ECOAGENT
ECOLOGY & BIODIVERSITY CONSULTANTS

A biodiversity and wetland assessment of the proposed for the proposed Dunnottar Township situated on Portions of remaining extent 1 and 83 of the Farm Grootfontein 165 IR, Gauteng

A biodiversity and wetland assessment of the proposed for the proposed Dunnottar Township situated on Portions of remaining extent 1 and 83 of the Farm Grootfontein 165 IR, Gauteng

by
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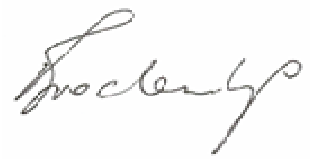
DECLARATION OF INDEPENDENCE

We,
George Johannes Bredenkamp (SACNASP # 400086/83)
Ignatius Lourens Rautenbach (SACNASP # 400300/05),
Alan Charles Kemp (SACNASP 400059/09)
Jacobus Casparus Petrus van Wyk (SACNASP # 400062/09)
declare that we:

- hold higher degrees in the biological sciences, which allowed registration by S.A. Council for National Scientific Professions (SACNASP) as Professional Ecologist or Zoologists that sanction us to function independently as specialist scientific consultants;
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was our own work from inception and reflects exclusively our observations and unbiased scientific interpretations, and executed to the best of our abilities;
- abide by the Code of Ethics of the SACNASP;
- are committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas we appreciate opportunities to learn through constructive criticism and debate, we reserve the right to form and hold our own opinions within the constraints of our training, experience and results and therefore will not submit willingly to the interests of other parties or change our statements to appease or unduly benefit them;
- are subcontracted as specialist consultants for the project "A biodiversity and wetland assessment of the proposed for the proposed Dunnottar Township situated on Portions of remaining extent 1 and 83 of the Farm Grootfontein 165 IR, Gauteng " as described in this report;
- have no financial interest in the proposed development other than remuneration for the work performed;
- do not have, and will not have in the future any vested or conflicting interests in the proposed development;
- undertake to disclose to the consultant and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2006;
- reserve the right to only transfer our intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent from the client will be required for any of us to release of any part of this report to third parties.
- In addition, remuneration for services provided by us is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

I.L. Rautenbach

J.C.P. van Wyk



G.J. Bredenkamp

A.C Kemp

DISCLAIMER:

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. The vegetation and fauna team can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. Although the authors exercised due care and diligence in rendering services and preparing documents, they accept no liability, and the client, by receiving this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the authors and by the use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

ABSTRACT

Vegetation and Flora

It is planned to develop a residential area situated on Portions of remaining extent 1 and 83 of the Farm Grootfontein 165 IR, Gauteng (Figure 3.1). Five plant communities (mapping units, ecosystems) were identified, ecologically assessed and described. Of these the Seasonal and Temporary Wetlands are considered to be Highly sensitive. The Transformed and Degraded Grassland has Medium-Low sensitivity while Highly Transformed Areas and Old Rock Mine Dump have Low sensitivity.

There is a single red data listed plant species (*Hypoxis hemerocallidea*) and no protected plant species in any of these plant communities. The development of the area can be supported in these areas, though there should be a 32 m buffer zone surrounding the wetlands.

The proposed development can be supported.

Mammals

Three of the major habitat types are present on the site, i.e. terrestrial, arboreal and wetlands. The conservation status of these three habitats is regarded as "transformed" Species richness has been dramatically reduced by urban encroachment, isolation and habitat neglect or destruction. No more than 15 species remained, and it is predicted that over time these will also perish as result of some or other catastrophic or inbreeding.

No rare or endangered mammal species now reside on the study site.

It is suggested that the planned development be supported.

Birds

The main impact of this extensive township development for birds is likely to affect those species that reside and breed on the natural grasslands. The vegetation of the site is however so degraded that the site is not seen as an important site for birds. Therefore, the proposed development may be supported.

Herpetofauna

In terms of the National Water Act, all wetlands in and around the study area must be considered as ecologically sensitive. The wetlands are sensitive.

It is concluded that some herpetofauna species, all widely distributed generalists, do occur or may occur on the study site. There is however no reason to conserve the site habitats for the sake of any herpetofauna species.

From a herpetofauna perspective there is no objection against the development.

Wetlands

No species of conservation concern are present within the wetland. The species richness is regarded as low. It is however important to note that all rivers and wetlands in South Africa

are considered to be ecological sensitive systems and enjoy legal protection (National Water Act 1998, National Environmental Management Act, 1998), and their ecological sensitivity is accordingly indicated as high. The development should however not affect the wetland system, as all developments should be outside the buffer zone of at least 32 m.
Care should also to plan and construct an adequate stormwater system, to avoid erosion as far as possible.

1. BACKGROUND INFORMATION

It is planned to develop a residential area situated on Portions of remaining extent 1 and 83 of the Farm Grootfontein 165 IR, Gauteng (Figure 1.1). The site formed part of the historic Vlakfontein gold mine, which was mined from 1942 to closure in 1977 by Gold Fields of South Africa. Parts of the site are now operated by Ekurhuleni Municipality, namely the electrical substation and the concrete water storage reservoir. There are also old houses along the M63 highway towards the north-eastern part of the site, used as a nursery.

Figure 1.1: The planned development area south of Dunnottar (map provided by Envirobalance Solutions)

The planned development requires an Environmental Impact Assessment. Envirobalance Solutions requested a biodiversity and wetland assessment as part of the Environmental Impact Assessment process.

Eco-Agent CC was appointed by Alley Roads Mega Projects to assess the vegetation and flora and undertake a mammal, bird, reptile and amphibian study as well as a wetland assessment. This investigation is in accordance with the EIA Regulations No. R982-985, Department of Environmental Affairs and Tourism, 4 December 2014 emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as well as the National Water Act 1998 (Act 36 of 1998) and additions, and other relevant legislation.

The assignment is interpreted as follows: Compile a study of the vegetation, flora and vertebrate fauna and wetlands of the site, with emphasis on Red Data plant and vertebrate species that occur or may occur on the site. In order to compile this, the following had to be done:

1.1. Initial preparations:

- Obtain all relevant maps and information on the natural environment of the concerned area.
- This includes information on Red Data plant and vertebrate species that may occur in the area.

1.2. Vegetation and habitat survey:

- List the plant species (trees, shrubs, grasses and herbaceous species) present for plant community and ecosystem delimitation.
- Identify potential red data plant species, alien plant species, and medicinal plants.
- Examine the diversity and structure of the plants (trees, shrubs, grasses and herbaceous species) present, to delimit those plant communities and ecosystems relevant to vertebrate fauna distributions and abundance.

1.3. Plant community delimitation and description

- Process data (vegetation and habitat classification) to determine vegetation types (= plant communities) on an ecological basis.
- Describe the habitat and vegetation.
- Determine the sensitivity of the site for biodiversity and presence of rare or protected plant species.
- Prepare a vegetation map of the area.
- Prepare a sensitivity map of the plant communities present, if relevant.

1.4. Faunal assessment

- Compile lists of mammals, birds and herpetofauna that can be expected in the area
- Obtain lists of the Red Data vertebrates that can be expected in the area.
- Assess the quantitative and qualitative condition of suitable habitat for the Red Listed vertebrates that may occur in the area.
- Assess the possibility of Red Listed fauna being present on the study site.
- Compile a list of occurrences.

1.5. Wetland assessment

- Conform the presence / absence of wetlands on the site
- Do a wetland delineation and classification
- Do a Present Ecological State (PES) and Ecological Importance assessment
- Compile a Risk Matrix table

1.6. General

- Identify and describe particular ecologically sensitive areas.

- Identify transformed areas in need of special treatment or management, e.g. bush encroachment, erosion, water pollution, degraded areas, reclamation areas.
- Make recommendations on aspects that should be monitored during development.

1.7. Impact Assessment

- Compile prescribed impact assessment tables and associated descriptions of impacts on vegetation, flora, fauna and wetlands and suggest possible mitigation measures.

This report combines a site visit by the EcoAgent team on 6 November 2017 to assess the vegetation, flora, wetlands and vertebrate fauna and possible impacts of the development on the biodiversity, and if needed, to suggest possible mitigation options.

This report focuses on vegetation and sensitive habitats and wetlands as well as the reigning status of vertebrates and threatened plants those occur or are likely to occur on the proposed development site, and whose conservation status should be considered in the decision-making process. Special attention was paid to the qualitative and quantitative habitat conditions for Red Data plant and vertebrate species deemed present on the site. An objective of the investigation was to gauge which species still persist on the site and to compile a list of mammal, bird and herpetofauna species that may occur in the ecosystems found within the study area.

2. RATIONALE AND SCOPE

It is widely recognised that to conserve natural resources it is of the utmost importance to maintain ecological processes and life support systems for plants, animals and humans. To ensure that sustainable development takes place, it is therefore important that possible impacts on the environment are considered before relevant authorities approve any development. This led to legislation protecting the natural environment. In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90 % of all members of the United Nations. In South Africa, the Environmental Conservation Act (Act 73 of 1989), the National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998) and the National Environmental Management Biodiversity Act, 2004 (Act 10 0f 2004) ensure the protection of ecological processes, natural systems and natural beauty, as well as the preservation of biotic diversity within the natural environment. They also ensure the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes, products or activities. In support of these Acts, a draft list of Threatened Ecosystems was published (Government Gazette 2009), as part of the National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004), and these Threatened Ecosystems are described by SANBI & DEAT (2009) and a list of Threatened or Protected Species (TOPS) regulations is also available (NEMBA Notice 388 of 2013).International and national Red Data lists have also been produced for various plant and animal taxa.

All components of the ecosystems (physical environment, vegetation, animals) at a site are interrelated and interdependent. A holistic approach is therefore imperative to include effectively the development, utilisation and, where necessary, conservation of the given natural resources into an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001).

It is therefore necessary to make a thorough inventory of the plant communities, flora and vertebrate fauna on the site, in order to evaluate the biodiversity and possible presence of species of conservation concern, red listed species and protected species. This inventory should then serve as a scientific and ecological basis for the planning exercises and the subsequent development.

Definitions and Legal Framework

In a South African legal context, the term watercourse is often used rather than the terms wetland or river. The National Water Act (NWA) (1998) includes wetlands and rivers into the definition of the term watercourse.

Watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which water flows, and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Riparian habitat is the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). The National Water Act, 1998 (Act No. 36 of 1998), defines a riparian habitat as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.".

In contrast, the National Water Act, 1998 (Act 36 of 1998) defines a wetland as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."(see also Ollis *et al*. 2013)

Generally 32 m is regarded as standard for a buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and Regulation 598, Government Gazette 37885, August 2014).

Authoritative legislation that lists impacts and activities on biodiversity and wetlands and riparian areas that requires authorisation includes (Armstrong, 2009):

- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- The older Environment Conservation Act, 1989 (Act 73 of 1989);
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983);
- National Water Act, 1998 (Act 36 of 1998);
- National Forests Act, 1998 (Act 84 of 1998);
- National Environmental Management: Protected Areas Act 2003 (Act 57 Of 2003) (as Amendment Act 31 of 2004 and Amendment Act 15 of 2009)
- Government Notice Regulation 1182 and 1183 of 5 September 1997, as amended (ECA);
- Government Notice Regulation 385, 386 and 387 of 21 April 2006 (NEMA);
- Government Notice Regulation 392, 393, 394 and 396 of 4 May 2007 (NEMA);
- Government Notice Regulation 398 of 24 March 2004 (NEMA); and
- Government Notice Regulation 544, 545 and 546 of 18 June 2010 (NEMA)
- Government Notice Regulation 982, 983, 984 and 985 of 4 December 2014 (NEMA).

In summary:

- Vegetation, Flora and ecosystems are protected by National Environmental Management Act, 1998 (Act No. 107 of 1998) and the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- Wetlands and other watercourses are protected water resources in the National Water Act (NWA), Act 36 of 1998.
- Development or transformation of a watercourse is regarded as a water use, which can only be allowed through an approved Water Use License, irrespective of the condition of the affected watercourse.

- The NWA defines water use in a watercourse specifically related to wetlands and riparian areas as broad impacts that include the following:
    - impeding or diverting the flow of water in a watercourse (Section 21 c); and
    - altering the bed, banks, course or characteristics of a watercourse (Section 21 i);
- A recent DWA stipulation published in Government Gazette No 32805 on 18 December 2009 also require that a Water Use License should be applied for when any wetlands are present within a 500 m radius of water use activities as defined by section 21 (c) and section 21 (i) of the NWA. A Risk Matrix should by compiled for any development within 500 m of a wetland
- Risk assessment for developments that are located within 500 m of the edge of a wetland, in accordance with DWA Notice 509 of 2016 - general authorisation in terms of section 39 of the National Water Act, 1998 (act no. 36 of 1998) for water uses as defined in section 21(c) or section 21(i)]
- Wetlands are also protected in other environmental legislation, such as the National Environmental Management Act (NEMA), Act 107 of 1998. The act lists several activities that require authorisation before they can be implemented.
- NEMA lists various activities that require authorisation, when the activity is located within 32 m or less from the edge of a wetland or other watercourse.

