habitat assessment to investigate the potential animal (mammals, avifauna, reptiles and amphibians) related impacts associated with the upgrading of expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area. It must be stressed that due to time as well as financial constraints no comprehensive vegetation or faunal surveys were conducted; but merely a brief assessment of the current ecological status of the proposed sites for the expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area for specialised habitats, as well as the remaining vegetation and specific habitats, one can make an assumption of the possible presence or absence of threatened plant and animal species. The survey was supplemented by literature investigations; personal records, historic data and previous surveys conducted in similar habitats from 1991-2017.

1.1 OBJECTIVES OF THE ECOLOGICAL SURVEY/ HABITAT ASSESSMENT

- To provide a basic description of the fauna and vegetation occurring along the existing line and the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area. List the prominent plant species (trees, shrubs, grasses and other herbaceous species of special interest) present for vegetation unit and ecosystem delimitation.
- To identify animal/faunal species (mammals, reptiles, amphibians) of conservation importance; which could possibly occur within and adjacent to the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area.
- To describe the available habitats on the expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area sites; including areas of important conservation value or areas most likely to form important habitat for remaining threatened plant and animal species.
- To determine potential impacts of the development on the vegetation as well as associated fauna occurring along the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area.
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area.

1.2 SCOPE OF STUDY

- A preliminary mammal, reptile and amphibian survey recording sightings and/or evidence of existing fauna and vegetation communities.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened animal species (Red Data Species), occurring or likely to occur within the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area.
- Identification of potential ecological impacts that could occur as a result of the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area and assess the significance of these, where possible.
- Investigate feasible and practical management recommendations that should be implemented to reduce or minimize the impacts, should the project be approved.
- Documentation of the findings of the study in a report.

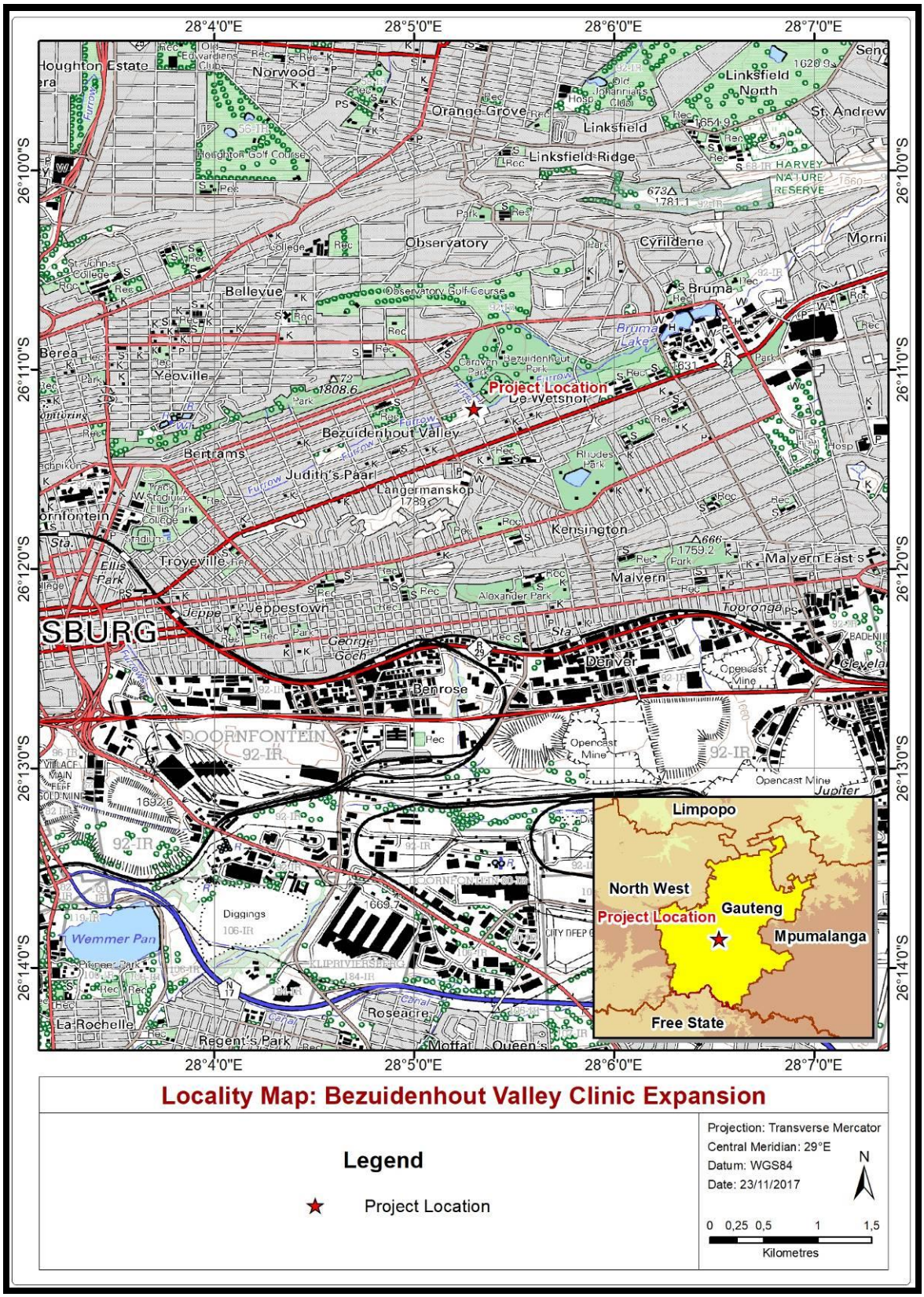

Figure 1. Locality map of the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area.

2. METHODOLOGY

2.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure and the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area. This was used as far as possible in order to identify potential "hot-spots" within and adjacent to the proposed site, e.g. Patches of undisturbed Soweto Highveld Grassland vegetation, palustrine wetlands (valley bottoms, pans/depressions and seeps), Rivers (Jukskei) and dams. Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and land use.

2.2 Literature Survey

A detailed literature search was undertaken to assess the current status of threatened fauna that have been historically known to occur in the study area for the Johannesburg 2628 AA quarter degree grid cell (or 1: 50 000 map unit), within which the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area are located. The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009) as well as an internet search using the new and old POSA (http://posa.sanbi.org). *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and updated *The Red List of Mammals of South Africa, Swaziland and Lesotho* (Child *et al*. *2016*) for mammals. *The 2014 Updated Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* (Barnes 2000), *Roberts- Birds of Southern Africa VII*th *ed.* (Hockey *et al*. 2005) as well as SABAP2 (http://sabap2.adu.org.za) for birds. *A Complete Guide to the Frogs of Southern Africa* (du Preez & Carruthers 2009) and *The Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians as well as SAFAP's FrogMAP (http://vmus.adu.org.za). The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001), Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland (Bates *et al.* 2014) and SARCA's ReptiMAP (http://sarca.adu.org.za accessed on the 4th of December 2017 for reptiles.

2.3 Site Investigation Methodology

A preliminary assessment of the status, spatial requirements and habitat preferences of all priority species along the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area as well as potential threats was conducted. For certain faunal species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature. For other species, little of this information was readily available and conservation targets remain speculative. Species assessments will be updated when additional data becomes available and where appropriate, proposed conservation targets will be revised.

One general habitat sensitivity scan was carried out on the 18th of November 2017. This preliminary site visit did not entail intensive surveying or utilisation of any sampling methods and can rather be viewed as being an opportunity to identify sensitive habitats occurring within the expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area sites.

All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as animal tracks (footprints, droppings) to identify animals. The data was supplemented by previous surveys conducted in similar habitats, literature investigations, personal records and historic data. Different habitats were explored to identify any sensitive or specialized species. Habitats explored included the transformed Soweto Highveld Grassland or weed invaded vacant stand adjacent to the concrete canal or canalised section of the Jukskei River and the transformed and regularly maintained park dominated by the exotic and alien invasive Kikuyu (*Pennisetum clandestinum**). Microhabitats explored included dumped building rubble, logs and stumps. Mammal names are as used by Skinner and Chimimba (2005), Robert's bird names (Hockey *et al.* 2005), reptile names by Branch (1998) and Alexander and Marais (2007) and amphibian names by Du Preez and Carruthers (2009) and Minter *et.al.* (2004)

2.4 Uncertainties in predicting results

- Limitation to a base-line ecological survey for only 1 day (4 hours) during the early summer months (November). Rain had fallen prior as well as during the site visit in November. Although restricted to a single site visit the entire sites proposed for the expansion and parking areas are completely transformed and the concrete embanked channel or canalised section of the Jukskei is of low sensitivity and ecological functioning.
- The majority of threatened species are extremely seasonal only emerging after sufficient heavy early summer rainfall (November-March).
- The majority of threatened species are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons/ years.
- Limitation of historic data and available databases for the areas.
- The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records) and previous surveys conducted in similar habitats between 1991-2017).
- The majority of the red data atlases are outdated especially pertaining to frogs as well as inadequate coverage of some areas by the atlases.

2.5 Gaps in the baseline data

- Little long-term, verified data of faunal species distribution on micro-habitat level along the proposed alignments.
- Little long-term, verified data on impacts of the on-going sewerage spillages, current formal residential activities and vagrants on the fauna.
- The riverine habitats of the Jukskei River have been completely transformed and the rivers and artificially channelled in a concrete embanked channel with no natural "in-stream' habitats. The section of the Jukskei River has been transformed into a sterile stormwater drain with high levels of alien invasive vegetation above the concrete/rock embankments. A few alien invasive and weedy plants have colonised the cracks in the concrete embankments (*Grevillea robusta*, Acer buergerianum**).

3. Vegetation and Faunal habitat Availability

Vegetation structure is generally accepted to be more critical in determining faunal habitat than actual plant composition. Therefore, the description of vegetation presented in this study concentrates on factors relevant to faunal species abundance and distribution, and does not give an exhaustive list of plant species which occur in the study area. No comprehensive vegetation or faunal surveys were conducted due to time and financial constraints and faunal species lists provided in the Appendix are of species most likely to occur on the site using habitat as an indicator of species presence. The study area falls within the Johannesburg 2628 AA quarter degree grid cell. Vegetation composition in the area consists of Mesic Highveld Grasslands in various stages of transformation and degradation falling within the **Soweto Highveld Grassland (Gm 8)** vegetation unit. **No natural Soweto Highveld grassland occurs on the site or within the adjacent Bezuidenhout Valley area**.

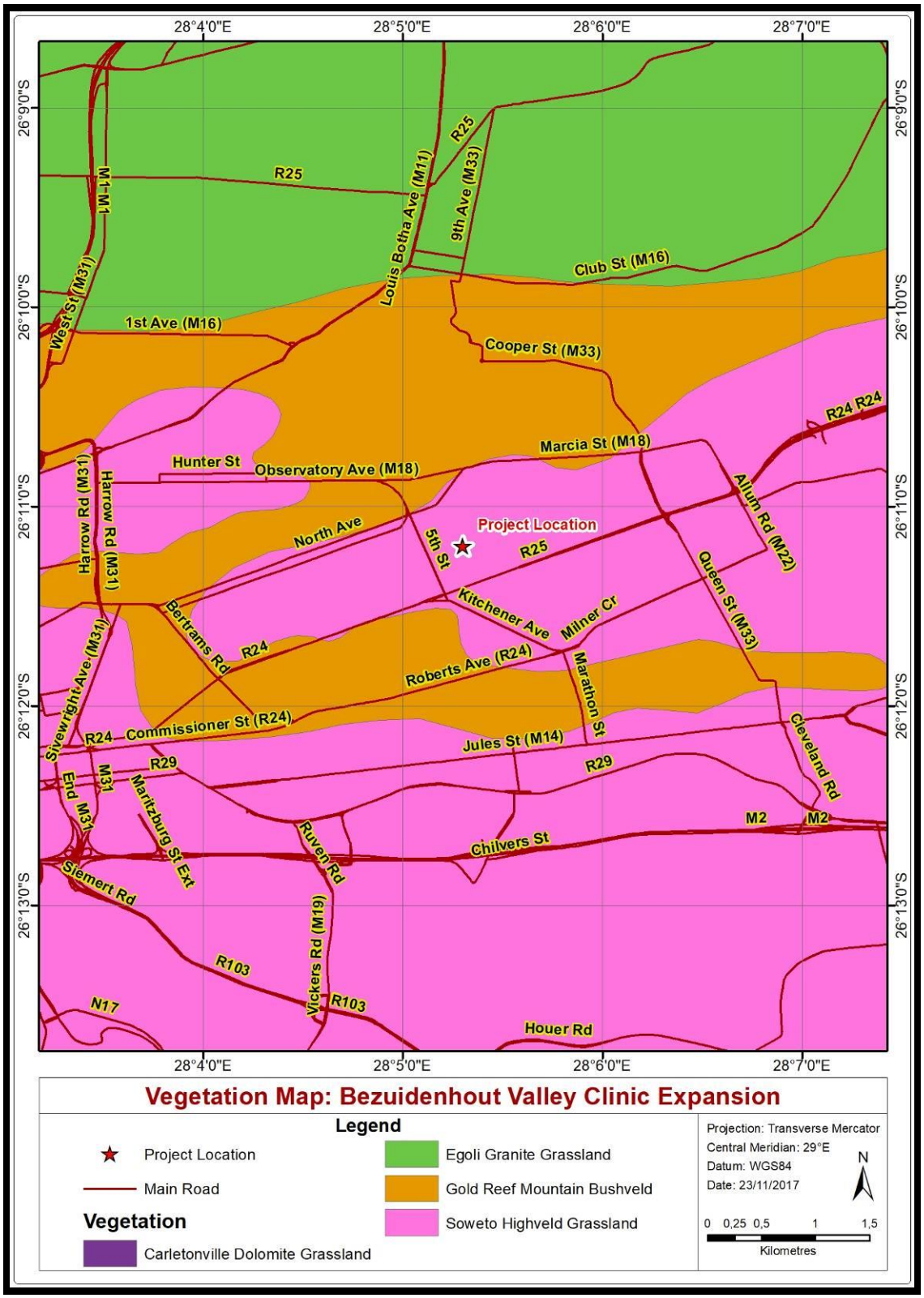

Figure 2. Vegetation types observed proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area (adapted from Mucina et al. 2006).

Figure 3. A collage of photographs displaying the major habitats observed within the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area. A: The project involves the expansion of the existing Bez-valley Clinic. The clinic and adjacent residential properties and parks comprise of completely transformed Soweto Highveld Grassland. **B**: The proposed expansion site is situated within a completely transformed vacant stand immediately adjacent o the clinic. The vacant stand is dominated by the exotic and alien invasive Kikuyu (*Pennisetum clandestinum**), pioneer weedy plant and grass species as well as scattered alien invasive plant and tree species. **C:** The proposed parking area is situated within a completely transformed kikuyu dominated park. No indigenous vegetation remains within the regularly maintained expansive lawns. **D:** The two sites are separated by the artificially channelled Jukskei River. The artificially concreted lined channel displays no natural riparian vegetation and no 'in-stream' habitats. A burst bulk sewer line occurs immediately adjacent to the concrete stormwater channel results in deterioration of water quality. Medium-High levels of alien invasive vegetation occurs along the canalised section of the Jukskei River.

3.2. Vegetation type

Mesic Highveld Grassland is found mainly in the eastern, precipitation-rich regions of the Highveld, extending as far as the Northern Escarpment. These are predominantly 'sour' grasslands and are dominated primarily by andropogonoid grasses. The different grassland units are distinguished on the basis of geology and other substrate properties, as well as elevation, topography and rainfall.

The vegetation of the site falls within the **Soweto Highveld Grassland (Gm 8)** vegetation unit (Mucina & Rutherford 2006) or **Moist Clay Highveld Grassland** (35) (Low & Rebelo 1995).

Synonyms:

Turf Highveld (A52), *Themeda triandra-Aristida bipartita* Grassland.

Statistics:

10 265 km2; ~ 79% transformed; 0.00% conserved.

Locality & Physical Geography:

Mpumalanga, Gauteng (and to a very small extent into neighbouring Free State and North-West) Provinces: In a broad band roughly delimited by the N 17 road between Ermelo until Johannesburg in the north, Perdekop in the southeast and the Vaal River (border with the Free State) in the south it extends further westwards along the southern edge of the Johannesburg Dome (including part of Soweto) as far as the vicinity of Randfontein. In southern Gauteng it includes the surrounds of Vanderbijlpark and Vereeniging as well as Sasolburg in the northern Free State. Found in the Bethal-Standerton area in the southern parts of Mpumalanga, on flat to slightly undulating plains, at 1 420-1 760 m.

Vegetation & Landscape Features: The vegetation is dominated by grasses species reaching a height of ~1.0 m (*Themeda triandra*) while the herbaceous component (averages 0.9 m tall) comprises a cover of about 5%. Dominant species are *Themeda triandra* and *Hyparrhenia hirta.* In places not disturbed, on scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover. No patches of natural *Themeda triandra* grassland, ridges or large rocky outcrops were observed on the site or adjacent areas.

Geology and Soils Shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) or the intrusive Karoo Suite dolerites which feature prominently in the area. In the south, the Volksrust Formation (Karoo Supergroup) is found and in the west, the rocks of the older Transvaal, Ventersdorp and Witwatersrand Supergroups are most significant. Soils are deep, reddish on flat plains and are typically Ea, Ba and Bb land types. The predominating soils along the drainage lines and valley bottom wetlands are very clayey, black vertic or near vertic, mostly of montmorillonitic clays.

Vegetation:

Red grass *Themeda triandra* exclusively dominates areas which are not severely degraded. Characteristic species are Three-awn Rolling Grass *Aristida bipartita,* Black-seed Fingergrass *Digitaria ternata,* Large-seed Setaria *Setaria nigrirostris, S. incrassata* and *Panicum coloratum.* Other important species are Weeping Lovegrass *Eragrostis curvula,* Speargrass *Heteropogon contortus,* Golden Setaria *Setaria sphacelata, Elionurus muticus, Microchloa caffra, Brachiaria serrata, Eragrostis plana* with Feathered Chloris *Chloris virgata,* Couchgrass *Cynodon dactylon* and Tassel Bristle grass *Aristida congesta* prominent at degraded sites.

Dicotyledonous forbs are prominent and include *Berkheya pinnatifida,* Flower-in-a-cage *Crabbea acaulis,* Hair-flower *Chaetacanthus costatus, Salvia repens, Pseudognaphalium luteo-album, Abildgaardia ovata, Anthospermum pumilum, Bulbostylis contexta* and *Evolvulus alsinoides.* Low forb diversity observed in study are due to annual grass harvesting as well as extensive livestock grazing activities.

IMPORTANT TAXA

Graminoids (Grasses): *Andropogon appendiculatus*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Cynodon dactylon,*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. curvula*, *E. plana*, *E. planiculmis*, *E. racemosa*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Setaria nigrirostris*, *S. sphacelata*, *Themeda triandra*, *Tristachya leucothrix*, *Andropogon schirensis, Aristida adscensionis, A. bipartita, A. congesta, A. junciformis* subsp. *galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra, Paspalum dilatatum.*

Herbs: *Hermannia depressa*, *Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera* var. *aspera, Graderia subintegra Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium* var. *nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effusa, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*

Geophytic Herbs: *Crinum* spp., *Haemanthus humilis* subsp. *hirsutus, H. montanus.*

Herbaceous Climber: *Rhynchosia totta.*

Low Shrubs: *Anthospermum hispidulum, A. rigidum* subsp. *pumilum, Berkheya annectens, Felicia muricata, Ziziphus zeyheriana.*

Key Environmental Parameters*:*

This vegetation type is restricted to very clayey soils of the high rainfall areas of the southern Mpumalanga highveld.

Economic Uses*:*

The clay soils are often not ploughed, and mostly utilised for grazing by cattle and sheep. The site is currently utilised for maze lands and the remaining open Mesic Highveld grasslands for extensive cattle grazing activities. Existing embanked dams as well as the powerline occur within the area.

Conservation Status*:*

Soweto Highveld grasslands are considered to be **Endangered**. The conservation target is 24%. Only a handful of patches statutorily conserved (Waldrift, Krugersdorp, Leeuwkuil, Suikerbosrand, Rolfe's Pan Nature Reserves) or privately conserved (Johanna Jacobs, Tweefontein, Gert Jacobs, Nikolaas and Avalon Nature Reserves, Heidelberg Natural Heritage Site). Almost half of the area already transformed by cultivation, urban sprawl, mining and building of road infrastructure. Some areas have been flooded by dams (Grootdraai, Leeukuil, Trichardtsfontein, Vaal, Willem Brummer). Erosion is generally very low (93%).

3.3 Vegetation observed within the study site

The study site occurs on flat to gently undulating terrain sloping towards the central artificially canalised Jukskei River or stormwater channel. The majority of the site comprises homogenous transformed exotic and alien invasive Kikuyu (Pennisetum clandestinum) lawns. The proposed clinic expansion site contains less regularly maintained kikuyu grasslands which have been colonised by weedy and alien invasive plant and tree species. The proposed parking area is dominated by regularly maintained kikuyu lawns and weedy lawn species. The transformed or kikuyu dominated grassland and alien invaded open areas observed within the proposed expansion site and proposed parking area as well as the adjacent open areas are divided into one sensitivity classes namely **Transformed Soweto Highveld Grasslands** with **Low sensitivity**. The artificially canalised Jukskei River or stormwater channel contains no natural hydrophilic and hygrophilous/riparian vegetation and has extremely poor water quality and impoverished habitats and is considered to be of **Low Sensitivity**.