The Scope and objectives of this study is therefore:

- To identify and map the vegetation units as ecosystems that occur on the site,
- To assess the ecological sensitivity of these ecosystems and comment on ecologically sensitive areas, in term of their biodiversity and where needed ecosystem function
- To assess qualitatively and quantitatively the significance of the fauna habitat components and current general conservation status of the site,
- To comment on connectivity with natural vegetation and habitats on adjacent sites,
- To assess wetlands present on the site,
- To recommend suitable buffer zones, if relevant,
- To provide a list of plant and vertebrate fauna species that do or might occur on site and that may be affected by the development, and to identify species of conservation concern,
- To highlight potential impacts of the proposed development on vegetation, fauna and flora and wetlands of the study site, and
- To provide management recommendations that might mitigate negative and enhance positive impacts, should the proposed development be approved.

3. STUDY SITE

3.1 Location and the receiving environment

It is planned to develop a residential area situated on Portions of remaining extent 1 and 83 of the Farm Grootfontein 165 IR, Gauteng (Figure 3.1). The site is located directly south of the Town Dunnottar, south of the M45 (Vlakfontein Road) and west of the M63 (Nigel-Dunnottar Road).

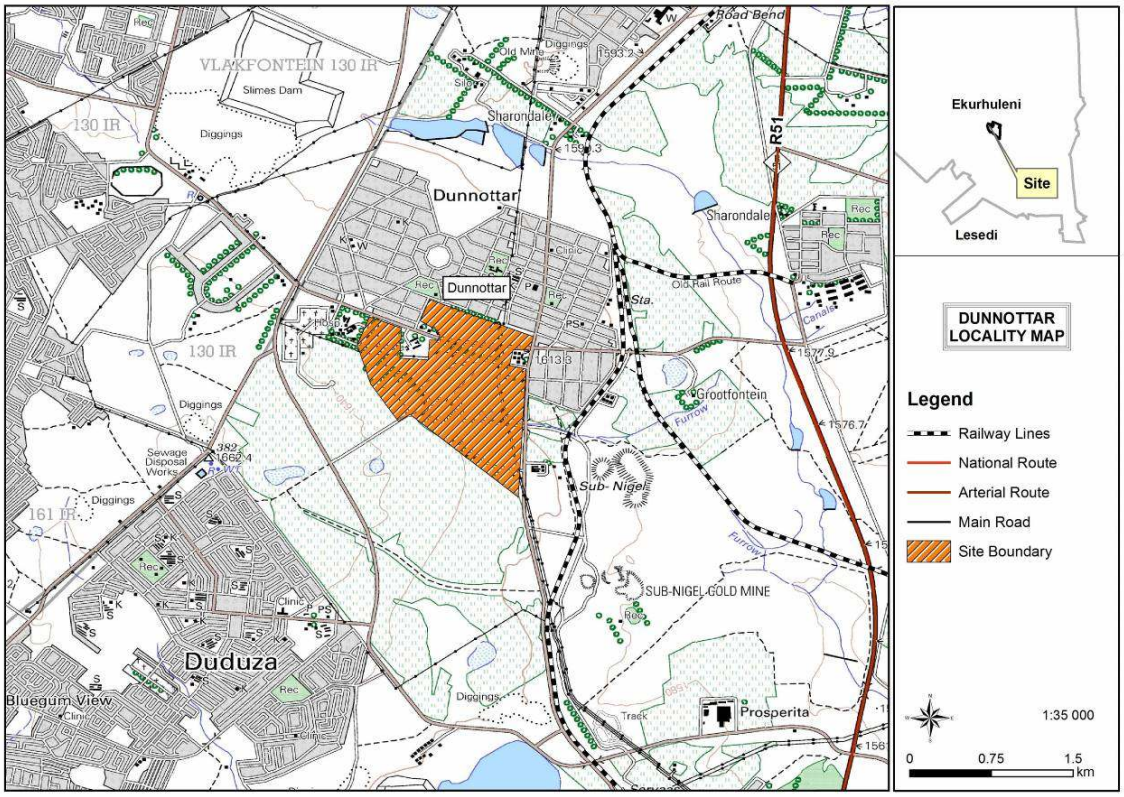


Figure 3.1: The locality of the site

Figure 3.2: The locality of the study site in relation to surrounding developed areas and roads

Figure 3.3 Google Earth Image of the site indicating the disturbed nature of the site

3.2 Geology and Soil

The geology in the site area is complex, including gold-bearing quartzite, conglomerate and sandy shale of the Central Rand Group, Witwatersrand Supergroup, and also basaltic lava

of the Klipriviersberg Group of the Ventersdorp Supergroup. Soils are mostly shallow and mostly highly disturbed by the previous mining activities.

3.3 Regional Climate

Summer rainfall and with a mean annual precipitation exceeding 600 mm. Extreme variation exists between winter minimum and summer maximum temperatures and also between day and night temperatures. The winters are dry and cold and frost is frequent in winter.

3.4 Topography and Drainage

The site is located in the flat to slightly undulating plain, but low hills occur within this vegetation type, notable at the Heidelberg and Nigel areas. Many small pans occur in the general area, though not close to the site (Figure 3.2). A small drainage line that originates in the highly disturbed mining area on the site flows eastwards over the eastern part of the site (Figure 3.4). This drainage line is greatly disturbed by mining and agriculture to the east of the site. A small dam was constructed on the site many years ago, but the dam-wall was broken (Figure 3.5) and the damaged dam currently holds very little water.

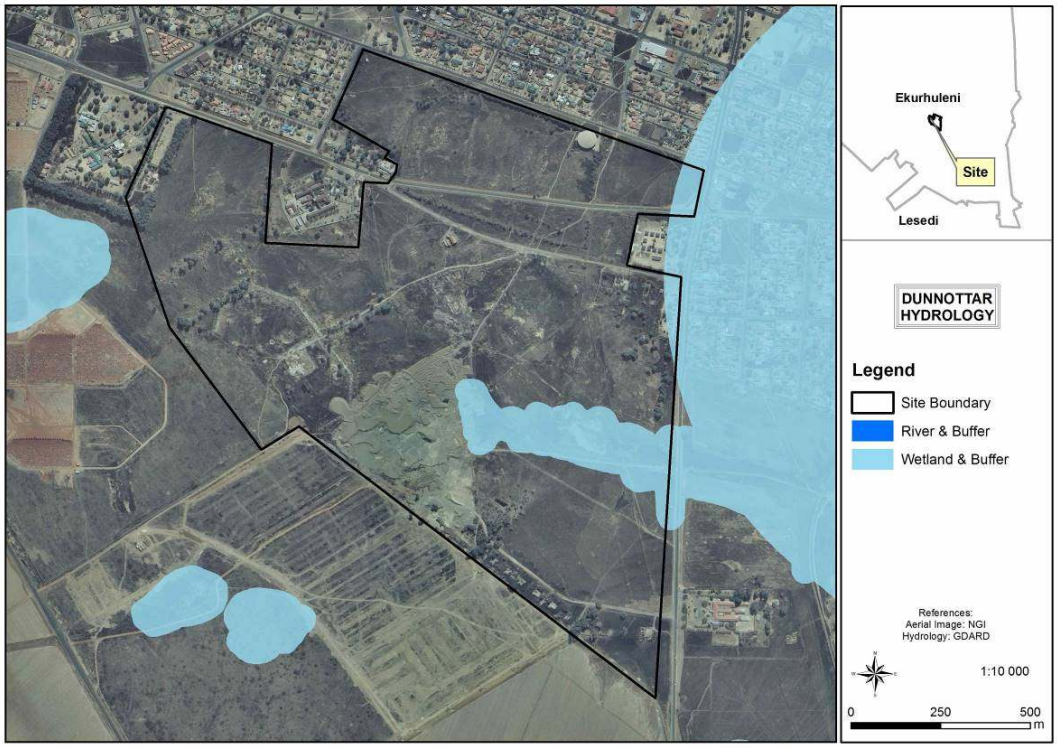


Figure 3.4: The general hydrology of the site and surrounding areas (GDARD)

Figure 3.5: The dam wall and broken area.

3.5 Land-use

The site area has been used for mining since the 1940's and many surrounding areas have been used for maize agriculture. The site area is surrounded by residential, mining and agricultural areas (Figure 3.2)

3.6 Vegetation Types

The site is situated within the Themeda Veld as described by Acocks (1953). Low & Rebelo (1996) described the vegetation of the area as Moist Clay Highveld Grassland vegetation type. In the new vegetation map of South Africa (Mucina & Rutherford 2006) the area falls mainly within the Tsakane Clay Grassland (Figure 3.6), which is an endangered vegetation type (Mucina & Rutherford 2006; SANBI & DEAT 2009).

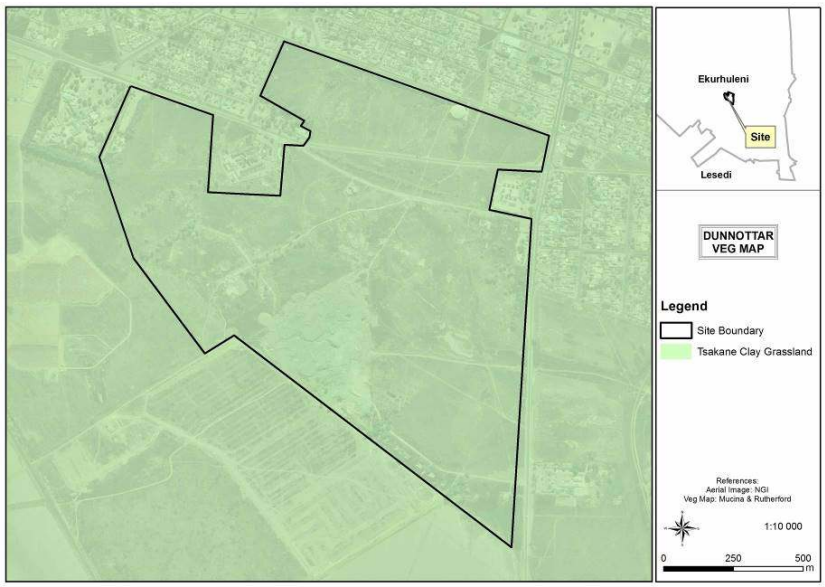


Figure 3.6: The entire site falls within Tsakane Clay Grassland.

As the site was previously mining property, the vegetation is totally transformed, degraded and secondary (Figure 3.3). Very little of the original grassland remained. The woody species present are all alien, planted by the mining company many years ago.

4. METHODS: VEGETATION AND FLORA

4.1. Initial preparations:

For background information, the relevant maps, aerial photographs and other information on the natural environment of the concerned area were obtained.

4.2. Site visit: vegetation and flora

Highly disturbed, transformed vegetation and wetland occur on the site. At several sites within each plant community / habitat type, a description of the dominant and characteristic species found was made. These descriptions were based on total floristic composition, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). Data recorded resulted in a list of the plant species present, including trees, shrubs, grasses and forbs. A comprehensive species list was therefore derived for the site. These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina *et al*. 2000) and are considered to be an efficient method of describing vegetation and capturing species information. Additional notes were made of any other features that might have an ecological influence.

The identified systems are not only described in terms of their plant species composition, but also evaluated in terms of the potential habitat for Red Data plant species.

Threatened ecosystems are identified using Mucina & Rutherford (2006) and SANBI & DEAT 2009).

Critically Endangered, Endangered, Vulnerable and Protected Species (NEMBA species, TOPS species) are evaluated against the list published in Department of Environmental Affairs and Tourism Notice No. 2007 (National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)).

Protected trees are identified in accordance with the list of nationally protected trees published in Government Notice No. 29062 3 (2006) (National Forests Act, 1998 (Act No. 84 0f 1998), as Amended (Department of Water Affairs Notice No 897, 2006).

Lists of Red Data plant species for the area were obtained from the SANBI data bases, with updated threatened status, (Raimondo *et al* 2009) for the map grid 2527DB. These lists were then evaluated in terms of habitat available on the site.

Alien invasive species, according to the Conservation of Agricultural Resources Act (Act No.43 of 1983) as listed in Henderson (2001) and other weeds Bromilov (2010) are indicated.

Medicinal plants are indicated according to Van Wyk, Van Oudthoorn & Gericke (1997).

4.3. Conservation Value

The GDARD C-Plan version 3.3 indicates that the greater portion of the site is Ecological Support Area (Figure 4.1), though the northern part and south-eastern part are regarded as Important in terms of conservation. This includes degraded grassland in the northen and eastern parts as well as the drainage line wetland.

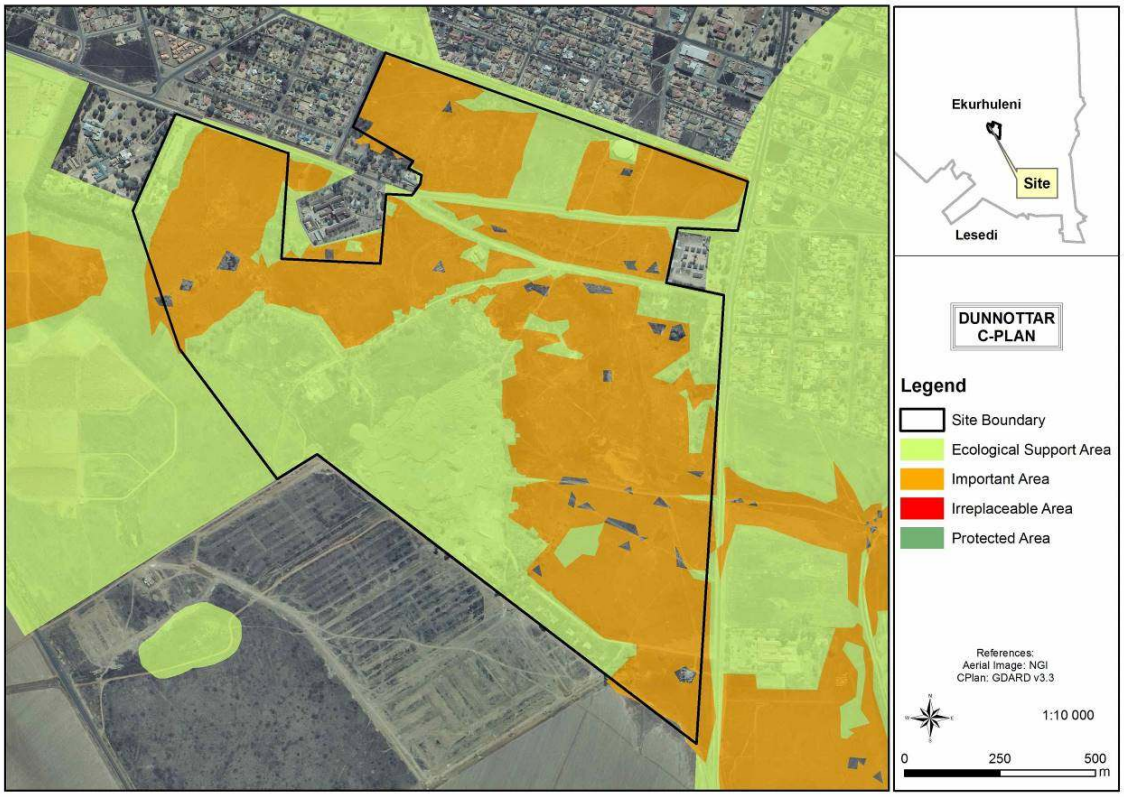


Figure 4.1: The conservation value of the site and surrounding area (GDARD C-Plan version 3.3).

The following **conservation value** categories were used for each site:
High: Ecologically sensitive and valuable land with high species richness and/or sensitive ecosystems or red data species that should be conserved and no developed allowed.
Medium-high: Land where sections are disturbed but which is in general ecologically sensitive to development/disturbances.
Medium: Land on which low impact development with limited impact on the vegetation / ecosystem could be considered for development. It is recommended that certain portions of the natural vegetation be maintained as open space.
Medium-low: Land of which small sections could be considered to conserve but where the area in general has little conservation value.
Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation.

4.4 Ecological Sensitivity

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent & Coker 1992). Therefore, the vegetation of an area will largely determine the ecological sensitivity thereof.

The vegetation sensitivity assessment aims to identify whether the vegetation within the study area is of conservation concern and thus sensitive to development:

In order to determine the sensitivity of the vegetation (ecosystem) on the site, weighting scores are calculated per plant community. The following six criteria are used and each allocated a value of 0-3.

- Conservation status of a regional vegetation unit;
- Listed ecosystem (e.g. wetlands, hills and ridges etc)
- Legislative protection (e.g. threatened ecosystems, SANBI & DEAT 2009)
- Plant species of conservation concern (e.g. red listed, nationally or provincially protected plant species, habitat or potential habitat to plants species of conservation concern, protected plants or protected trees);
- Situated within ecologically functionally important features (e.g. wetlands or riparian areas; important habitat for rare fauna species)
- Conservation importance (e.g. untransformed and un-fragmented natural vegetation, high plant species richness, important habitat for rare fauna species).

Sensitivity is calculated as the sum the values of the criteria. The vegetation with the lowest score represents the vegetation that has the least / limited sensitivity). A maximum score of 18 can be obtained, a score of 15-18 indicated high sensitivity. The sensitivity scores are as follows (Table 5.1):

Table 5.1: Sensitivity Weighting scores for vegetation.

Scoring	15-18	12-14	9-11	6-8	0-5
Sensitivity	High	Medium-High	Medium	Medium-Low	Low

Development on vegetation that has High sensitivity will normally not be supported, except that specific circumstances may still lead to support of the proposed development.

Portions of vegetation with Medium-High or Medium sensitivity should be conserved**.**

Development may be supported on vegetation considered to have Medium-Low or Low sensitivity.

GDARD requirements include that sensitivity should include only High and Low sensitivity.

The categories are as follows:

High: High and Medium-High conservation priority categories mentioned above are considered to have a High sensitivity and development should not be supported.
Low: Medium, Medium-Low and Low conservation priority categories mentioned above are considered to have a Low sensitivity and development may be supported. Portions of vegetation with a Medium conservation priority should be conserved.

4.5 Plant Species Status

Plant species recorded in each plant community with an indication of the status of the species by using the following symbols:
A = Alien woody species; D = Dominant; d = subdominant; G = Garden or Garden Escape; M = Medicinal plant species; P = Protected trees species; p = provincially protected species; RD = Red data listed plant; W = weed.

4.6 Species Richness

Species Richness is interpreted as follows: Number of indigenous species recorded in the sample plots representing the plant community. Alien woody species and weeds are not included (Table 5.2).

Table 5.2: Categories of plant species richness.

No of species	**Category**
1-24	Low
25-39	Medium
40-59	High
60+	Very High

5. METHODS: WETLAND ASSESSMENT

The **delineation** method documented by the Department of Water affairs and Forestry in their document "A practical field procedure for identification and delineation of wetlands and riparian areas" (DWAF, 2005), and the Minimum Requirements for Biodiversity Assessments (GDARD, 2014) were followed for the field survey.. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas, such as soil and vegetation as well as the terrain unit indicator.

A hand held Garmin Montana GPS was used to capture GPS co-ordinates in the field. Google maps and 1:50 000 cadastral maps were used as reference material for the mapping of the wetland boundaries. These were converted to digital image backdrops and delineation lines (wetland boundaries) were imposed accordingly after the field survey.

The **wetland classification** follows the guidelines described by (Ollis *et al.* 2013).

Present Ecological State (PES) is used to determine the current ecological condition of the resource (Macfarlane *et al.* 2007). This is assessed relative to the deviation from the Reference State which is the natural or pre-impacted condition of the system. The reference state refers to the natural dynamics of the wetland system prior to development. The PES is determined per component - for rivers the drivers could for example be flow, estimated water quality and geomorphology; and the biotic response indicators for example riparian vegetation hydrophytic vegetation or aquatic fauna. PES categories for every component are integrated into an overall PES for the wetland being investigated. This integrated PES is also referred to as the EcoStatus of the wetland (Grobler 2013).

Ecological importance
Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999).

Risk matrix
Risk assessment for developments that are located within 500 m of the edge of a wetland, in accordance with DWA Notice 509 of 2016 - general authorisation in terms of section 39 of the national water act, 1998 (act no. 36 of 1998) for water uses as defined in section 21(c) or section 21(i)]

Limitations
The disturbed nature of the site.

6. METHODS: VERTEBRATES

6.1. Field Surveying Mammals and Herpetofauna

The site was visited on 6 November 2017. During this the observed and derived presence of vertebrates associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African mammals and herpetofauna coupled to the qualitative and quantitative nature of recognized habitats.

The 500 meter wide transect along the proposed sewer line was scanned for important vertebrate habitats. During the site visit mammals and herpetofauna were identified by visual sightings by driving and walking in transects across the site. No trapping or mist netting was conducted, as the terms of reference did not require such intensive work. In addition, mammals were also identified by means of spoor, droppings, burrows or roosting sites.

Three criteria were used to gauge the probability of occurrences of mammals and herpetofauna species on the study site. These include known distribution ranges, habitat preferences and the qualitative and quantitative presences of suitable habitats.

6.2. Desktop Survey Mammals and Herpetofauna

As many mammals, reptiles and amphibians are either secretive, nocturnal, hibernators, migrators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of confidence irrespective of season.

The probability of occurrences of vertebrate species was based on their respective geographical distributional ranges and the suitability of on-site habitats.

High probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

Medium probability pertains to a mammal species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is also taken into consideration. Species categorized as medium normally do not occur at high population numbers, but cannot be deemed as rare.

A low probability of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some mammals categorized as low are generally deemed to be rare.

6.3 Specific Requirements: Mammals

During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or wetland-associated species such as Juliana's golden mole (*Neamblosomus juliana*), Highveld golden mole (*Amblysomus septentrionalis*), Rough-haired golden mole (*Chrysospalax villosus*), African marsh rat (*Dasymys incomtus*), Angoni vlei rat (*Otomys angoniensis*), Vlei rat (*Otomys irroratus*), White-tailed rat (*Mystromys albicaudatus*), a member of shrews such as the Forest shrew (*Myosorex varius*), Southern African hedgehog *(Atelerix frontalis), a number of bats such as the* Short-eared trident bat (*Cloeotis percivali*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Marsh mongoose (*Atilax paludinosus*), Brown hyena (*Parahyaena brunnea*).

6.4 Specific Requirements: Herpetofauna

A list of species which may occur on the site was compiled, based on the impressions gathered during the site visit, as well as publications such as FitzSimons' Snakes of Southern Africa (Broadley, 1990), Field Guide to Snakes and other Reptiles of Southern Africa (Branch, 1998), A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007), Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland (Bates, Branch, Bauer, Burger, Marais, Alexander & De Villiers, 2014), Amphibians of Central and Southern Africa (Channing 2001), Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter, Burger, Harrison, Braack, Bishop & Kloepfer, 2004, 2004) and A Complete Guide to the Frogs of Southern Africa (Du Preez & Carruth ers, 2009). The latest taxonomic nomenclature was used. The potential occurrences of Giant Bullfrog (*Pyxicephalus adspersus*) and Southern African Python (*Python natalensis*) are important.
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6.5 Assessment Criteria mammals and herpetofauna

The conservation status of habitats within the study site can be assigned to one of five levels of sensitivity, i.e.

High: Ecologically sensitive and valuable land, with high species richness, sensitive ecosystems or Red Data species, that should be conserved and no development allowed.

Medium-high: Land where sections are disturbed but that is still ecologically sensitive to development/disturbance.

Medium: Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces.

Medium-low: Land on which small sections could be considered for conservation but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or avifauna.

6.6 Field and Desktop Surveying Birds

Birds occurring at the site of the proposed development were assessed in several steps, as detailed below. Red-listed species were identified using the recent (2015) Red Data Book for South Africa, Lesotho and Swaziland {Taylor, 2015 #91}.

Prior to the site visit, a desktop study was undertaken in which bird species that potentially occur at the site and in the surrounding areas were identified using data from the first and second South African Bird Atlas Projects (SABAP 1 and 2). A list of species potentially occurring at the site was developed This species list is thus based on an area much larger than the actual development site. This approach is adopted to ensure that all species potentially occurring at the site, whether resident, nomadic, or migratory, are identified.

A site visit took place on 6 November 2017, with a total of approximately 6 hours spent on site. The weather during the visit was warm, partly cloudy and with little wind. During the site visit, birds occurring at the site were identified by walking transects. During walking transects all birds encountered (seen or heard) were identified, nests observed were identified, and the avian habitats present were assessed.