Figure 4. An elevation profile of the proposed clinic's expansion site as well as the proposed parking area. The sites have a gentle slope averaging 3 %. The lowest lying portions of the sites are the artificial stormwater channel or canalised Jukskei River on the southern and northern boundaries.

3.3.1 Transformed and Weed Invaded Kikuyu Grasslands

Vegetation Type	Soweto Highveld Grassland (Gm 8)	**Tree cover**	0-20 %
Soil	Brown sandy soils	**Shrub cover**	0-1 %
Topography	Flat to gently undulating	**Herb cover**	0-5 %
Land use	Residential, clinic and parks	**Grass cover**	20-80 %
Dominant Tree species	*Celtis sinensis*, Morus alba*, Ligustrum japonicum*, Melia azedarach*, Quercus robur, Vachellia karroo, Robinia pseudoacacia*, Solanum mauritianum*, Acer buergerianum*, Grevillea robusta*, Phytolacca dioica**		
Dominant Grass spp.	*Pennisetum clandestinum*, Bromus catharticus, Cyperus esculentus, Hyparrhenia hirta, Cynodon dactylon, Typha capensis*		
Dominant Herb spp.	*Plantago lanceolata, Bidens pilosa, Conyza bonariensis, Tragus, Sonchus asper subsp. asper, Tagetes minuta, Tragopogon dubius, Dichondra micrantha, Trifolium repens, Verbena brasiliensis*, Verbena bonariensis**		

Alien Invasive Species	*Araujia sericifera*, Canna indica*, Celtis sinensis*, Cardiospermum grandiflorum*, Ipomoea purpurea*, Morus alba*, Ligustrum japonicum*, Melia azedarach*, Quercus robur, Vachellia karroo, Robinia pseudoacacia*, Solanum mauritianum*, Acer buergerianum*, Grevillea robusta*, Mirabilis jalapa*, Phytolacca dioica*, Cirsium vulgare*, Lantana camara*, Solanum mauritianum*, Pennisetum clandestinum*, Verbena brasiliensis*, Verbena bonariensis**
Red Data Species	None observed or likely to occur
Sensitivity & Conservation Potential	**Low**

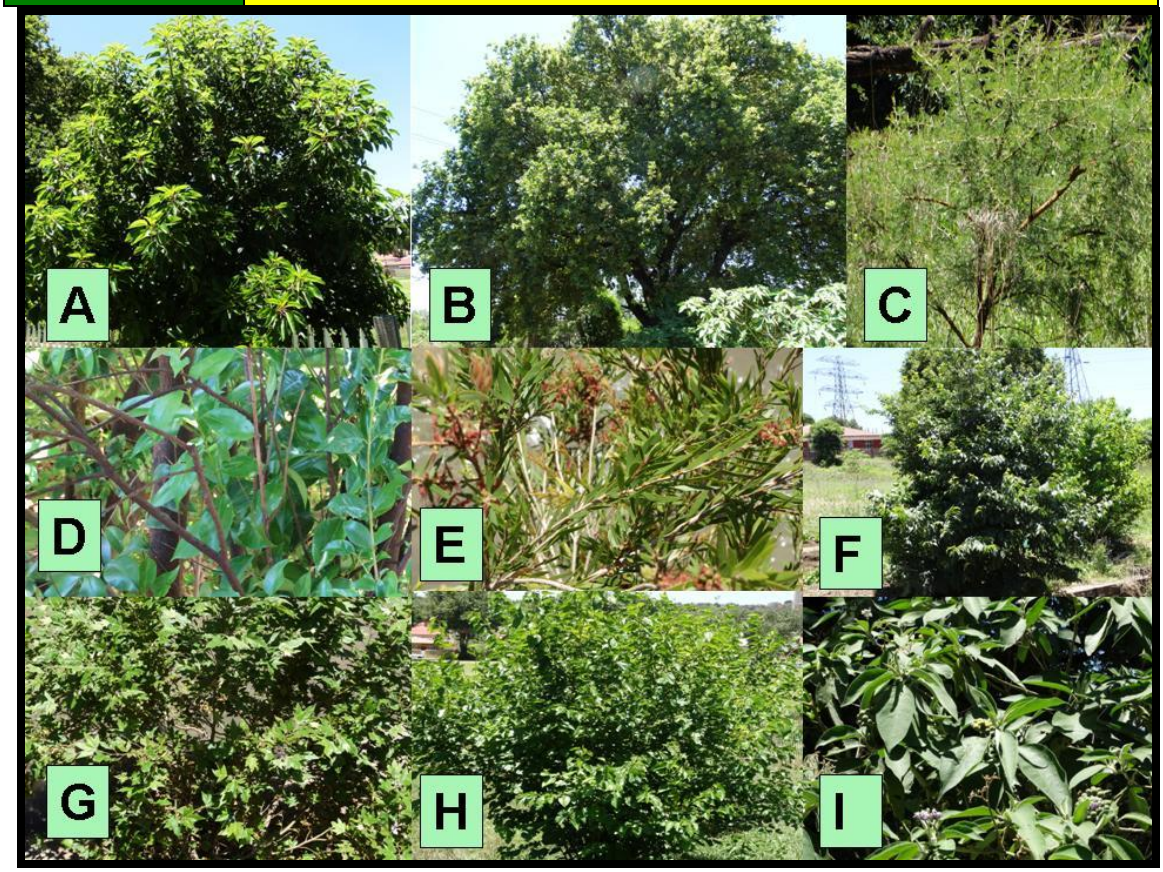

Figure 5. Dominant tree species observed on the sites. A: Belhambra *Phytolacca dioica** (Category 3 Invader); **B:** English Oak *Quercus robur*; **C:** Sweet-thorn *Vachellia karroo*; **D:** Chinese Privet *Ligustrum japonicum** (Category 1b Invader); **E:** Australian Silky Oak *Grevillea robusta** (Category 1b Invader); F: Chinese Nettle Tree *Celtis sinensis** (Category 3 Invader); **G:** Chinese Maple *Acer buergerianum** (Category 3 Invader); **H:** White Mulberry M*orus* alba * (Category 1b Invader) and **I:** Bugweed *Solanum mauritianum** (Category 1b Weed).

The transformed grasslands occur within and adjacent to the proposed sites are dominated by the exotic and alien invasive Kikuyu (*Pennisetum clandestinum**) lawns as well as extensive stands of alien invasive and exotic tree species. The grass layer is well-developed developed in certain areas and dominated by the exotic and invasive *Pennisetum clandestinum** and pioneer weedy plant and alien invasive species. The transformed grasslands comprising road reserves/pavements, alien and exotic tree parklands and kikuyu weed invaded grasslands are considered to be of **low sensitivity** and **conservation potential**.

3.4 Protected Tree Species

In terms of the National Forests Act 1998 (Act No 84 of 1998) certain tree species can be identified and declared as protected. The Department of Agriculture (now Department of Agriculture, Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15 (1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. No protected tree species were observed or are likely to occur on the proposed clinic expansion and parking sites. The area is dominated by completely transformed kikuyu grasslands. The adjacent trees are exotic and mostly invasive species. A single small *Vachellia karroo* has seeded on the site. It should ideally be removed and relocated adjacent to the stormwater canal.

3.5 Red Data / Endemic Species

Several red listed plant species have been listed for the 2628 AA Quarter Degree area of the study site (see Appendix). No suitable habitat occurs within the transformed kikuyu dominated sites for any red listed plant species.

4. RESULTS OF THE INITIAL FAUNAL SURVEY OR HABITAT ASSESSMENT

One general habitat sensitivity scans were carried out on site on the 18th of November 2017. The preliminary site visit did not entail intensive surveying or utilisation of any sampling methods and can rather be viewed as being an opportunity to identify sensitive faunal habitats occurring along the proposed expansion of the existing Bezuidenhout Valley Clinic as well as a proposed new parking area. All animals (mammals (larger), avifauna (birds), reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as animal tracks (footprints, droppings and feathers) to identify animals. The majority of mammals were identified by visual observations as well as droppings and various burrow types. The majority of birds were identified by visual observations as well as calls. Reptiles and amphibians were actively searched for under suitable refuges such as logs, stumps, dumped building rubble, tyres and carpets and identified by actual specimens observed.

4.1 MAMMALS

No small mammal trappings were conducted due to time constraints and the limitations that the results from single night or brief field surveys would pose. The brief fieldwork was augmented with previous surveys in similar habitats as well as published data. Mammal species recorded within the study area as well as those that may occur within the study area, on the basis of available distribution records and known habitat requirements; are included in the Table 2 below. The majority of larger mammal species are likely to have been eradicated or have moved away from the area, as a result of on-going urban sprawl, hunting and poaching as well as severe habitat alteration and degradation within Bezuidenhout Valley. Common Duiker, Southern Reedbuck, Aardvark, Porcupine, Blacked-Back Jackal have however been recorded from surrounding grasslands and rocky ridges situated to the north.

The vegetation on the site is completely transformed and offers extremely limited suitable habitat for remaining mammals species. Mammal species most likely to occur on the site include urban exploiters such as the exotic House rat and House mouse as well as feral cats. The open kikuyu grasslands provide suitable habitat for African Molerats. Low mammal diversity is expected within the transformed and impoverished habitats within the proposed Bez-Valley clinic's expansion site and parking areas.

The site was also surveyed for the following wetland associated mammals:

Cape or African Clawless Otters (*Aonyx capensis*)

The African clawless otter (*Aonyx capensis*) is the larger of the two otter species and is predominantly aquatic (Skinner & Chimimba 2005). It is known to move up tributaries into small streams, provided these streams support an adequate supply of food. This species does not wander widely from water, thus is unlikely to occur in drier grassland areas.

Aonyx capensis is generally solitary, but occasionally occurs in pairs or family groups. They are active swimmers, but generally rest during the heat of the day in dry places, including holes in the ground, cavities under rocks, erosion gullies or dense reed beds adjacent to their habitat. The most important prey item in this environment would be crabs belonging to the genus *Potamonautes* (Skinner and Chimimba 2005). These crabs constitute the highest macro-invertebrate biomass in many rivers of the subregion. As fish are not an indispensable part of their diet, very small streams containing only crabs and frogs can supply these otters with sufficient food. Provided the aquatic conditions are suitable, and there is adequate cover in which to rest, this species bears no relation to the surrounding terrain, so may be found in a variety of habitat types, from pure grassland to mixed bushveld (Skinner & Chimimba 2005).

According to the Regional Red List of Threatened Mammal Species (2016), this species is listed as "Near-Threatened" C2a (i). *Aonyx capensis* is considered an indicator or flagship species. This means that its presence can be used as an accurate indicator of aquatic ecosystem health.

No latrines of Cape Clawless Otters were observed adjacent to the artificially channelled Jukskei River or stormwater channel. Poor water quality due to on-going sewerage contamination into the stormwater channel significantly reduces the likelihood of any Cape Clawless Otters occurring. The channel has limited vegetation and no dense reed beds for refuge and extremely limited suitable foraging and dispersal a habitat for Cape Clawless Otters. The stormwater channel extends into Johannesburg city centre which is a 'High-Risk' area for any remaining Otters.

Spotted-necked Otter (*Hydrictis maculicollis*)

This otter has a longer, slimmer body than *Aonyx capensis*, and is ideally adapted to an aquatic life (Skinner & Chimimba 2005). They are confined to large rivers, lakes and swamps associated with extensive areas of open water and are more closely confined to this habitat than *Aonyx capensis*. They are distinguished from *Aonyx capensis* by having distinctly webbed feet and they lack the characteristic white facial and chest markings of *Aonyx capensis*.

Hydrictis maculicollis is a group-living diurnal species, showing peaks of activity during the early morning and late afternoon. They vocalise frequently, especially during play. Their resting places and dens are found in close proximity to water and are most likely located in dense vegetation cover, excavations under the roots of trees, holes under rock ledges or in holes occasionally excavated by the otters themselves where there is suitable alluvial soil. Their diet consists primarily of fish and the crab species belonging to the genus *Potamonautes* (Skinner and Chimimba 2005).

Spotted-necked otters are adapted ideally to an aquatic life and are confined to the larger river systems, dams, lakes and swamps which have extensive areas of open water. No suitable habitat occurs for this species on the actual site or surrounding degraded Jukskei River for Spotted-necked Otters.

Water or Marsh Mongoose (*Atilax paludinosus*)

This species is so named because of its close association with rivers, streams, marshes, swamps, wet vleis and dams. Although closely associated with an aquatic habitat, *Atilax paludinosus* is known to wander widely from this habitat type when foraging (Skinner & Chimimba 2005). This species will remain in an area even when the water dries up temporarily and show adjustments to environmental changes by converting to a diet consisting of terrestrial food resources. Although opportunistic feeders, their dominant prey item consists of crabs of the genus Potamonautes. A wide variety of terrestrial prey is taken, ranging from mammals to insects. Occasionally plant material is eaten to supplement the diet (Skinner & Chimimba 2005).

Atilax paludinosus is primarily solitary, however breeding pairs and females with offspring can occasionally be seen. Foraging typically occurs at night. While being an excellent swimmer, the marsh mongoose does not readily swim. They rest in piles of grass and other debris in thick reed beds, usually situated on raised ground. The faeces of *Atilax paludinosus* can be distinguished from the otter species by smell. The faeces of the otter species typically smell of fish, while *Atilax paludinosus* faeces characteristically smell like that of other carnivores.

No latrines of Marsh Mongooses were observed adjacent to the artificially channelled Jukskei River or stormwater channel. Poor water quality due to on-going sewerage contamination into the stormwater channel significantly reduces the likelihood of any Marsh Mongoose occurring. The channel has limited vegetation and no dense reed beds for refuge and extremely limited suitable foraging and dispersal a habitat for Marsh Mongoose. The stormwater channel extends into Johannesburg city centre which is a 'High-Risk' area for any remaining Marsh Mongooses.

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Rough-haired Golden Mole (*Chrysopalax villosus*)

No suitable habitat occurs around the artificial stormwater channel and no seasonally inundated wetlands.

African Marsh Rat or Water Rat (*Dasymys incomtus*)

The African marsh rat (*Dasymys incomtus*) is associated with a wet habitat, occurring in the reed beds, semi-aquatic grasses and grassy areas close to water (Skinner & Chimimba 2005). It is a both terrestrial and semi-aquatic species, moving freely in surface runs, even when these are shallowly submerged by water. *Dasymys incomtus* is also a competent swimmer. The feeding area is characterised by scattered grass and reed cuttings (Skinner & Chimimba 2005).

This species is predominantly crepuscular and nocturnal, becoming active towards sunset. Nests are constructed in a depression on sloping ground bordering swampy edge of river, and this species favours grassy tussocks for nesting as this provides cover and protection from predators. This species is most likely solitary, with offspring dispersing soon after weaning. The habitat favoured by this species is also utilised by *Otomys* spp., hence the likelihood of coexistence between these species is high.

No suitable habitat (dense reed beds, semi-aquatic grasses) occurs along the canalised section of the Jukskei River on the site. No runs, burrows or nests were noted on the site during the brief survey.

Angoni Vlei Rat (*Otomys angoniensis*)

The Angoni vlei rat (*Otomys angoniensis*) is are terrestrial and cursorial species, occurring primarily in grasslands and woodlands (Skinner & Chimimba 2005). Although closely associated with dense reed beds and semi-aquatic grasses of vlei and river bed areas, the species is known to occur on drier grasslands far from water. The nest is characteristically domed, constructed from shredded vegetation in clumps of tussock grass above water level. Well-defined runs extend outwards from the nests towards the feeding grounds (Skinner & Chimimba 2005).

Otomys angoniensis is predominantly diurnal, with some crepuscular and nocturnal activity. This habit of *Otomys angoniensis* makes it distinguishable from *Otomys irroratus*, as the species are easily confused when visually observed. *Otomys angoniensis* can be found singly, in pairs or in family parties, again distinguishing it from the closely related *Otomys irroratus*. The species is wholly herbivorous, and short lengths of discarded grass stems mark their feeding grounds (Skinner & Chimimba 2005).

South African Vlei Rat (*Otomys auratus*)

South African Vlei rats (*Otomys auratus*) are so named because of their association with damp vleis and wet grassland on the fringes of streams and swamps (Skinner & Chimimba 2005). They are not, however, strictly confined to this type of habitat. They are predominantly terrestrial and to some extent semi-aquatic, and they will seldom enter the water except when forced to do so. They are wholly herbivorous, eating nearly all plant species occurring in their habitat (Skinner & Chimimba 2005). While they are known to be more abundant in habitats associated with damp soil in vleis, or along streams and rivers, they do occur throughout a variety of grassland types (Skinner & Chimimba 2005). In addition, O*tomys auratus s* is predominantly crepuscular; however the species does show some diurnal and nocturnal activity (Skinner & Chimimba 2005). They are primarily solitary, and are seldom found in groups or pairs. They commonly construct saucer-shaped nests in clumps of grass, which are clearly marked by runs leading to their feeding areas. Short lengths of grass stems characterise their feeding grounds. The angle of the cutting is characteristically at a 45° angle. Coprophagy (the eating of faeces) is common in this species.

No suitable habitat (dense reed beds, semi-aquatic grasses) occurs along the artificially channelled section of the Juskei River. No runs, burrows or nests were noted on the site during the brief survey. No evidence of runs or domed nests of shredded vegetation in clumps of tussock grasses were observed. No piles of short lengths of discarded grass stems were observed (foraging areas). No natural

grassland areas occur on the site which is dominated by exotic lawns and trees as well as weedy plant species.

Table 1: Mammal species recorded in the study area during the brief field survey and supplemented from previous surveys conducted in similar habitats and in the Johannesburg area (introduced species are in bold).

COMMON NAME	SCIENTIFIC NAME
Transvaal free-tailed Bat	*Tadarida ventralis*
Scrub Hare	*Lepus saxatilis*
House Mouse	***Mus musculus***
*African (Common) Mole-rat	*Cryptomys hottentotus*
Four-striped Grass Mouse	*Rhabdomys pumilio*
Pouched Mouse	*Saccostomus campestris*
Natal Multimammate Mouse	*Mastomys natalensis*
House Rat	***Rattus rattus***
Domestic Cat	***Felis catus***
Common Genet	*Genetta genetta*
Yellow Mongoose	*Cynictis penicillata*
Slender Mongoose	*Galerella sanguinea*

*** observed during current survey**

THREATENED SPECIES

According to the "South African Red Data Book of Terrestrial Mammals" (Smithers 1986) and Skinner and Smithers (1990) updated by the IUCN Council in December 1995, the study area falls within the distribution ranges of 12 species which are placed into one of known threatened species (Endangered, Vulnerable and Rare).

Due to the high levels of habitat destruction as well as human activity within the study area it is however unlikely that the study area comprises significant habitat for any species of threatened mammal. Low mammal diversity is expected from the completely transformed and impoverished habitats on the site.

4.2 AVIFAUNA/BIRDS

Due to time constraints no comprehensive bird lists could be compiled. During brief site visitations (total of 4 hrs), 14 bird species were recorded (see Table 8). According to the second South African Bird Atlas Project (SABAP2) 204 bird species have been recorded within the 2610_2805 pentad. The majority of bird species recorded during the brief field survey are common, widespread and typical of an urban residential habitat. Numbers of bird species in the Bezuidenhout Valley area have declined mainly due to increased levels of human disturbances (quad and off-road bikes); extensive habitat transformation due to increased urban sprawl; as well as severe habitat degradation of the wetlands due to massive amounts of raw or untreated sewerage entering into the river systems (Jukskei). Human activity has transformed grasslands in South Africa to a point where few pristine examples exist (Low & Rebelo 1996; Barnes 1998). Factors such as agricultural intensification, increased pasture management (overgrazing), decrease in grassland management due to frequent fires and land-use alteration (urbanisation).

Continuing pressure on sensitive wetland and surrounding open moist grassland habitat are largely responsible for the decline of the threatened avifaunal species. Low bird diversity was observed within the transformed areas of the site and included urban exploiters such as Common Mynah, Cape Sparrow, House Sparrow, Red-eyed Dove, Cattle Egret, Cape Turtle Dove, Rock Dove, Laughing Dove, Hadeda Ibis and Pied Crow.

Table 2: Threatened bird species recorded in the Bezuidenhout area.

Species	Conservation status (2014)	Habitat requirements (Barnes 2000; Hockey *et al*	SABAP2 Reporting rate 2610_2805	Likelihood of interaction with proposed infrastructure

		2005; Harrison *et al* 1997; personal observations)	(%)	
Verreauxs' Eagle *Aquila verreauxi*	Vulnerable	Mountainous and rocky areas with large cliffs for breeding. Breeding pair at Walter Sisulu Botanical Gardens	0.98	Low
Half-collared Kingfisher *Alcedo semitorquata*	Near threatened	Fast-flowing clear, streams and rivers. Observed around artificially created dams	3.24	Low

It is highly unlikely that any Red Data bird species will be displaced by the habitat transformation that will take place as a result of the expansion of the clinic and parking area. The impact on smaller, non-Red Data ground-nesting species that are potentially breeding in the area (very limited) due to regular mowing of grasses will be local in extent, in that it will not affect regional or national populations in any significant way. The site offers no suitable habitat for any threatened bird species and impoverished habitats for remaining bird species.