Limitations
The disturbed nature of the site.

7. RESULTS: VEGETATION

7.1 Vegetation (map units) Classification

All vegetation units on the site are highly disturbed, rather transformed by previous mining operations. Although the mine was closed in 1977, the area is still highly disturbed today. Currently the entire western part of the site is highly transformed, with ruins of previous infrastructure still present. Remains of an old rock waste dump are still present In the central-southern part of the site. Alien trees that were planted during the mining period still occur scattered over the site. Five mapping units were identified (Figure 9.1, Table 9.1). The ecological sensitivity is of the mapping units are shown in Figure 9.2.

Table 7.1: List of mapping units with ecological sensitivity:

	Vegetation mapping unit	**Sensitivity analysis result**	**Sensitivity GDARD requirement**
1	Transformed and Degraded Grassland	Medium-Low	Low
2	Highly Transformed Area	Low	Low
3	Seasonal Wetland	Medium-High	High
4	Temporal Wetland	Medium	High
5	Old rock mine dump	Low	Low

A vegetation map indicating the distribution of the mapping units is presented in Figure 7.1, while the ecoogical sensitivity is given in Figure 7.2

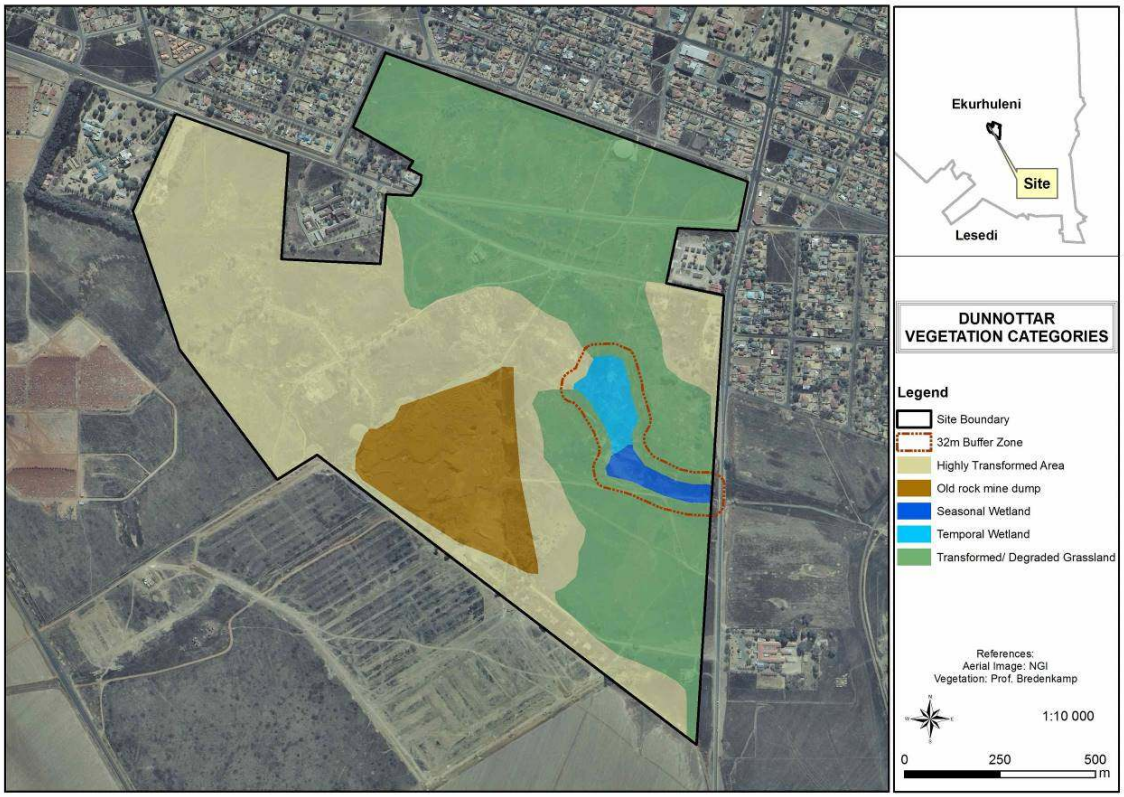

Figure 7.1: A vegetation map of the site.

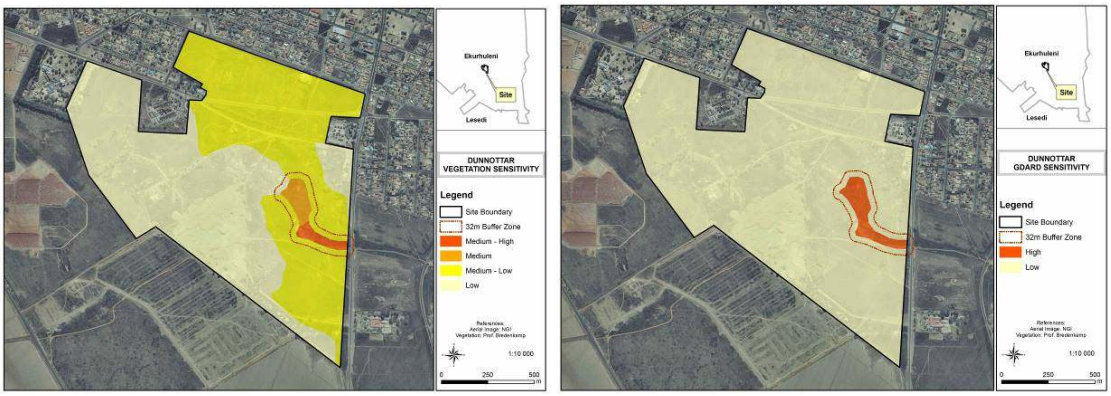

Figure 7.2: Ecological sensitivity of the site:

Left: In accordance to the result of the sensitivity analysis,

Right: In accordance to the GDARD requirements

7.2 Description of the vegetation of the mapping units

7.2.1. Transformed and Degraded Grassland

This grassland occurs in the northern and eastern parts of the study site (Figure 7.1). Due to decades of intensive disturbance by the mining operation and related activity, the vegetation became degraded, even locally transformed (e.g. old fields, trampling, reservoir, alien tree species)(Figure 7.3). This is clearly illustrated in Figure 3.3. Furthermore, the site is totally surrounded by residential area, graveyard, mining and agriculture, isolating the site from any natural vegetation that is still in a fair condition.

The grass cover is low with the pioneer species *Cynodon dactylon* and *Eragrostis curvula* the most prominent. The anthropogenic *Hyparrhenia hirta* and pioneer *Melinis repens* are also conspicuous. Several forbs occur in the area, several being weed species. Woody species were all planted many years ago, these include the indigenous *Searsia lancea* but mostly alien species such as *Pinus, Platanus, Quercus, Cedrus, Populus* and others.

Figure 7.3: A collage of photographs illustrating the Transformed and Degraded Grassland.

The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Acacia dealbata	A	*Pinus* sp	A
Agave americana	A	*Platanus acerifolia*	A
Cedrus deodara	A	*Populus alba*	A
Cestrum laevigatum	A	*Quercus robur*	A
Elephantorrhiza elephantina		*Searsia lancea*	
Eucalyptus sp	A	*Ulmus parvifolia*	A

Grasses and sedges

Aristida congesta		*Juncus* sp	
Cynodon dactylon	d	*Melinis repens*	
Eragrostis curvula	d	*Pennisetum clandestinum*	A
Hyparrhenia hirta	d	*Setaria sphacelata*	
		Themeda triandra	

Forbs

Acalypha angustata		*Hypoxis rigidula*	
Arctotis arctotoides		*Kohautia amatymbica*	
Euphorbia striata		*Ledebouria revoluta*	
Felicia muricata		*Rhynchosia totta*	
Gomphocarpus fruticosa	W	*Solanum panduriforme*	W
Helichrysum nudifolium		*Tagetes minuta*	W
Hilliardiella oligocephala		*Verbena aristigera*	W
Hypoxis hemerocallidea	RDM	*Verbena bonariensis*	W
Hypoxis iridifolia			

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	2	10	12	0	0	0
Grasses	7	1	8	0	0	0
Forbs	12	5	17	1	0	1
Total	21	16	37	1	0	1

The species richness is low and a single red data listed species was found. More than a third of the plant species recorded are alien or weed species.

Transformed and Degraded Grassland summary			
Status	Transformed and degraded		
Soil	Degraded	**Rockiness**	0-15%
Conservation value:	Low	**Ecological sensitivity**	Low
Species richness:	Medium	**Need for rehabilitation**	High
Dominant spp.	*Cynodon dactylon, Eragrostis curvula*		

Discussion

In spite of being located within Tsakane Clay Grassland and indicated as of conservation value in the GDARD C-Plan 3.3, the assessment indicated that due to decades of intensive disturbance by the mining operation and related activity, the vegetation became degraded, even locally transformed (e.g. old fields, trampling, reservoir, alien tree species) This is clearly illustrated in Figure 3.3. Furthermore, the site is totally surrounded by residential area, huge graveyard, mining and agriculture, isolating the site from any natural vegetation that is still in a fair condition, thereby closing natural corridors. The vegetation of this site is without any doubt not suited for conservation, and ideally located for development of much needed residential area. Part of this plant community will however be protected in the 32 m buffer zone surrounding the wetlands (plant communities 3 & 4 discussed below).

Development in this plant community can be supported.

7.2.2. Highly Transformed Area

This mapping unit occurs over the south-western half of the site (Figure 7.1). This area was totally transformed by the previous mining operations (Figure 7.4). Rubble from the ruins of previous infrastructure, old foundations results of old earth works, old roads and alien trees. The soil is extremely disturbed, previous earth works caused many scattered soil and rubble heaps, with places where rain water can accumulate between the heaps, causing local unwanted wet conditions.

The herbaceous vegetation includes extensive patches of *Pennisetum clandestinum (*Kikuyu grass), with *Cynodon dactylon, Eragrostis curvula* and *Hyparrhenia hirta* locally prominent. In the wet areas between the soil dumps some individuals of *Juncus* sp and *Cyperus* sp occur.

Figure 7.4: Scenes within the Highly Transformed Area.

The following plant species were recorded in this plant community:

Acacia mearnsii	A	*Pinus* sp	A
Eucalyptus sp	A	*Platanus acerifolia*	A
Lantana camara	A	*Populus alba*	A

Grasses and sedges

Aristida congesta	*Cynodon dactylon*

Cyperus sp		*Melinis repens*	
Eragrostis curvula	d	*Pennisetum clandestinum*	A
Juncus sp			

Forbs

Bidens bipinnata	W	*Tagetes minuta*	W
Datura stramonium	WM	*Verbena aristigera*	W
Gomphocarpus fruticosus	W	*Verbena bonariensis*	W

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	0	6	6	0	0	0
Grasses	6	1	7	0	0	0
Forbs	0	6	6	0	0	1
Total	6	13	19	0	0	1

Alien and weedy species represent most of the species richness in this transformed area.

Highly Transformed Area summary			
Status	Transformed		
Soil	Highly transformed, rubble, old earth works	**Rockiness**	0-10% rubble
Conservation value:	Low	**Ecological sensitivity**	Low
Species richness:	Low	**Need for rehabilitation**	High
Dominant spp.	*Eucalyptus* sp, *Pennisetum clandestinum, Eragrostis curvula, Cynodon dactylon*		

Discussion

The species richness is Low, with no protected trees present and no red data listed plant species were recorded. The vegetation was transformed. The ecological sensitivity is considered to be Low.

Development in this plant community can be supported.

7.2.3. Seasonal Wetland

A small seasonal wetland is present close to the eastern boundary of the site (Figure 7.1). This small drainage line originates in the highly disturbed mining area on the site and flows eastwards over the far eastern part of the site (Figure 3.4). This drainage line is greatly disturbed by mining and agriculture to the east of the site. A small dam was constructed on the site many years ago, but the dam-wall was broken (Figure 3.5) and the damaged dam currently holds very little water.This wetland is highly disturbed but still has limited functionality and is almost entirely covered by *Typha capensis* (Figure 7.5) and only few other species were recorded in the wet part.

Figure 7.5: The seasonal Wetland. Note the disturbed condition of this wetland.