4.3 REPTILES

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe during field surveys. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to human presence in the area coupled with increased habitat destruction and disturbances around the site are all causal factors in the alteration of reptile species occurring on the site and surrounding areas. No low-lying rock outcrops or extrusions occur throughout the site and hence the lack of rupicolous species.

No termite mounds *Trinervitermes haberlandii* were observed on or adjacent to the sites. Termite mounds offer important refuges for numerous frog, lizard and snake species. Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna.

Termite mounds also provide nesting site for numerous snakes, lizards (varanids) and refuge habitats for several smaller mammals (shrews) and frogs. No large indigenous tree species were observed on the site. Trees including stumps, bark and holes are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas,

geckos and monitors). The majority of tree species occurring within and adjacent to the proposed sit are exotics and alien invasive species.

The indiscriminate killing of all snake species as well as the illegal collecting of certain species for private and the commercial pet industry reduces reptile populations especially snake populations drastically. The frequent mowing of the kikuyu dominated lawns on the site will have a high impact on remaining reptiles. The mowing of the grasses significantly reduces the vegetative cover and could possible result in increased predation levels. Low reptile diversity within the transformed kikuyu dominated park as well as weed invaded vacant stand.

Reptile species recorded from the Bezuidenhout Valley during the current and previous surveys included Rinkhals (*Hemachatus haemachatus*), Mole Snake (*Pseudaspis cana*), Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Montane Speckled Skink (*Trachylepis* (*Mabuya*) *punctatissima*), Cape Skink (Trachylepis (*Mabuya*) *capensis*) Ground Agama (*Agama aculeata*), Cape Thick-toed Gecko (*Pachydactylus capensis)*. The wetlands including dams offer suitable habitat for South African Marsh terrapin (*Pelomedusa galeata*) and Water Monitor (*Varanus niloticus*). The poor water quality as well as high levels of anthropogenic disturbances along the Jukskei River significantly reduces the suitability.

Low reptile diversity is expected from the site and adjacent area due to extensive habitat transformation and degradation as well as high levels of anthropogenic disturbances. Two reptile species were recorded namely the urban exploiting Cape Dwarf gecko *Lygodactylus capensis* and Speckled Rock Skink *Trachylepis punctassissima*.

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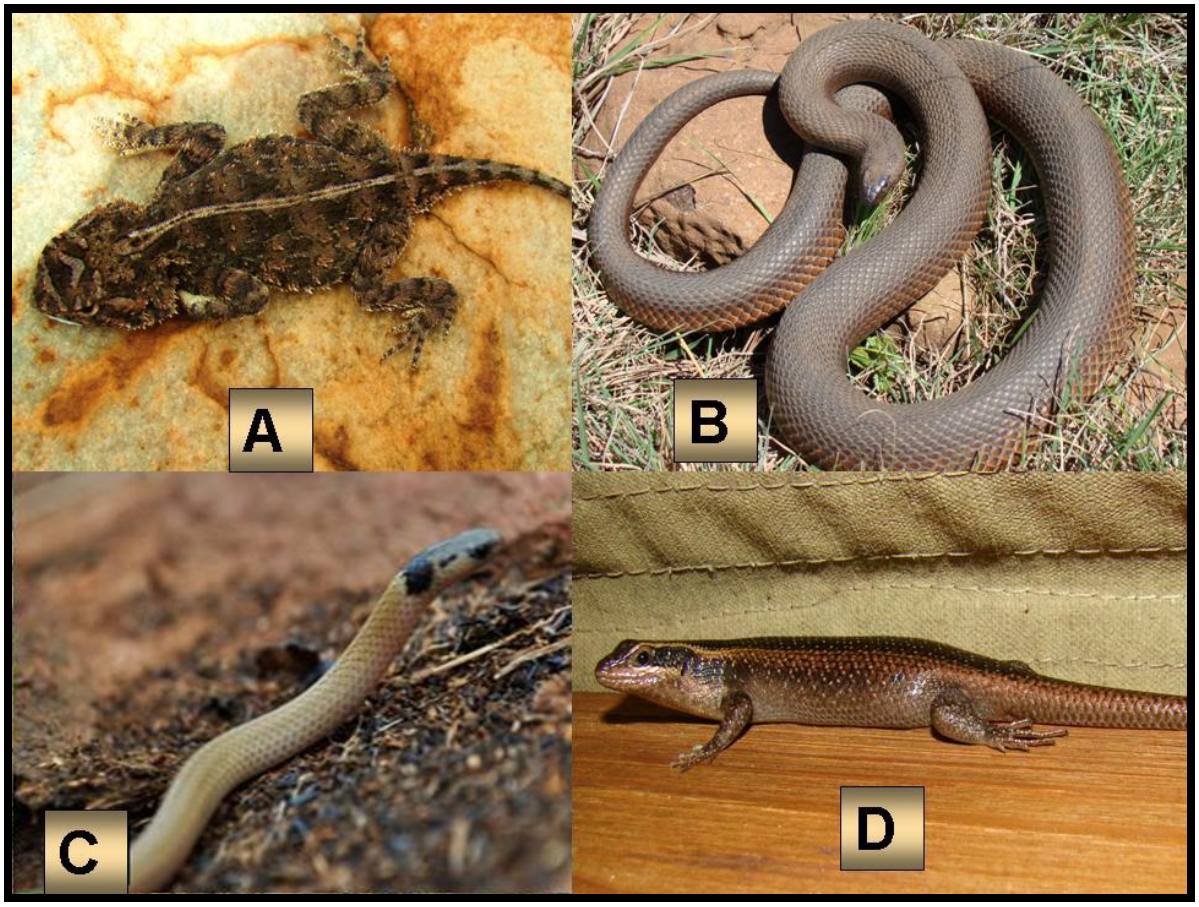

Figure 9: Reptile species likely to occur on the site and adjacent areas include A: Distant's Ground Agama (*Agama aculeata distanti*); **B:** Mole Snake (*Pseudaspis cana*); **C:** Cape or Black-headed (*Aparallactus capensis)*; **D:** *Speckled Rock Skink (*Trachylepis punctatissima*).

Table 3. Reptile species recorded from the 2628 AA QDGC according to ReptileMAP (SARCA 2014).

Family	Common name	Genus	Species	Subspecies	Red list category	No. records	Atlas region endemic
Agamidae	Distant's Ground Agama	*Agama*	*aculeata*	distanti	Least Concern (SARCA 2014)	1	Yes
Agamidae	Southern Rock Agama	*Agama*	*atra*		Least Concern (SARCA 2014)	5	
Chamaeleonidae	Eastern Cape Dwarf Chameleon	*Bradypodion*	*ventrale*		Least Concern (SARCA 2014)	1	Yes
Colubridae	Red-lipped Snake	*Crotaphopeltis*	*hotamboeia*		Least Concern (SARCA 2014)	4	
Colubridae	Rhombic Egg-eater	*Dasypeltis*	*scabra*		Least Concern (SARCA 2014)	4	
Cordylidae	Common Girdled Lizard	*Cordylus*	*vittifer*		Least Concern (SARCA 2014)	1	
Elapidae	Rinkhals	*Hemachatus*	*haemachatus*		Least Concern (SARCA 2014)	4	
Gekkonidae	Common Tropical House Gecko	*Hemidactylus*	*mabouia*		Least Concern (SARCA 2014)	1	
Gekkonidae	Common Dwarf Gecko	*Lygodactylus*	*capensis*	capensis	Least Concern (SARCA 2014)	19	
Gekkonidae	Transvaal Gecko	*Pachydactylus*	*affinis*		Least Concern (SARCA 2014)	8	Yes
Gekkonidae	Cape Gecko	*Pachydactylus*	*capensis*		Least Concern (SARCA 2014)	1	
Gerrhosauridae	Yellow-throated Plated Lizard	*Gerrhosaurus*	*flavigularis*		Least Concern (SARCA 2014)	2	
Lamprophiidae	Black-headed Centipede-eater	*Aparallactus*	*capensis*		Least Concern (SARCA 2014)	3	

Lamprophiidae	Bibron's Stiletto Snake	*Atractaspis*	*bibronii*		Least Concern (SARCA 2014)	1	
Lamprophiidae	Brown House Snake	*Boaedon*	*capensis*		Least Concern (SARCA 2014)	1	
Lamprophiidae	Aurora House Snake	*Lamprophis*	*aurora*		Least Concern (SARCA 2014)	8	Yes
Lamprophiidae	Olive House Snake	*Lycodonomorphus*	*inornatus*		Least Concern (SARCA 2014)	6	Yes
Lamprophiidae	Brown Water Snake	*Lycodonomorphus*	*rufulus*		Least Concern (SARCA 2014)	4	
Lamprophiidae	Cape Wolf Snake	*Lycophidion*	*capense*	capense	Least Concern (SARCA 2014)	1	
Lamprophiidae	Western Yellow-bellied Sand Snake	*Psammophis*	*subtaeniatus*		Least Concern (SARCA 2014)	1	
Pelomedusidae	South African Marsh Terrapin	*Pelomedusa*	*galeata*		Not evaluated	1	
Scincidae	Wahlberg's Snake-eyed Skink	*Panaspis*	*wahlbergii*		Least Concern (SARCA 2014)	1	
Scincidae	Cape Skink	*Trachylepis*	*capensis*		Least Concern (SARCA 2014)	2	
Scincidae	Speckled Rock Skink	*Trachylepis*	*punctatissima*		Least Concern (SARCA 2014)	14	
Scincidae	Variable Skink	*Trachylepis*	*varia*		Least Concern (SARCA 2014)	3	
Testudinidae	Leopard Tortoise	*Stigmochelys*	*pardalis*		Least Concern (SARCA 2014)	1	
Typhlopidae	Bibron's Blind Snake	*Afrotyphlops*	*bibronii*		Least Concern (SARCA 2014)	3	

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

No threatened reptile species have been recorded for the 2628 AA QDGC (SARCA 2014) or are likely to occur within the proposed study area. The proposed expansion of the clinic and parking area will most likely have a **low-negligible**, negative impact on any reptile species (albeit limited) which may occur in the area.