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The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Populus alba A

Grasses and sedges

Leersia hexandra
Leptochloa fusca
Paspalum dilatatum
Schoenoplectus corymbosus
Typha capensis

Forbs
Persicaria lapathifolia

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	0	1	1	0	0	0
Grasses	5	0	5	0	0	0
Forbs	1	0	1	0	0	0
Total	6	1	7	0	0	0

3. Seasonal Wetland summary			
Status	Wetland, though highly disturbed		
Soil	Wet	**Rockiness**	0%
Conservation value:	Medium-High	**Ecological sensitivity**	Medium-High (sens analysis) High (GDARD requirement)
Species richness:	Low	**Need for rehabilitation**	High
Dominant spp.	*Typha capensis*		

Discussion

No species of conservation concern are present. The species richness is regarded as low. It is however important to note that all rivers and wetlands in South Africa are considered to be ecological sensitive systems and enjoy legal protection (National Water Act 1998, National Environmental Management Act, 1998), (see also paragraph 11 Results: Wetland Assessment below), and their ecological sensitivity is accordingly indicated as high. The development should however not affect the vegetation of the drainage line, as all developments should be outside the buffer zone of at least 32 m.

7.2.4. Temporary Wetland

The temporary wetland occurs in the catchment area of the drainage line, north-west of the seasonal wetland (Figure 7.1). This catchment starts immediately below the Highly Transformed area (Figure 7.1). The temporary Wetland is mainly covered by hygrophilous grasses, though the rush *Juncus* sp is conspicuous (Figure 7.6). Other species include the grasses *Imperata cylindrica, Eragrostis plana, Pennisetum clandestinum, Kyllinga erecta* and *Leptochloa fusca*. Several forb species were recorded, e.g. *Senecio erubescens, Conyza* podocephala and *Berkheya radula*.

Figure 7.6 The Temporary Wetland. Note the tall-growing *Juncus* sp.

4. Temporary Wetland			
Status	Disturbed wetland		
Soil	Clayey	**Rockiness**	10-30%
Conservation value:	Medium	**Ecological sensitivity**	Medium (sens analysis) High (GDARD requirement)
Species richness:	Low	**Need for rehabilitation**	High
Dominant spp.	*Juncus* sp, *Imperata cylindrica, Eragrostis plana, Pennisetum clandestinum*		

The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Stoebe vulgaris

Grasses and sedges

Cyperus rupestris		*Juncus* sp	d
Eragrostis plana	d	*Kyllinga erecta*	
Fuirena pubescens		*Paspalum dilatatum*	
Hyparrhenia hirta		*Pennisetum clandestinum*	Ad
Imperata cylindrica	d		

Forbs

Berkheya radula		*Moraea spathulata*	
Cirsium vulgare	W	*Senecio erubescens*	
Conyza podocephala		*Solanum sisymbrifolium*	W
Helichrysum pilosellum		*Verbena bonariensis*	W

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	1	0	1	0	0	0
Grasses and sedges	8	1	9	0	0	0
Forbs	5	3	8	0	0	0
Total	14	4	18	0	0	1

Discussion

The species richness is low, with no protected trees present in this plant community. No red data listed plant species were recorded. The ecological sensitivity is considered to be Medium, though in accordance with GDARD requirements, and also the National Water Act (1998) this system is classified as wetland and therefore enjoys legislative protection. .

The development should however not affect the vegetation of the drainage line, as all developments should be outside the buffer zone of at least 32 m.

7.2.5 Old Rock Mine Dump

This old rock mine dump is situated at the south-western boundary of the site (Figure 7.1). This is totally transformed area (Figures 7.3, 7.4 & 7.5) and from a vegetation perspective has no value and is therefore not discussed further.

However, where feasible, development in this area can be supported.

5. Old Rock Mine Dump summary			
Status	Transformed		
Soil	No soil,	**Rockiness**	100%
Conservation value:	Low	**Ecological sensitivity**	Low
Species richness:	Low	**Need for rehabilitation**	High
Dominant spp.	nil		

7.3 Plants of Conservation Concern

Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened, Extinct in the wild, Data deficient, Near-threatened, Critically rare, Rare and Declining. These plants are nationally protected by the National Environmental Management: Biodiversity Act (Raimondo *et al*, 2009).

Threatened species are those that are facing high risk of extinction, indicated by the categories Critically Endangered (CE), Endangered (EN) and Vulnerable (VU). Species of Conservation Concern include the Threatened Species, but additionally have the categories Near Threatened (NT), Data Deficient (DD), (DDT = lack of taxonomic data), Critically Rare (CR), Rare (R) and Declining (D). This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009).

Table 7.1 The following red data plant species have previously been collected from Grid 2628AD (Precis 2017)

Family	Species	Status	Habita on site
Euphorbiaceae	Acalypha caperonioides Baill. var. caperonioides	DDT	Marginally?
Crassulaceae	Adromischus umbraticola C.A.Sm. subsp. umbraticola	NT	No
Apiaceae	Alepidea peduncularis A.Rich.	DDT	No
Asteraceae	Cineraria longipes S.Moore	VU	No
Hyacinthaceae	Drimia elata Jacq.	DDT	No
Orchidaceae	Eulophia coddii A.V.Hall	VU	
Hypoxidaceae	Hypoxis hemerocallidea Fisch., C.A.Mey. & Avé-Lall.	Declining	Yes, present
Aquifoliaceae	Ilex mitis (L.) Radlk. var. mitis	Declining	No
Mesembryanthemaceae	Khadia beswickii (L.Bolus) N.E.Br.	VU	No
Mesembryanthemaceae	Lithops lesliei (N.E.Br.) N.E.Br. subsp. lesliei	NT	No
Myrothamnaceae	Myrothamnus flabellifolius Welw.	DDT	No
Santalaceae	Thesium boissierianum A.DC.	DDT	No?

A large population of the declining species of conservation concern, *Hypoxis hemerocallidea*, was found on the site at approximately 26°21"08"S; 28°25'52"E (Figure 7.7). No other plant species of conservation concern occur on the site. This is probably due to the long-term disturbance, degradation and transformation caused by the mining operation. This species is listed as threatened as it is collected by traditional healers due to its medicinal value, though it occurs widespread in South Africa and it is by no means rare. It is suggested that these plants be rescued and donated to botanical gardens, where they can be planted as ornamental plants. They are easily transplanted.

Figure 7.7: A large population of the declining *Hypoxis hemerocallidea* occurs on the site.

7.4. Provincially Protected Plants

Apart from the single Red Data species listed above, no provincially protected plants were found on the site.

7.5. Nationally Protected Plants

No protected trees or TOPS /NEMBA plant species occur on the site.

7.6. Alien Invasive Plant Species

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants controlled and eradicated by means of an eradication and monitoring program. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The amended Regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) identifies three categories of problem plants:

Category 1 (Declared weeds): plants may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish plant, maintain, propagate or sell/import any category 1 plant species;
Category 2 (Declared invaders): plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled; and
Category 3 (Declared invaders): plants are ornamentally used and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30 m of a 1:50 year flood line and must be prevented from spreading.

In addition, a second draft of the Alien and Invasive Species Regulations, as well as a new draft list of categories of invasive species in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) was published in the Government Gazette No. 32090, in April 2009. Any species designated under section 70 cannot be propagated, grown, bought or sold by the industry without a permit. Whereas CARA previously classified problem plants into two groups - declared weeds and plant invaders - the amended regulations make provision for four groups: declared weeds (Category 1 plants), plant invaders (Category 2 and Category 3 plants) and indicators of bush encroachment. The first three groups consist of undesirable alien plants and are covered by Regulation 15. Bush encroachers, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
Category 1b: Invasive species requiring compulsory control as part of an invasive species control program. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management program. No permits will be issued.
Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

In terms of the amendments to the regulations under the Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983) and Regulation 598, Government Gazette 37885, August 2014)(Alien and Invasive Species Regulations), landowners are legally responsible for the control of alien species on their properties.

Some declared invasive plants (Henderson 2001) that should be removed and controlled (Conservation of Agricultural Resources Act (Act 43 of 1983) include:

Acacia dealbata	Category 2
Acacia mearnsii	Category 2
Agave americana	Category 2
Cestrum laevigatum	Category 1
Cirsium vulgare	Category 1
Eucalyptus sp	Category 2
Pennisetum clandestinum	Category 2
Pinus sp	Category 2
Populus alba	Category 2
Ulmus parvifolia	Category 3

Other weeds not placed under Categories 1, 2 or 3 include:
Bidens bipinnata
Gomphocarpus fruticosus
Tagetes minuta
Verbena aristigera
Verbena bonariensis

These weedy herbaceous species occur on the site, but they are not listed in terms of the above-mentioned legislation.

7.7. Vegetation Importance and Sensitivity

The result of the sensitivity analysis is given in Table 7.2.

In spite of being located within Tsakane Clay Grassland and indicated as of conservation value in the GDARD C-Plan 3.3, the assessment indicated that due to decades of intensive disturbance by the mining operation and related activity, the vegetation became degraded, even locally transformed (e.g. old fields, trampling, reservoir, alien tree species) This is clearly illustrated in Figure 3.3. Furthermore, the site is totally surrounded by residential area, huge graveyard, mining and agriculture, isolating the site from any natural vegetation that is still in a fair condition, thereby closing natural corridors. The sensitivity is therefore downgraded to Medium-Low, and in accordance with GDARD requirements indicated as Low.

Table 7.2: Scoring of vegetation that occurs within the study area.

Vegetation	Conservation Status of regional Vegetation unit	Listed Ecosystem	Legislated Protection	Species of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18
1. Transformed and Degraded Grassland	**3**	**1**	**2**	**1**	**1**	**0**	**8** **Medium Low**
2. Highly Transformed Area	**0**	**0**	**0**	**0**	**1**	**0**	**1** **Low**
3. Seasonal Wetland	**3**	**3**	**3**	**0**	**2**	**2**	**13** **Medium-High**
4. Temporary Wetland	**3**	**3**	**3**	**0**	**1**	**2**	**11** **Medium-**
5. Old Rock Mine Dump	**0**	**0**	**0**	**0**	**0**	**0**	**0** **Low**

The Highly Transformed Areas and Old Rock Mine Dump have Low ecological sensitivity.

The result of the sensitivity assessment (Table 9.2) indicates the Seasonal and Temporary wetlands are considered to have Medium-High and Medium sensitivity respectively. It is however important to note that all rivers and wetlands in South Africa are considered to be ecological sensitive systems and enjoy legal protection (National Water Act 1998, National Environmental Management Act, 1998), (see also paragraph 6 Results: Wetland Assessment below), and their ecological sensitivity is accordingly indicated as High.

7.8: Conclusion: Vegetation and Flora

Five plant communities (mapping units, ecosystems) were identified, ecologically assessed and described. Of these the Seasonal and Temporary Wetlands are considered to be Highly sensitive. The Transformed and Degraded Grassland has Medium-Low sensitivity while Highly Transformed Areas and Old Rock Mine Dump have Low sensitivity.

There is a single red data listed plant species (*Hypoxis hemerocallidea*) and no protected plant species in any of these plant communities. The development of the area can be supported in these areas, though there should be a 32 m buffer zone surrounding the wetlands.

8. RESULTS: MAMMALS

8.1 Mammal Habitat Assessment

Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the former's work has been superseded by the work of the latter two, the definitions of biomes are similar and both remain valid for mammals and are therefore recognized as a reasonable determinant of mammal distribution.

The local occurrences of vertebrates are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of vertebrate species by evaluating the habitat types within the context of global distribution ranges. Sight records and information from residents or knowledgeable locals audit such deductions.

Three of the major habitat types are present on the site, i.e. terrestrial, arboreal and wetlands.

The terrestrial habitat of the unbuilt portion consists of very disturbed / transformed Highveld Grassland (Figure 7.3). The substrate consists of dark-brown compacted soil, mostly imbedded with gravel and even rocks, which presents a challenge to burrowing small mammals such as the Highveld gerbil. However, it is obvious that the grassland, which was highly disturbed and degraded by the previous mining activities, is now over-utilized by grazing and by regular fires. The terrain has also been subjected to extensive earthworks of a disclosed nature.

The wetland habitat-type (Figure 7.5) is formed by a drainage line that originates at the mine dumps; as such the quality of water is suspect. The seasonal drainage has been dammed at places, forming small permanent water bodies supporting dense water vegetation such as *Typha* and other water plants along their banks. This habitat is less compromised by overuse and abuse although moisture-reliant vegetation is used by grazers. The paltry edge vegetation is susceptible to fires when they are dry at the end on winter.

The arboreal habitat is formed by alien trees (Figure 7.4) such as palms, poplars, planes, blue gums, pines and wattles. Although the karee trees are indigenous to South Africa, they are alien to the site itself.

8.2. Observed and Expected Mammal Species Richness

To maintain the diversity of species, connectivity is an imperative to allow for immigration and emigration. The site is now isolated by mine dumps, old fields and urbanization. As such connectivity is (and has been) non-functional for decades.