4.4 AMPHIBIANS

The amphibian populations in Gauteng Province are faced with several environmental threats. Habitat destruction and alien vegetation resulting in fragmentation of populations is probably the major threats facing all frog species. Extensive urban sprawl has already resulted in the rapid destruction and fragmentation of the habitat of populations of the species discussed here. Extensive illegal dumping, alien vegetation invasion, sewerage contaminations and severe fires in the grassland catchment areas result in extensive silting up of streams and wetlands, threatening the breeding habitat of these frogs. The biphasic life cycle of most frogs, as well as their semi-permeable skin makes them particularly vulnerable to pollutants and other environmental stresses. Consequently frogs can be used as environmental bio-monitors to indicate the quality of the environment. Chemical pollution and acidification constitute a major threat to frog populations. Heavy metals such as aluminium, cadmium, copper, zinc and iron are all toxic to amphibians. It can be inferred from studies on fish that nickel, lead and manganese will also have deleterious effects on frog populations (Bishop 1996).

Herbicides and pesticides often cause developmental abnormalities or mortalities. A recent report has shown that widely used and apparently safe herbicides containing the active ingredient glyphosphate are extremely toxic to tadpoles and frogs (Bishop 1996). These herbicides are widely used in agricultural lands, plantations, as well as in nature reserves for alien plant control and the making of firebreaks.

Another threat to the continued survival of these frog species, is the damming of rivers, streams and wetlands. In many cases this action is followed by the introduction of alien fish species, with their associated parasites, for angling purposes in these pans and dams. The preferred breeding habitat of five of the species discussed is natural, shallow, ephemeral pools and streams in palustrine wetlands. Deeper man-made dams and weirs alter and shrink the breeding habitat of these frogs considerably. Invasive predator fish species may also be a threat to the survival of the species. The on-going sewerage spills into the Jukskei River, pans and wetlands results in severe deterioration of water quality and has a high impact on remaining frog species.

No actual survey was undertaken due to extreme time constraints for an adequate herpetological survey. The majority of species in Gauteng Province are classified as explosive breeders completing their short duration reproductive cycle in the early summer months between (November-January). These frog species only emerge after the first heavy summer rainfalls and are dormant during the cold winter months. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles.

The brief amphibian survey was undertaken for 1 day (no nocturnal surveys) during the early summer months (November). It had rained within the previous 24 hours as well as during the site visit. One frog was recorded during the brief field survey on the site a single Guttural Toad (*Sclerophrys gutturalis*). No frog species were observed calling or breeding within the concrete stormwater channel. The majority of frog species recorded or likely to occur on the site are common and widespread and typical of degraded wetlands as well as artificially created stormwater channel environment.

Table 4: List of frog species recorded from the 2628 AA QDGC according to FrogMAP.

Family	Common name	Genus	Species	Red list category	No. records	Atlas region endemic
Bufonidae	Red Toad	*Schismaderma*	*carens*	Least Concern	9	
Bufonidae	Raucous Toad	*Sclerophrys*	*capensis*	Least Concern	2	
Bufonidae	Guttural Toad	*Sclerophrys*	*gutturalis*	Least Concern	11	
Hyperoliidae	Bubbling Kassina	*Kassina*	*senegalensis*	Least Concern	2	
Pipidae	Common Platanna	*Xenopus*	*laevis*	Least Concern	8	
Pyxicephalidae	Delalande's River Frog	*Amietia*	*delalandii*	Least Concern	6	Yes
Pyxicephalidae	Cape River Frog	*Amietia*	*fuscigula*	Least Concern	1	
Pyxicephalidae	Common Caco	*Cacosternum*	*boettgeri*	Least Concern	6	
Pyxicephalidae	Giant Bull Frog	*Pyxicephalus*	*adspersus*	Near Threatened	4	
Pyxicephalidae	Tremelo Sand Frog	*Tomopterna*	*cryptotis*	Least Concern	2	
Pyxicephalidae	Natal Sand Frog	*Tomopterna*	*natalensis*	Least Concern	4	

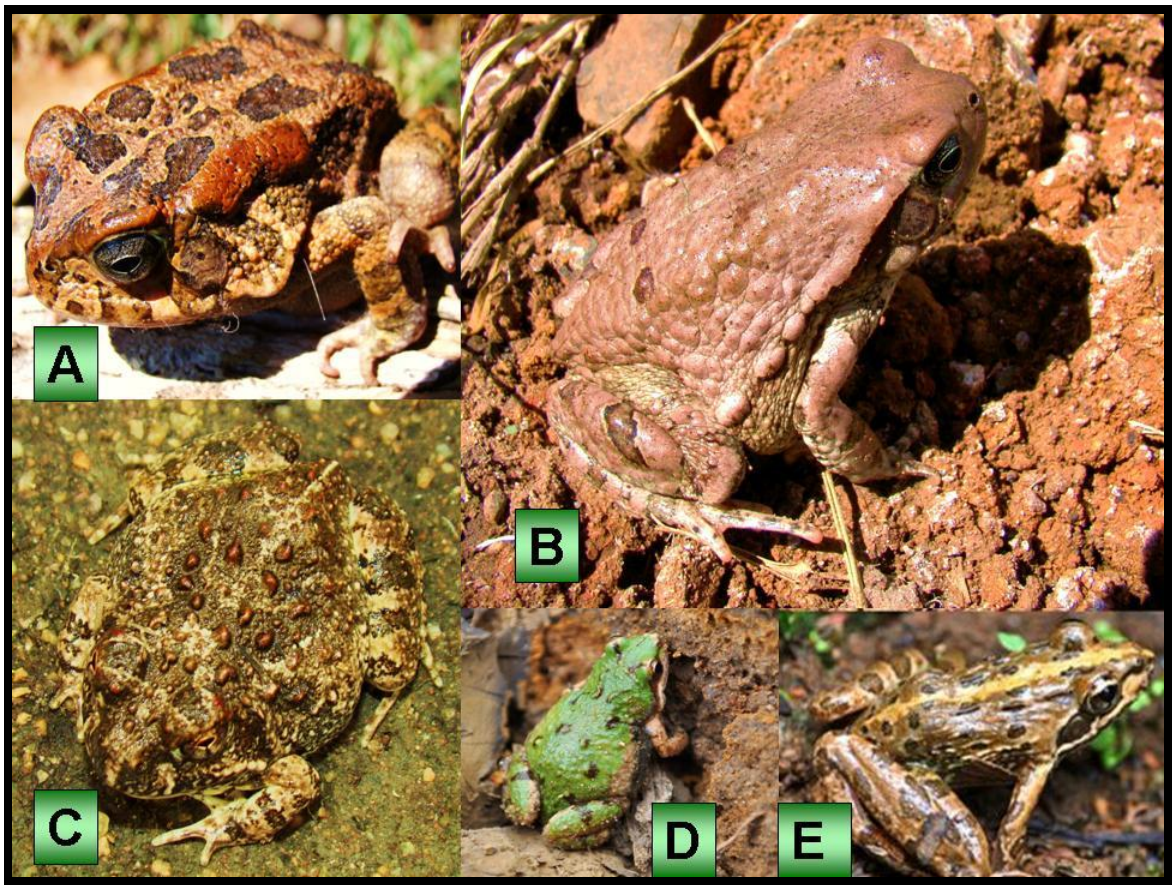

Figure 10 . A collage of photographs displaying frog species recorded (*) during brief field survey or likely to occur in suitable habitat around the site. **A: ***Guttural Toad (Sclerophrys *gutturalis*); **B:** Red Toad (*Schismaderma carens*); **C:** Tremelo Sand Frog (*Tomopterna cryptotis*); **D:** Common Caco (*Cacosternum boettgeri*) and **E:** Delalande's River Frog (*Amietia delalandii*).

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

Figure 11. Four record of Giant Bullfrogs have been recorded from the 2628 AA QDGC according to FrogMAP.

Giant Bullfrog *(Pyxicephalus adspersus)*

As the largest southern African frog, it spends most of the year underground encased in a transparent cocoon, emerging only after heavy thunderstorms in summer. The Bullfrog breeds in shallow, temporary rain-filled pans and small wetlands in grassland and savanna (Passmore and Carruthers 1995), as well as in the Great Karroo (SAFAP). Although the species occurs widespread in southern Africa (Lambiris 1988), the populations in Gauteng and Mpumalanga are threatened by habitat degradation and fragmentation.

The Giant Bullfrog is currently assigned as a near-threatened species (IUCN Red List category). Giant Bullfrogs have been recorded from the 2628 AA quarter degree grid squares during the South African Frog Atlas Project (SAFAP). Bullfrog density commonly varies within certain habitats (open grassland habitat). High densities are often associated with specific microhabitats or patches (hygrophytic or aquatic ephemerophytic grass and sedge dominated temporary pans) that can be identified and randomly sampled. Emphasis must be placed on remaining natural open grassland habitats (important migratory and foraging areas) as well as seasonal wetlands (drainage and marshland vegetation) surrounding the site. Due to the deterioration of water quality as well as lenthic or flowing stormwater channel; it is highly unlikely that the artificially created stormwater channel constitutes suitable breeding habitat for Giant Bullfrogs. The adjacent transformed grasslands offer no suitable foraging and extremely limited dispersal habitat due to existing houses, wall and primary access roads.

The expansion of the clinic and parking areas will pose a limited threat to the amphibians occurring in the area, largely due to extensive habitat transformation and destruction as well as increased anthropogenic impacts already evident at the sites. The on-going burst and leaking sewer lines have resulted in deterioration of water quality within the stormwater channel and would have had a negative impact on the remaining frog species which breed in this degraded and impoverished habitats. Low amphibian diversity is expected from the Bezuidenhout Valley area and the adjacent degraded Jukskei River.

5. SENSITIVE HABITATS ON THE SITE AND ADJACENT AREAS

From a desktop study using inter alia aerial photographs and Google Earth ™ imagery as well as preliminary site investigation (18th of November 2017) the following four sensitivity categories of areas were identified:

High: Areas with high species richness and habitat diversity comprising natural indigenous plant species. These areas are ecologically valuable and important for ecosystem functioning.

Medium-High: An area with a relatively natural species composition; a threatened or unique ecosystem; moderate species and habitat diversity. These areas are ecologically valuable and important for buffering adjacent ecosystem functioning (valley bottom wetlands).

Medium: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity but is currently degraded. Could be developed with mitigation and expected low impact on adjacent ecosystems.

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants. Development could be supported with little to no impact on the adjacent natural vegetation / ecosystem. The entire site and stormwater channel are considered low sensitivity

Figure 11 . Preliminary sensitivity map for the expansion of the Bez valley Clinic and parking area

6. IMPACT RANKING OF POTENTIAL IMPACTS TO ASSOCIATED FAUNA

The activities associated with a given development project may have impacts during the construction and/or operational phases. In this report, the assessment of impacts was divided into two phases associated with a project. These are i) the *construction phase* including surveying and other activities associated with the planning of the project, construction and all the activities associated with construction until the contractor leaves the site and iii) the *operational phase* which includes all activities associated with the operation and maintenance of the proposed development. The criteria against which the activities were assessed are presented in the tables below.