Historically, the uncompromised site in pristine condition harbored a full complement of terrestrial small and medium-sized mammals adapted to inland Highveld Grassland biome. We have no doubt that discerning small mammals such as the white-tailed rat, grass-climbing mice and the hedgehog, have been displaced.

The site is now hemmed in by tilled fields, mine dumps and urbanization and is as such essentially an ecological island. Surviving species and populations are threatened by inbreeding and ultimately by localized extinction since gene flow is no longer possible, apart from catastrophic events such as fire and over-utilization.

Presently no more than 15 species could persist (Table 8.1).

All large mammals (viz. elephants, buffaloes, black wildebeests, plain's zebras, lions, brown and spotted hyenas, aardwolves,) have a century or more ago been hunted out for sport or to maximise farming practices. More recently progressive intensive land-use practices (particular urbanization) systematically displaced medium-sized mammals such as baboons, vervet monkeys, pangolin, black-backed jackals, aardwolf etc. Some species are assumed to be on the edge of disappearing from the site such as the scrub hare and the two genet species. Species that managed to persist are all robust species with wide ecological tolerances or/and with high reproductive rates, some of whom are inclined to become problem animals in an urban setting.

The conservation status of the site is abominable. As such, discerning species such as white-tailed rats have been displaced by the destructive practices that impacted on habitat quality.

Considering the fact that arboreal mammals are not adapted to exist in alien trees, as well as the fact the site falls outside their distributional ranges, these are also absent from the site.

Table 8.1: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al [2003], Skinner & Chimimba [2005], Apps [2012] and Stuart & Stuart [2015]).

	SCIENTIFIC NAME	ENGLISH NAME
	Order Lagomorpha	
	Family Leporidae	
√	*Lepus saxatilis*	Scrub hare
	Order Rodentia	
	Family Bathyergidae	
√	*Cryptomys hottentotus*	African mole rat
	Family Tryonomyidae	
?	*Thryonomys swinderianus*	Greater cane rat
	Family Muridae	
*	*Rhabdomys pumilio*	Four-striped grass mouse
*	*Mus minutoides*	Pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
*	*Aethomys ineptus*	Tete veld rat
*	*Otomys irroratus*	Vlei rat
?	*Gerbilliscus brantsii*	Highveld gerbil
	Order Eulipotypha	
	Family Soricidae	
DD?	*Myosorex varius*	Forest shrew
DD?	*Crocidura hirta*	Lesser red musk shrew
	Order Chiroptera	
	Family Molossidae	

*	*Tadarida aegyptiaca*	Egyptian free-tailed bat
	Family Vespertilionidae	
*	*Neoromicia capensis*	Cape serotine bat
*	*Scotophilus dinganii*	African yellow house bat
*	*Scotophilus viridis*	Greenish yellow house bat
	Order Carnivora	
	Family Viverridae	
?	*Genetta genetta*	Small-spotted genet
*	*Genetta tigrina*	SA large-spotted genet
	Family Herpestidae	
*	*Cynictis penicillata*	Yellow mongoose
*	*Galerella sanguinea*	Slender mongoose

√ Definitely there or have a *high* probability to occur;
***** *Medium* probability to occur based on ecological and distributional parameters;
? *Low* probability to occur based on ecological and distributional parameters.

Threatened and Red Listed Mammal Species

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

The two Red Data species (Table 8.1) are shrews ranked as "Data Deficient" (Friedmann and Daly, 2004), which is a precautionary category to compensate for a dearth of field data in making a factual assessment of their true conservation status. "DD"-rated shrews operate at the apex of their food pyramid via an invertebrate trophic sublevel, which means that their population numbers are significantly lower than that of their prey species in order to maintain sustainable prey population levels. Because of their diet, they are furthermore not readily trapped with conventional bait or traps, which may mean that their numbers are under-estimated. Specimen collection of shrews using drift fences and pitfalls invariably yield better acquisition results than live-trapping, which reiterate the sentiment that shrews numbers are more often than not under-estimated and that many species' conservation status are misconstrued.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

None of the species listed in Table 8 is particularly rare.

Threatened mammal species recognised:

-By the IUCN Red Data List

The compilation of Red Data mammals (Friedman and Daly (editors) 2004) is in fact a contribution to the IUCN initiative. Opinions expressed therein are elucidated above.

-By the Biodiversity Act No 10 of 2004

None.

By the Regulations of the Provincial Authority

This is closely follow in the findings of a panel of mammologists (Friedman and Day [Eds.] 2004).

-Endemism:

None of the species purported to be residents of the study site and surrounding areas are endemic to Gauteng.

Conclusion

Species richness has been dramatically reduced by urban encroachment, isolation and habitat neglect or destruction. No more than 15 species remained, and it is predicted that over time these will also perish as result of some or other catastrophic or inbreeding.

No rare or endangered mammal species now reside on the study site.

It is suggested that the planned development be supported.

9. RESULTS: BIRDS

9.1 General

A list of bird species expected to occur on site was derived initially from the quarter-degree grid records presented in an atlas of southern African birds (Harrison et al. 1997). Based on an assessment of the habitats present at the site, and on the best regional fieldguide for the area (Marais & Peacock 2008), the list was then reduced to those species that were judged as 'possible' or 'likely' to occur within those habitats as residents or regular visitors. Due to the considerable aerial mobility of birds, a number of additional species might be expected as infrequent nomads or vagrants, but these were not included on the list. It was judged that the habitats available would offer no significant material support or conservation assistance to these species, and that if they did occur it would be temporarily and in insignificant numbers. 'Possible' refers to species that might use their mobility to make intermittent use of the habitats available when they are in a particular condition (during or after rain, flood, drought, burn, grazing, seeding, flowering) or season (regional, intra-African or inter-continental migrants). 'Likely' refers to species that are expected to make regular use of the site for feeding, roosting and/or breeding. Species actually recorded on site during the field survey are expected to fall into the latter category unless annotated otherwise.

No objective assessment was made of the carrying capacity of the habitat for any species, since this varies through time and birds are capable of arriving or departing as conditions change. Special attention was paid to species considered as threatened internationally or nationally (Taylor et al. 2015), and to those considered as species of conservation priority within Gauteng (GDARD 2014a, 2014b). The category assigned to these species was raised to include infrequent visitors as 'likely', based on the precautionary principle. Further details of the extent and limits of various habitat types detected during the field survey and on adjacent properties were also obtained by study of satellite images from Google Earth.

The habitats occupied by flighted birds differ from those of most terrestrial vertebrates in being explicitly three-dimensional, especially for aerial-feeding species and in the airspace above landscapes with low relief and short vegetation, such as occurred at the site. In the two primarily terrestrial dimensions, most birds are also more dependent on vegetation structure, and substrate texture and colour, than they are on vegetation composition, with the exception of a minority of species with particular food requirements of foliage, flowers, fruit or seeds. However, although the vegetation biomes and units most recently described for South Africa are defined primarily on vegetation composition, they do offer good analyses of the abiotic factors that also underlie these divisions, such as topography, geology, soil types and climate, and on general structural features of vegetation types and landscapes (Mucina & Rutherford, 2006). The habitats at the site occur primarily within the Tsakane Clay Grassland (Mucina & Rutherford, 2006).

The aerial mobility of birds also demands paying attention to the principal habitats surrounding the study site and their conservation status, not just those along the immediate borders but also more distant habitats that might provide sources for species visiting the site and sinks for those breeding on site. In this regard, the rocky ridges within Andesite

Mountain Bushveld extend far to the southeast (Balfour, Greylingstad), and west (~15 km to Suikerbosrand Nature Reserve), while the Blesbokspruit may form an important ecological corridor of open water. The Marievale Bird Sanctuary, SA021, is an Important Bird Area (IBA) and RAMSAR site, and downstream is the Karan floodplain above the Blesbokspruit-Suikerbosrandrivier confluence, a proposed IBA and RAMSAR site (Kemp 2006 a & c).

Birds are also a relatively visible and audible group of homeothermic vertebrates, active throughout the year, and with habitat preferences that can be evaluated from experience, by reference to the comprehensive literature available and by the subset of species that can be detected by a field survey during a particular season and time of day. Such information and experience also informs and enables searches for particular species of conservation concern.

9.2 Bird Habitat Assessment

The principal habitat types detected on the site that are most relevant to bird ecology and community structure are:

- A small wetland occur on the site, mainly covered with *Typha capensis* with very little surface water visible.
- Degraded grasslands. These occur on a stony substrate with shallow soils in the northern and eastern half of the site, on slight slopes. The vegetation has been well grazed, most recently by cattle, but not to the extent of any serious invasion by woody shrubs such as *Stoebe vulgaris*, and with few signs of recent damage by burning. The grasses are all shortly grazed. A few alien trees, all planted long ago by the mine, occur in the grassland.
- Highly Degraded, transformed area with ruins of the old mine and a rock mine dump.
- Agricultural lands in the vicinity of the site.

The other habitats adjacent to the study site are mostly residential and mining areas.

9.3 Expected and Observed Bird Species Richness

A total of 105 species are expected or were recorded on the site (Table 9.1). Of these only 32 species were recorded on the site during the visit.

Only a few of the expected species are typical generalists that might occupy all of the habitats available, especially the various lands transformed by agriculture and other man-induced alterations, while others are aerial feeders that mainly use the airspace above the habitats.

The species of grasslands suggest that this habitat is in not in such a good condition to support a high diversity of typical species. The adjacent agricultural lands, with hayfields, recovering grasslands and the associated weeds, augment the quality of the habitat for

species of grassland habitat by offering a variety and abundance of animal and plant foods in the immediate proximity.

The adjacent agricultural lands support a number of species that also occur in the grasslands.

9.4 Threatened and Red Listed Bird Species

There are five species that are among those listed as of special conservation concern within Gauteng Province (GDARD 2014a, 2014b), and some of these are also of national and even international concern (Taylor *et al.* 2015). Several of these are expected to only visit the site occasionally (Cape Vulture, Lesser Kestrel and Secretarybird), since there exists no obvious roost or breeding habitats for these species on site. All are species that have either large home ranges or wander widely in search of food.

The degraded grassland does not really offer suitable breeding habitat for White-bellied Korhaan or Blue Cranes.

Table 9.1: Bird species diversity expected and observed at the Bultfontein study site. Names and systematic order after Hockey *et al*. (2005), habitat preferences as above, estimated probability of occurrence, and national Red Data (Taylor *et al.* 2015) and GDARD conservation priority (GDARD 2014a, 2014b).

Scientific names	Common names	Probability of occurrence+	Priority species, †
Francolinus levaillantii	Orange River Francolin	**	
Francolinus levaillantoides	Red-winged Francolin	*	
Pternistes swainsonii	Swainson's Spurfowl	**	
Coturnix coturnix	Common Quail	S	
Numida meleagris	Helmeted Guineafowl	**	
Alopochen aegyptiacus	Egyptian Goose	**	
Anas undulate	Yellow-billed Duck	**	
Turnix sylvatica	Kurrichane Buttonquail	*	
Merops apiaster	European Bee-eater	*	
Chrysococcyx caprius	Diederik Cuckoo	**	
Tachymarptis melba	Alpine Swift	*	
Apus apus	European Swift	*	
Apus barbatus	African Black Swift	*	
Apus affinis	Little Swift	**	
Apus caffer	White-rumped Swift	S	
Apus horus	Horus Swift	*	
Columba livia	Rock Dove	**	
Columba guinea	Speckled Pigeon	**	

Streptopelia senegalensis	Laughing Dove	S	
Streptopelia capicola	Cape Turtle-Dove	S	
Streptopelia semitorquata	Red-eyed Dove	**	
Oena capensis	Namaqua Dove	*	
Neotis denhami	Denham's Bustard	*	
Eupodotis afraoides	Northern Black Korhaan	**	
Eupodotis senegalensis	White-bellied Korhaan	**	†
Anthropoides paradiseus	Blue Crane	*	†
Burhinus capensis	Spotted Thick-knee	**	
Charadrius pecuarius	Kittlitz's Plover	*	
Vanellus armatus	Blacksmith Lapwing	S	
Vanellus coronatus	Crowned Lapwing	S	
Cursorius temminckii	Temminck's Courser	**	
Glareola nordmanni	Black-winged Pratincole	*	
Elanus caeruleus	Black-shouldered Kite	**	
Milvus migrans	Black Kite	*	
Gyps coprotheres	Cape Vulture	*	†
Circus macrourus	Pallid Harrier	**	
Circus pygargus	Montagu's Harrier	**	
Buteo vulpinus	Steppe Buzzard	**	
Buteo rufofuscus	Jackal Buzzard	*	
Sagittarius serpentarius	Secretarybird	**	†
Falco naumanni	Lesser Kestrel	**	†
Falco rupicoloides	Greater Kestrel	**	
Falco amurensis	Amur Falcon	**	
Falco biarmicus	Lanner Falcon	*	
Falco peregrinus	Peregrine Falcon	*	
Ardea melanocephala	Black-headed Heron	**	
Bubulcus ibis	Cattle Egret	S	
Bostrychia hagedash	Hadeda Ibis	H	
Ciconia ciconia	White Stork	**	
Telophorus zeylonus	Bokmakierie	H	
Corvus albus	Pied Crow	**	
Lanius collurio	Red-backed Shrike	*	
Lanius minor	Lesser Grey Shrike	*	
Lanius collaris	Common Fiscal	S	
Riparia paludicola	Brown-throated Martin	S	
Riparia cincta	Banded Martin	S	
Hirundo rustica	Barn Swallow	**	
Cecropis cucullata	Greater Striped Swallow	S	
Petrochelidon spilodera	South African Cliff Swallow	**	
Hirundo fuligula	Rock Martin	*	

Delichon urbicum	Common House Martin	*	
Acrocephalus palustris	Marsh Warbler	**	
Cisticola tinniens	Levaillant's Cisticola	S	
Cisticola juncidis	Zitting Cisticola	**	
Cisticola aridulus	Desert Cisticola	**	
Cisticola textrix	Cloud Cisticola	**	
Cisticola ayresii	Wing-snapping Cisticola	**	
Prinia flavicans	Black-chested Prinia	S	
Mirafra cheniana	Melodious Lark	S	
Mirafra africana	Rufous-naped Lark	S	
Mirafra fasciolata	Eastern Clapper Lark	**	
Chersomanes albofasciata	Spike-heeled Lark	S	
Certhilauda semitorquata	Eastern Long-billed Lark	**	
Calandrella cinerea	Red-capped Lark	S	
Spizocorys conirostris	Pink-billed Lark	*	
Saxicola torquata	African Stonechat	S	
Oenanthe pileata	Capped Wheatear	**	
Myrmecocichla formicivora	Southern Anteating Chat	S	
Lamprotornis bicolor	Pied Starling	**	
Creatophora cinerea	Wattled Starling	**	
Acridotheres tristis	Common Myna	**	
Ploceus velatus	Southern Masked Weaver	S	
Quelea quelea	Red-billed Quelea	S	
Euplectes orix	Southern Red Bishop	S	
Euplectes albonotatus	White-winged Widowbird	**	
Euplectes progne	Long-tailed Widowbird	S	
Anomalospiza imberbis	Cuckoo Finch	*	
Ortygospiza fuscicrissa	African Quail-finch	**	
Amadina erythrocephala	Red-headed Finch	S	
Estrilda astrild	Common Waxbill	S	
Vidua macroura	Pin-tailed Whydah	**	
Passer domesticus	House Sparrow	**	
Passer melanurus	Cape Sparrow	S	
Motacilla capensis	Cape Wagtail	S	
Motacilla flava	Yellow Wagtail	*	
Macronyx capensis	Cape Longclaw	S	
Anthus cinnamomeus	African Pipit	S	
Anthus leucophrys	Plain-backed Pipit	**	
Anthus vaalensis	Buffy Pipit	**	

Anthus similis	Long-billed Pipit	**	
Crithagra mozambica	Yellow-fronted Canary	*	
Crithagra atrogularis	Black-throated Canary	**	
Crithagra flaviventris	Yellow Canary	*	
Crithagra gularis	Streaky-headed Seedeater	H	

+ Probability of occurrence (see text): * - possible; ** - likely; S – sighted; H – heard

9.5 Conclusion

The main impact of this extensive township development for birds is likely to affect those species that reside and breed on the natural grasslands. The vegetation of the site is however so degraded that the site is not seen as an important site for birds. Therefore, the proposed development may be supported.

10. RESULTS: HERPETOFAUNA

10.1 Herpetofauna Habitat Assessment

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges. From a herpetological habitat perspective, it was established that all four major habitats are naturally present on the study site, namely terrestrial, arboreal, rupicolous and wetland-associated vegetation cover.

Most of the study site consists of transformed grassland. Some of the natural grassland was transformed for mining activities.

Good natural rupicolous habitat is present as old ruins of the mining infrastructure and the old rock mine dump. An important feature of the study site is the absence of indigenous trees, though many individuals of alien tree species are present. Arboreal habitat is therefore not optimal. There are, however, numerous dead logs which provide shelter for several herpetofauna species.

A small dam occurs on the study site. This water source provides (limited) habitat for some water-dependent herpetofauna.

Connectivity to the site is poor, as the site is surrounded by residential areas, roads, mining areas and to a lesser degree agriculture.

10.2 Observed and Expected Herpetofaunal Species Richness

Of the 29 reptile species which may occur on the study site (Table 1), two were confirmed during the site visit (Table 10.2) and of the 10 amphibian species which may possibly occur on the study site (Table 10.1), one was confirmed during the site visit (Table 10.2).

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected of habitat that is severely disturbed. Most of the species of the resident diversity (Table 10.1) are fairly common and widespread (viz. the common house snake, mole snake, speckled rock skink, Cape gecko, guttural toad, Boettger's caco, common platanna and the common river frog).

Most of these herpetofauna species are robust generalists. It should be noted that potential occurrence is interpreted as being possible over a period of time, as a result of expansions and contractions of population densities and ranges which stimulate migration.

Table 10.1: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Carruthers & Carruthers (1979), Branch (1998), Alexander & Marais (2007), Minter, *et.al* (2004), Koen (2007), Du Preez & Carruthers (2009) and Bates, *et.al* 2014.

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	**REPTILES**
	Order: TESTUDINES	**TORTOISES & TERRAPINS**
	Family: Pelomedusidae	**Side-necked Terrapins**
√	*Pelomedusa subrufa*	Marsh Terrapin
	Order: SQUAMATA	**SCALE-BEARING REPTILES**
	Suborder:LACERTILIA	**LIZARDS**
	Family: Gekkonidae	**Geckos**
√	*Pachydactylus capensis*	Cape Gecko
	Family:Lacertidae	**Old World Lizards or Lacertids**
√	*Nucras lalandii*	Delalande's Sandveld Lizard
	Family: Gerrhosauridae	**Plated Lizards**
*	*Gerhosaurus flavigularis*	Yellow-throated Plated Lizard
	Family: Cordylidae	**Cordylids**
√	*Cordylus vittifer*	Common Girdled Lizard
	Family: Scincidae	**Skinks**
√	*Afroablepharus wahlbergii*	Wahlberg's Snake-Eyed Skink
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Speckled Rock Skink
√	*Trachylepis varia*	Variable Skink
	Family: Varanidae	**Monitors**
√	*Varanus niloticus*	Nile Monitor
	Family: Agamidae	**Agamas**
√	*Agama aculeata distanti*	Eastern Ground Agama
	Suborder: SERPENTES	**SNAKES**
	Family: Typhlopidae	**Blind Snakes**
√	*Afrotyphlops bibronii*	Bibron's Blind Snake
	Family: Leptotyphlopidae	**Thread Snakes**
√	*Leptotyphlops scutifrons*	Peter's Thread Snake
	Family: Viperidae	**Adders**
√	*Bitis arietans arietans*	Puff Adder
√	*Causus rhombeatus*	Rhombic Night Adder
	Family: Lamprophiidae	
√	*Aparallactus capensis*	Black-headed Centipede Eater
NT?	*Homoroselaps dorsalis*	Striped Harlequin Snake
√	*Boaedon capensis*	Common House Snake
*	*Lamprophis aurora*	Aurora House Snake
√	*Lycodonomorphus rufulus*	Brown Water Snake
√	*Lycophidion capense*	Cape Wolf Snake
√	*Psammophis crucifer*	Cross-Marked Grass Snake
√	*Psammophylax rhombeatus*	Spotted Grass Snake
*	*Duberria lutrix*	Common Slug Eater
*	*Prosymna sundevallii*	Sundevall's Shovel-snout
√	*Pseudaspis cana*	Mole Snake

	SCIENTIFIC NAME	ENGLISH NAME
	Family: Elapidae	**Cobras, Mambas and Others**
√	*Hemachatus haemachatus*	Rinkhals
	Family: Colubridae	
√	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
√	*Dasypeltis scabra*	Rhombic Egg Eater
	CLASS: AMPHIBIA	**AMPHIBIANS**
	Order: ANURA	**FROGS**
	Family: Pipidae	**Clawed Frogs**
√	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	**Toads**
√	*Amietaophrynus gutturalis*	Guttural Toad
*	*Amietaophrynus rangeri*	Raucous Toad
√	*Schismaderma carens*	Red Toad
	Family: Hyperoliidae	**Reed Frogs**
√	*Kassina senegalesis*	Bubbling Kassina
	Family: Pyxicephalidae	
√	*Amietia angolensis*	Common River Frog
√	*Cocosternum boettgeri*	Boettger's Caco
NT?	*Pyxicephalus adspersus*	Giant Bullfrog
√	*Tomopterna cryptotis*	Tremolo Sand Frog
√	*Tomopterna natalensis*	Natal Sand Frog

√ Definitely there or have a *high* probability of occurring;
* *Medium* probability of occurring based on ecological and distributional parameters;
? *Low* probability of occurring based on ecological and distributional parameters.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, *et.al*, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 10.2: Reptile and Amphibian species positively confirmed on the study site, observed indicators and habitat

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
Trachylepis punctatissima	Speckled Rock Skink	Sight record of a few adults	Rupicolous habitat
Agama aculeata	Ground Agama	Sight record of an adult	Terrestrial habitat
Amietia angolensis	Common River Frog	Sight record of a few adults	Aquatic habitat

The speckled rock skink, ground agama and common river frog listed in Table10. 2, should be common on the study site and elsewhere in its range.

10.3 Red Listed Herpetofauna

-By the Scientific Community

The striped harlequin snake has been recorded on the 2628AC (Alberton) quarter degree square (TVL Museum Records or Ditsong Museum of Natural History), but no moribund termitaria, where this species is most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on any study site, but there is a very small chance this species could occur on this particular study site. The species has been collected south of the study site in the Suikerbosrand Nature Reserve (Koen, 2007).

The coppery grass lizard has not been recorded on this quarter degree square (TVL Museum Records or Ditsong Museum of Natural History), and has not been collected south of the study site in the Suikerbosrand Nature Reserve (Koen, 2007). This species does probably not occur on the study site.

Koen (2007) in his extended survey of the herpetofauna of the Suikerbosrand Nature Reserve, collected two juvenile bullfrogss from the southern part of the reserve. The study site has a temporary dam, which is a potential breeding places for giant bullfrogs. Giant bullfrogs prefer warm, stagnant water, which giant bullfrog tadpoles need for rapid development (Van Wyk, Kok & Du Preez, 1992). Bullfrog breeding sites are mostly temporary, in order to avoid predation from fish. A gentle slope allows for shallow water (less than 10cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. The study site has sandy though compacted soil and is not very suitable as dispersal area. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods. There is small chance that giant bullfrog may occur on the site.

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*, 2004) to Least Concern in South Africa.

10.4 Discussion and Conclusion

It is concluded that some herpetofauna species, all widely distributed generalists, do occur or may occur on the study site. There is however no reason to conserve the site habitats for the sake of any herpetofauna species and the proposed development can be supported.

11. WETLAND ASSESSMENT

11.1 General description of the wetland on the site

A small seasonal wetland is present close to the eastern boundary of the site (Figure 7.1). This small drainage line originates in the highly disturbed mining area on the site and flows eastwards over the far eastern part of the site (Figure 3.4). This drainage line is greatly disturbed by mining and agriculture to the east of the site. A small dam was constructed on the site many years ago, but the dam-wall was broken (Figure 3.5) and the damaged dam currently holds very little water.This wetland is highly disturbed but still has limited functionality and is almost entirely covered by *Typha capensis* (Figure 7.5) and only few other species were recorded in the wet part.

The small temporary wetland occurs in the catchment area of the drainage line, north-west of the seasonal wetland (Figure 7.1). This catchment starts immediately below the Highly Transformed area (Figure 7.1). Water flows only intermittently in this wetland. The temporary Wetland is mainly covered by hygrophilous grasses, though the rush *Juncus* sp is conspicuous (Figure 7.6). Other species include the grasses *Imperata cylindrica, Eragrostis plana, Pennisetum clandestinum, Kyllinga erecta* and *Leptochloa fusca*. Several forb species were recorded, e.g. *Senecio erubescens, Conyza* podocephala and *Berkheya radula*.

The banks of these wetlands are very gradual, but is is clear that the entire area was severely disturbed in the past. No riparian zone occurs here.