Table 6: Criteria to be used for the Rating of Impacts

Criteria	Extent			
EXTENT	National (4) The whole of South Africa	Regional (3) Provincial and parts of neighbouring provinces	Local (2) Within a radius of 2 km of the construction site	Site (1) Within the construction site
DURATION	Permanent (4) Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient	Long-term (3) The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory.	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Short-term (1) The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase
INTENSITY	Very High (4) Natural, cultural and social functions and processes are altered to extent that they permanently cease	High (3) Natural, cultural and social functions and processes are altered to extent that they temporarily cease.	Moderate (2) Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
PROBABILITY OF OCCURRENCE	Definite (4) Impact will certainly occur	Highly Probable (3) Most likely that the impact will occur	Possible (2) The impact may occur	Improbable (1) Likelihood of the impact materialising is very low

Table 7: Criteria for the Rating of Classified Impacts.

Class	Description
Any positive value	Any positive / beneficial 'impact', i.e. where no harm will occur due to the activity being undertaken.
Low impact (1-5 points)	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
Medium impact (6-10 points)	Mitigation is possible with additional design and construction inputs.
Medium-High impact (11 -15 points)	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment
High impact (16 -20 points)	The design of the site may be affected. Mitigation and possible remediation are essential during the construction and/or operational phases. The effects of the impact may affect the broader environment.
Very high impact (21 - 25 points)	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a "very high impact" is likely to be a fatal flaw.
Status	Denotes the perceived effect of the impact on the affected area.
Positive (+)	Beneficial impact.
Negative (-)	Deleterious or adverse impact.
Neutral (/)	Impact is neither beneficial nor adverse.

Significance = P + F + E + D + I

Minimum value of 5, maximum of 25

Status determines if positive / negative It is important to note that the status of an impact is assigned based on the status quo – i.e. should the project not proceed. Therefore, not all negative impacts are equally significant.

Table 8: Summary table of ranking of potential impacts of the construction phase of the expansion of the clinic and parking area on vegetation and associated fauna.

POTENTIAL IMPACT	EXTENT	DURATION	INTENSITY	PROBABILITY OF OCCURRENCE	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Loss of Protected or rare plant species	Site (1) Within the construction sites	Long-term (3) The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory.	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Loss of Faunal Habitat	Site (1) Within the construction servitude	Long-term (3) The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory.	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Threatened Fauna	Site (1) Within the construction servitude	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**

Deterioration of Water Quality within stormwater channel	Site (1) Within the construction sites	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated.	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected cease.	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Increased Human Presence	Site (1) Within the construction sites	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Vegetation Clearance	Site (1) Within the construction servitude	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Alien Vegetation	Site (1) Within the construction site	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Moderate (2) Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	Site (1) Within the construction site	**Medium impact (6-10 points)**	**Low impact (1-5 points)**

Table 9: Summary table of ranking of potential impacts of the operational phase of the Bez-valley clinic and parking area on vegetation and associated fauna.

POTENTIAL IMPACT	EXTENT	DURATION	INTENSITY	PROBABILITY OF OCCURRENCE	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Loss of Protected or rare plant species	Site (1) Within the expanded clinic and parking areas	Long-term (3) The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory.	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Loss of Faunal Habitat	Site (1) expanded clinic and parking areas	Long-term (3) The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory.	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Threatened Fauna	Site (1) expanded clinic and parking areas	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**

			processes are not affected			
Deterioration of Water Quality within stormwater channel	Site (1) Within the expanded clinic and parking areas	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated.	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected cease.	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Increased Human Presence	Site (1) expanded clinic and parking areas	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Vegetation Clearance	Site (1) expanded clinic and parking areas	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Low (1) Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected	Improbable (1) Likelihood of the impact materialising is very low	**Low impact (1-5 points)**	**Low impact (1-5 points)**
Alien Vegetation	Site (1) Within the construction site	Medium-term (2) The impact will last for the period of the construction phase, where after it will be entirely negated	Moderate (2) Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	Site (1) Within the construction site	**Medium impact (6-10 points)**	**Low impact (1-5 points)**

7. POTENTIAL IMPACTS OF THE PROPOSED EXPANSION OF BEZ-VALLEY CLINIC DEVELOPMENT ON THE ASSOCIATED FAUNA & FLORA

7.1 HABITAT DESTRUCTION AND ASSOCIATED DISTURBANCES TO REMAINING FAUNAL SPECIES

At a local scale the proposed Bez-Valley Clinic's expansion site and proposed parking areas comprises transformed and degraded habitats and vegetation and provides extremely limited suitable habitat for remaining animal species; and no suitable habitat for any threatened plant or faunal species. Due to high levels of human disturbance on the site and surrounding areas the majority of sensitive or rare species have disappeared or found suitable habitat away from the site. The proposed expansion of the clinic and parking areas will most-likely have an impact of **low; short-long term significance** on the remaining fauna if construction activities are restricted to the vacant and kikuyu parkland. An alien invasive removal programme needs to be implemented prior to construction activities in order to prevent further infestations within the site and adjacent stormwater canal.

During the construction phase of the proposed expansion of the clinic and parking areas and access bridge over the canalized section of the Jukskei River, some habitat destruction and alteration inevitably takes place. As the entire proposed sites are in transformed grassland habitats; extremely limited vegetation clearance will be required during the construction and operational phase of the project. Vegetation clearance will be restricted to the kikuyu and alien invaded and pioneer weedy ruderals dominated areas. These activities will have an impact on the associated fauna especially ground living and fossorial species occurring along or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. The proposed impact will be of **low; short-long term impact** on remaining (albeit) limited faunal species.

MITIGATION AND RECOMMENDATIONS

The following general recommendations are made to minimise the impacts of proposed Bez-valley clinic expansion on the immediate environment and remaining fauna:

- Close site supervision must be maintained during construction. A suitably qualified independent Environmental Control Officer (ECO) must be appointed to manage the project.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction within the site and access to the undeveloped areas, especially the stormwater channel must be strictly regulated ("no-go" areas during construction as well as operational activities).
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) and surface water in the area. Mobile toilets must be provided in order to minimize un-authorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed from the stream on completion of construction. All alien invasive plant should be removed from the sites as well as embankments above the stormwater channel to prevent further invasion.
- The embankments above the stormwater channel should be appropriately re-vegetated with indigenous plant species (see attached species list).
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.

7.2 CONSTRUCTION PHASE

General

- All construction activities should be strictly limited to the construction area. Vegetation clearance should be restricted to the site.
- Sufficient chemical toilets and waste bins must be provided in all areas where construction is taking place. These toilets and bins must furthermore be emptied regularly.
- Sanitation facilities shall be located within 100m from any point of work, but not closer than 10 m from the stormwater channel.
- All earthworks shall be undertaken in such a manner so as to minimize the extent of any impacts.
- Construction activities are to be restricted to business hours in order to limit disturbance of surrounding land owners in terms of *inter alia* noise.
- All vehicles associated with the construction activities should be in a serviced condition to prevent oil leaks etc and the possible contamination of the stormwater channel.

7.3 Erosion and Surface runoff

Urban development is characterised by large areas of sealed surfaces such as roads, houses etc. Impermeable surface cover ranges from 15% to 60% of suburban areas to almost 100% in central business districts. Infiltration is considerable reduced with an increase in surface run-off. Run-off is generally discharged to surface water systems and often contains pollutants. Pollutants range from organic matter, including sediments, plant materials and sewage, to toxic substances such as heavy metals, oils and hydrocarbons. Construction activities associated with urban development can lead to massive short-term erosion unless adequate measures are implemented to control surface run-off.

Mitigation and recommendations

- Vegetation plays a critical role in the hydrological cycle by influencing both the quantity and quality of surface run-off. It influences the quantity of run-off by intercepting rainfall, promoting infiltration and thus decreasing run-off. Vegetation can influence water quality in two ways: by binding soils thus protecting the surface layer, and by intercepting surface run-off thus buffering the pan against suspended and dissolved substances.
- When the speed of the run-off is reduced, suspended particles can settle out and dissolve substances, such as nutrients, can be assimilated by plants. The vegetation has a filtering effect. All storm-water and runoff must not enter directly into the stream. Storm-water and runoff should be channelled

through a natural grassland buffer areas reducing the erosional force and the potential risk of contamination of the concrete channeled stormwater drain.

- The timing of clearing activities is of vital importance. Clearing activities and earth scraping should preferably be restricted to the dry season in order to prevent erosion and siltation. The dry months are also the period when the majority of species are either dormant or finished with their breeding activities.
- Future soil stockpiling areas must follow environmentally sensitive practices and be situated a sufficient distance away from seepage or drainage areas towards the concrete stormwater channel or Jukskei River.
- Severely eroded areas should be stabilised with natural vegetation. The careful position of soil piles, and runoff control, during all phases of development, and planting of some vegetative cover after completion (indigenous groundcover, grasses etc.) will limit the extent of erosion occurring on the site.
- Soil removed from the site is to be appropriately stored for later use in back-filling. Sub-soil and topsoil (the top +/- 30-50 cm of the soil) should be stored separately.
- Soil stockpiles are to be protected from possible erosion, e.g. through covering of the stockpiles with tarpaulin, and limiting the height and angle of the stockpile. Soil stockpiles should not exceed 1 m in height.
- Soil stockpiling areas must be sufficiently situated away from the drainage areas towards the lower-lying stormwater channel.
- Any erosion channels developed during the construction period or during the vegetation establishment period should be backfilled and compacted, and the areas restored to a proper condition. The Contractor should ensure that cleared areas are effectively stabilised to prevent and control erosion.

7.4 Horticultural Activities

Landscape architects, and the developer, have an opportunity to conserve certain faunal biodiversity present on the site and possibly increase the biodiversity of certain animal species (birds). Vegetation has been reported to be the single most important habitat component for all species of animals. Linked to this, is the preservation, maintenance and creation of tracts of natural and ornamental vegetation in all stages of ecological succession, interconnected by corridors or green belts for escape, foraging, breeding and exploratory movements. Landscaping projects are all too frequently characterized by exotic or indigenous (not to the area) trees, planted at the same time, at the same size and are spaced at regular centered settings. The resulting pattern and structure is one of limited vegetation diversity, trees of uniform size, even age stands and little or no under-story planting. Only a few species of animals (urban exploiters) will occupy these limited niches, leading to decreased faunal biodiversity.

Mitigation and recommendation

- Gardens or landscaped areas around the proposed clinic should be planted with indigenous (preferably using endemic or local species from the area) grasses, forbs, shrubs and trees, which are water wise and require minimal horticultural practices.
- A Re-vegetation and Rehabilitation Manual should be prepared for the use of contractors, landscape architects and groundsmen. Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited. All alien vegetation should be eradicated over a five-year period.
- Where the removal of alien species may leave spoil exposed, alternative indigenous species should be established before eradication takes place.

8. REFERENCES

ACOCKS, J.P.H. 1988. *Veld Types of South Africa*. Memoirs of the Botanical Survey of South Africa, No.57: 1-146. Botanical Research Institute, Pretoria.

BISHOP, P. 1996. *Arena: Friends in Low Places*, Vol.3 No. 8. TA Publications, University of the Witwatersrand, Private Bag 3, WITS, 2050.

BRANCH, W.R. 1988. *Field Guide to the Snakes and other Reptiles of Southern Africa*. Struik Publishers, Cape Town.

BRONNER, G.N. 1996. Geographic patterns of morphometric variation in the Hottentot golden mole, *Amblysomus hottentotus* (Insectivora: Chrysochloridae). A multivariate analysis. *Mammalia* 60(4): 729-751.

BRONNER, G.N. 2000. New species and subspecies of Golden Mole (Chrysochloridae: *Amblysomus*) from Mpumalanga, South Africa. *Mammalia,* 64: 41-54.

CARRUTHERS, V.C. 2001. *Frogs and Frogging in South Africa*. Struik Publishers, Cape Town.

COOK, C.L. 1996. *Aspects of the breeding biology and ecology of the Giant Bullfrog Pyxicephalus adspersus*. Unpublished MSc. Thesis, University of Pretoria, Pretoria.

DE GRAAF, G. 1981. *The rodents of southern Africa*. Butterworth Press, Pretoria.

JACOBSEN, N.H.G. 1989. A herpetological survey of the Transvaal. Unpublished Ph.D. thesis, University of Natal, Durban.

IUCN. 2000a. *IUCN Red List Categories*. Prepared by the IUCN Species Survival Commission, IUCN, Gland, Switzerland.

IUCN. 2000b. *The 2000 IUCN Red List of Threatened Species*.

LOW, A.B. and REBELO, A.G. 1998. *Vegetation of South Africa, Lesotho and Swaziland*. D.E.A. &T., Pretoria.

MARAIS, E. and PEACOCK, F. 2008. *The Chamberlain Guide to Birding Gauteng*. Miafra Publishing.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAAK, H.H, BISHOP, P.J, AND KLOEPFER, D. 2004. *Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series 9. Smithsonian Institution, Washington, DC.

MEESTER, J.A.J., RAUTENBACH, I.L., DIPPENAAR, N.J. & BAKER, C.M. 1986. Classification of southern African mammals. *Transvaal Museum Monograph* 5: 1-359.

MUCINA, L AND RUTHERFORD, M.C. (eds) 2006. The *vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. SANBI, Pretoria.

PASSMORE, N.I. and CARRUTHERS, V.C. 1995. *Frogs of South Africa. A Complete Guide*. Wits University Press, Witwatersrand.

ROBERTS, A. 1951. *The mammals of South Africa*. Central News Agency, Cape Town.

SIEGFIED, W.R. 1989. *Preservation of species in southern African nature reserves*. In: Huntley, B.J. (Ed). *Biotic Diversity in Southern Africa*, 186-201. Cape Town: Oxford University Press.

SKINNER, J.D. and SMITHERS, R.H.N. 1990. *The Mammals of the Southern African Subregion*. University of Pretoria, Pretoria.

SKINNER, J.D., and CHIMIMBA, C.T. 2005. *The Mammals of the Southern African Subregion* 3rd ed. Cambridge University Press.

SMITHERS, R.H.N. 1986. *South African Red Data Book-Terrestrial Mammals*. South African National Scientific Programmes Report No. 125: 1-214.

SOIL CLASSIFICATION WORKING GROUP. 1991. Soil Classification: a taxonomic system for South Africa. *Memoirs of the Agricultural Natural Resources of South Africa,* No 15,

VAN OUDTSHOORN, F. 1999. *Guide to grasses of southern Africa*. Briza Publications, Pretoria.

VAN WYK, A. E. & MALAN, S.J. 1998. *Field guide to the wild flowers of the highveld*. Struik Publishers (Pty) Ltd, Cape Town.

9. APPENDIX PROBABLE SPECIES LISTS

Table 5: Bird species recorded during brief field survey (Introduced species are in bold).

Roberts' Number	**Common name**	**Scientific Name**
94	Hadeda Ibis	*Bostrychia hagedash*
255	Crowned Lapwing (Plover)	*Vanellus coronatus*
258	Blacksmith Lapwing (Plover)	*Vanellus armatus*
349	Speckled Pigeon	*Columba guinea*
352	Red-eyed Dove	*Streptopelia semitorquata*
354	Cape Turtle Dove	*Streptopelia capicola*
355	Laughing Dove	*Streptopelia senegalensis*
424	Speckled Mousebird	*Colius striatus*
438	European Bee-Eater	*Merops apiaster*
548	Pied Crow	*Corvus albus*
568	Dark-capped Bulbul	*Pycnonotus tricolor*
596	Stonechat	*Saxicola torquata*
758	Common Myna	*Acridotheres tristis*

815	Lesser Masked Weaver	*Ploceus intermedius*
824	Southern Red Bishop	*Euplectes orix*
860	Pin-tailed Whydah	*Vidua macroura*

Table 6. Red listed plant species recorded from the 2628AA QDGC according to POSA.

FAMILY	SPECIES	RED LISTED STATUS	HABITAT	LIKELIHOOD OF OCCURRENCE
AIZOACEAE	*Khadia beswickii*	Vulnerable B1ab(iii,v)+2ab(iii,v)	Open shallow soil over rocks in grassland.	None
ASTERACEAE	*Cineraria austrotransvaalensis*	Near Threatened B1ab(iii)	Amongst rocks on steep hills and ridges, at the edge of thick bush or under trees on a range of rock types: quartzite, dolomite and shale, 1400-1700 m.	None
ASTERACEAE	*Cineraria longipes*	Vulnerable D2	Grassland, amongst rocks and along seepage lines, exclusively on basalt koppies on south-facing slopes.	None
APOCYNACEAE	*Stenostelma umbelluliferum*	Near Threatened B1ab(ii,iii,iv,v)	Deep black turf in open woodland mainly in the vicinity of drainage lines.	None
CRASSULACEAE	*Adromischus umbraticola subsp. umbraticola*	Near Threatened B1ab(ii,iii,v)	South-facing rock crevices on ridges, restricted to Gold Reef Mountain	

			Bushveld in the northern parts of its range, and Andesite Mountain Bushveld in the south.	
FABACEAE	*Pearsonia bracteata*	Near Threatened B1ab(i,ii,iii,iv,v)	Plateau grassland.	None
ORCHIDACEAE	*Holothrix randii*	Near Threatened B1ab(iii)+2ab(iii); C2a(i)	Grassy slopes and rock ledges, usually southern aspects.	None

Table 7. Suggested indigenous trees for the newly established gardens (species indigenous to the area are indicated with an ☺. It is strongly recommended that only these are planted as far as possible)

Botanical Name	**Common Name**
☺*Vachellia karroo*	Sweet Thorn
☺*Senegalia caffra*	Common Hook Thorn
Vachellia tortilis	Umbrella Thorn
Apodytes dimidiate	White Pear
Calodendron capense	Cape Chestnut
Cassia abbreviate	Long-tailed cassia
☺*Celtis Africana*	White stinkwood
☺*Combretum erythrophyllum*	River Bushwillow
☺*Cussonia paniculata*	Highveld cabbage
☺*Diospyros lycioides*	Blue bush
☺*Dombeya rotundifolia*	Wild pear
Ekebergia capensis	Cape ash
Erythrina lysistemon	Corral Tree
Ficus sycomorus	Sycamore fig
Grewia occidentalis	Cross berry
☺*Halleria lucida*	Tree Fuschia
Harpephyllum caffrum	Wild plum
Kiggelaria Africana	Wild peach
☺*Leucosidea sericea*	Ouhout
☺*Olea europaea subsp. africana*	Wild olive
Pappea capenis	Jacket plum
☺*Pittosporum viridiflorum*	Cheesewood
Podocarpus henkelii	Henkell's yellowwood
Pterocarpus rotundifolius	Round leaved Kiaat
Searsia chirindensis	Red Currant
☺*Searsia prinoides*	Dogwood
☺*Searsia leptodictya*	Mountain karee
Searsia lancea	Karee
☺*Searsia pyroides*	Common wild currant
Salix mucronata	Safsaf willow

Scotia brachypetala	Weeping boer-bean
Syzygium cordata	Water berry
Trichilia emetica	Natal mahogany
Vepris lanceolata	White ironwood
☺*Ziziphus mucronata*	Buffalo thorn

Table 8. Indigenous shrubs species recommended for the residential gardens. Species marked with ☺ should be used for re-vegetation along the stormwater channel or Jukskei River.

Botanical Name	**Common Name**
☺*Aloe greatheadii*	
☺*Aloe marlothii*	
Bauhinia species	Pride-of de-Kaap
Buddleja salinga	False olive
☺*Buddleja salvifolia*	Sagewood
Burchellia bubaline	Wild pomegranate
☺*Carissa macrocarpa*	Bird num-num
Dietes species	Wild iris
Dovyalis caffra	Kei apple
☺*Ehretia rigida*	Puzzle bush
Erica species	Heaths
Euryops species	Golden daisies
Felicia species	Wild daisy
Grewia flava	Wild currant
Helichrysum species	Everlastings
Leonotis leonorus	Wild dagga
Leucospernum species	Pincushions
Mackaya bella	Forest bell bush
Pavetta lanceolata	Forest's pride bush
Plectranthus species	Spur flowers
Plumbago auriculata	Cape leadwort
☺*Protea caffra*	Sugarbush
Psychotria capensis	Black birdberry
☺*Rhamnus prinoides*	Dogwood
Strelitzea reginae	Crane flower
Tecoma capensis	Cape honeysuckle
Thunbergia natalensis	Natal bluebell

Table 9. List of plants and shrubs are recommended for butterflies (nectar plants). Species marked with ☺ should be used for re-vegetation along the stomrwaterchannel or Jukskei River.

Pentas lanceolata and *Pentas lanceolata* "Coccinea"
☺*Buddleja salvifolia*
Verbena sp.
Asclepias sp.
Bougainvillea sp. Varieties such as Killie Campbell
Plumbago auriculata
Impatiens sp.
☺*Kalanchoe* species.
Lobelia species
Limonium species
Asystasia gangetica (Creeping Foxglove)