In spite of being so small it is still regarded as a wetland, it therefore has a high ecological sensitivity (Figure 7.2), and is still protected by the National Water Act (1998)., but patches of woody vegetation dominated by *Vachellia karroo* occur close to the watercourse.

11.2 Vegetation

Detailed descriptions of the vegetation of the Seasonal and Temporary Wetlands are given in paragraphs 7.2.3 and 7.2.4 above.

11.3 Wetland Soils

The soil along the wetlands is dark to black, clayey, merging from the adjacent red terrestrial soil. Darker soils are often associated with lower-lying areas with wetland conditions.

11.4 Classification of the wetlands

A classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (Ewart-Smith *et al*. 2006). This classification system was further developed and refined and a new classification system, the “Classification System for Wetlands and other Aquatic Ecosystem in South Africa” was published (Ollis *et al.* 2013).

The current wetland study follows this new classification system, by attempting to classify the wet area on the site in terms of a functional unit in line with a Level 6 category recognised in the classification system proposed (Ollis *et al*. 2013).

For both the Seasonal and Temporary Wetland the Levels 1, 2 and 3 are similar.

Level 1:

Inland system

Level 2: Regional Setting

DWA Ecoregion

According to the DWA Level 1 Ecoregions the area falls under the Highveld Ecoregion (Ecoregion 11), (Kleynhans *et al*. 2005). The topography is dominated by plains of low to moderate relief and the vegetation consists exclusively of grassland.

Bioregions

The site falls within the Mesic Highveld Grassland Bioregion of Mucina & Rutherford (2006). According to the most recent vegetation map of South Africa the vegetation on the study site is in the Tsakane Clay Grassland (Gm 9, Mucina & Rutherford, 2006).

Level 3: Landscape setting

The site area is classified as a **Plain**, - defined as an extensive area of low relief, generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. (Ollis *et al*. 2013).

Level 4: Hydrogeomorphic Unit (HGM unit)

The HGM wetland unit is a small unchannelled valley bottom wetland (Ollis *et al*. 2013). Dominant water inputs to these wetlands are from catchment area, which is located on the site in the highly disturbed mining area to the west of the wetland. Occasional, short-lived, feeble flows are possible during rainfall events (Ollis *et al*. 2013).

Level 5: Hydrological Regime -

The wetland on the site can be classified as **non-perennial** and **seasonal to temporary.**

Level 6: Descriptors:

The wetland can be described as:

Natural (but disturbed), Vegetated, With grasses, sedges and rushes, both indigenous and alien.

It is concluded that both the wetland is natural, though highly disturbed disturbed.

11.5 Wetland Condition (WET-Health) Present Ecological Status PES)

Wetland Condition is defined as a measure of the deviation of wetland structure and function from its natural reference condition (Macfarlane *et al*. 2007).

In the current assessment the hydrological, geo-morphological and vegetation integrity was assessed for the wetland unit associated with the study site to provide a Present Ecological Status (PES) score (Macfarlane *et al*. 2007). In terms of wetland functionality and status, health categories used by WET-Health are indicated in the Table below.

Table: Health categories used by WET-Health for describing the integrity of wetlands (Kleinhans *et al*. 1999, Macfarlane *et al*. 2007)

DESCRIPTION	**PES SCORE**	**MANAGEMENT**
Unmodified, natural.	A	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged.	B	Some human-related disturbance, but mostly of low impact
: Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact and the basic ecosystem functions are still predominantly unchanged.	C	**Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**D**	
The change in ecosystem processes and loss of natural habitat and biota is serious. The loss of natural habitat, biota and basic ecosystem functions is extensive	E	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	F	

The wetland can be regarded to have a Present Ecological Score (PES) of D, which means that multiple disturbances occurred within this wetland. These disturbances are associated with the previous mining activities that occurred on the site. The multiple disturbances

associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation have occurred over the years.

11.6 Ecological Importance and Sensitivity (EIS)

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity;
- Ecological functions; and
- Basic human needs.

Table: Ecological Importance and Sensitivity rating scale used for calculation of EIS scores (DWAF, 1999)

Ecological Importance and Sensitivity Categories	**Rating**	**Recommended Ecological Management Class**
Very High Wetlands that are considered ecologically important and sensitive on a national level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive on a provincial level. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <=3	B
Moderate **Wetlands that are considered to be ecologically important and sensitive on a local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and**	**>1 and <=2**	C

quality of water in major rivers		
Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1	D

The Spruit on eastern boundary of the site

The Ecological Importance and Sensitivity of the wetland System is regarded as being in Moderate (Class C)(Table above). These wetlands that are considered to be ecologically important and sensitive on the **local level only**. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers

11.7 Buffer Zones

Local government policies require that protective wetland buffer zones be calculated from the outer edge of the temporary zone of a wetland (32 m) and river buffer zones from the outer edge of the riparian zone (30 m), irrespective of site specific conditions and development type. (KZN DAEA, 2002; CoCT, 2008; GDACE, 2009; and most recently Regulation 598, Government Gazette 37885, August 2014).

A buffer zone of at least 32 m is relevant for this project.

11.8 Risk Matrix

The idea of the risk assessment is to evaluate the risk of the particular development(s) on the wetlands that occur within 500 m of the particular development. This project proposes the development of a residential area outside the 32 m buffer zone of the drainage line and wetland, though within the 500 m zone.

The Risk Assessment Key used the Risk Matrix is based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol. This Key is given in the Tables below:

RISK ASSESSMENT KEY (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

Negative Rating

TABLE 1- SEVERITY

How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat) ?

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

TABLE 2 – SPATIAL SCALE

How big is the area that the aspect is impacting on?

Area specific (at impact site)	1

Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – DURATION

How long does the aspect impact on the resource quality?

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the resource quality?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3

Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

TABLE 7 – DETECTION

How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property?

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

TABLE 8: RATING CLASSES

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.

56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Note that PES and EIS for the wetland system are discussed in Chapter 6 – Wetland Assessment.

Result: Risk Matrix

The Risk Matrix indicates that this development has a Low Risk of impacting on the wetland system.

Risk Mart (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)
NAME and REGISTRATION No of SACNASP Professional member: Prof GJ Bredenkamp Registration no. Pr. Sci. Nat.: 400086/83

Phase	Activity	Aspect	Impact	Severity				Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
				Flow Regime	Physico & Chemical	Habitat	Biota													
Construction	Site clearing,	Vegetation clearing	Loss of wetland habitat and functions	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	75	Refer to the mitigation measures included in this report
		Erosion		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Sedimentation		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Soil compaction		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Encroachment of invasive species		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	

Construction	Stormwater management	Erosion	Loss of wetland habitat and functions	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	Refer to the mitigation measures included in this report
		Sedimentation		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Change in hydrology of the wetland		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Geomorphology alteration		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Vegetation change		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
Operational	Stormwater management	Erosion	Loss of wetland habitat and functions	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	Refer to the mitigation measures included in this report
		Sedimentation		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Change in hydrology of the wetland		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Geomorphology alteration		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Vegetation change		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
Operational	Management of open spaces	Infestation by alien and invasive species	Loss of wetland habitat and functions	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	Refer to the mitigation measures included in this report
		Alteration in species composition		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	
		Trampling and unauthorised vehicle access		1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	90	

11.9 Conclusion

No species of conservation concern are present within the wetland. The species richness is regarded as low. It is however important to note that all rivers and wetlands in South Africa are considered to be ecological sensitive systems and enjoy legal protection (National Water Act 1998, National Environmental Management Act, 1998), and their ecological sensitivity is accordingly indicated as high. The development should however not affect the wetland system, as all developments should be outside the buffer zone of at least 32 m.
Care should also to plan and construct an adequate stormwater system, to avoid erosion as far as possible.

12. IMPACT ASSESSMENT

12.1. Methods

The methods and format of the impact tables used in this chapter are in accordance to the requirements of the 2014 Regulations.

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **probability (P)** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **duration (D)**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **extent (E)**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **magnitude (M)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- the **significance (S)**, which shall be determined through a synthesis of the characteristics described above (Table 10.1).
  The significance rating is calculated by the following formula:
  S (significance) = (D + E + M) x (P)
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The numerical value of the calculation is assigned to a significance category.

Table 12.1: Significance ranking of impacts

SIGNIFICANCE	**Very High**	**High**	**Moderate**	**Low**	**Minor**
	80-100	**60-79**	**40-59**	**20-39**	**1-19**

Impacts should be identified for the construction and operational phases of the proposed development. Proposed mitigation measures should be practical and feasible such that they can be realistically implemented by the applicant.

12.2 Impacts of the proposed development on the vegetation and flora of the site

Based on the identified plant communities (ecosystems) and degree of ecological sensitivity the impacts on vegetation are assessed in three groups, namely:

- Highly transformed vegetation with low sensitivity
- Degraded grassland vegetation with medium-low sensitivity
- Wetlands with high sensitivity

It should also be noted that the proposed residential development should be located outside the 32 m buffer of the wetland, in which case the wetland vegetation is not affected. The following impacts represent a worse case scenario for the particular plant communities.

12.2.1 Impact on Highly Transformed Area

The ecological sensitivity of the Highly Transformed area (Plant Communities 2 and 5) is considered to be **Low** (see description of vegetation, Chapter 7). This is mainly due to the transformed status of these plant communities, their relatively low species richness, the prominence of alien trees and absence of plant species of conservation concern.

The **significance of the impact** of the proposed development on this plant community, with mitigation, is therefore considered to be **Low** during construction and operational phases. From vegetation and flora point of view, the proposed development on this area can be supported.

Table 12.2: Impact on Highly Transformed Area: Loss of transformed vegetation due to clearing for construction of the residential town.

Nature: The footprint area or the proposed town development will be cleared of vegetation. The vegetation of these areas is however transformed as a result of previous mining activities. The development will result in the loss or disturbance of a few indigenous plant species. The removal of alien trees is a positive impact. The removal of vegetation will also expose soil (which is already severely disturbed) increasing the risk of erosion.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	2-5 years	2	2-5 years	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Major	8	Major	6
Significance	**Moderate**	**55**	**Moderate**	**45**
Status (positive or negative)	Negative, removal of alien trees is positive		Negative, removal of alien trees is positive	
OPERATIONAL PHASE				
Probability	Definite	5	Highly probable	5
Duration	Permanent	5	Permanent	5
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Major	8	Major	6
Significance	**High**	**70**	**High**	**60**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	High		High	
Can impacts be mitigated?	Yes			

Mitigation:

- This area is totally transformed due to previous mining activities – though the clearing of vegetation must be kept to a minimum and remain within the footprint earmarked for development – create open area with indigenous trees;
- Construction must be completed as quickly as possible
- Disturbed open areas must be rehabilitated immediately after construction has been completed by planting appropriate indigenous tree and grass species;
- Plant indigenous trees – no alien species

Cumulative impacts: Expected to reduce the natural environment in the area.

Residual Risks: Little anticipated provided that the mitigation measures are implemented correctly.

12.2.2 Impact on Transformed and Disturbed Grassland

The ecological sensitivity of this grassland community (plant communities 1) is considered to be medium-low. This is due to the degraded condition of this grassland, due to previous mining activities. A single red data plant species occurs on the site.

Table 12.3: Impact on Transformed and Disturbed Grassland: Loss of indigenous vegetation due to clearing for construction of the residential town.

Nature: The footprint for the proposed development will be totally cleared of grassland vegetation. This will result in the loss of some indigenous species, disturbance of plant populations and the fragmentation of the plant community. The removal of vegetation will also expose soil increasing the risk of erosion.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	2-5 years	2	2-5 years	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Major	7	Moderate	5
Significance	**Moderate**	**50**	**Moderate**	**40**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Permanent	5	Permanent	5
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Major	7	Moderate	5
Significance	**High**	**65**	**Moderate**	**55**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Medium	
Irreplaceable loss of resources?	Moderate		Moderate	
Can impacts be mitigated?	Yes			

Mitigation:

- The clearing of vegetation must be kept to a minimum and remain within the stands earmarked for development – leave some open space area (e.g. parks) with natural vegetation in tact;
- The buffer zone for the wetland is in this grassland – this area must remain with natural grassland
- Construction must be completed as quickly as possible
- Disturbed open areas must be rehabilitated immediately after construction has been completed in that area by planting appropriate indigenous tree and grass species;
- During the construction phase workers must be limited to areas under construction and access to the planned open areas must be strictly controlled;
- Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas.
- Plant indigenous trees – no alien species

Cumulative impacts: Expected to reduce the grassland environment in the area.

Residual Risks: Little anticipated provided that the mitigation measures are implemented correctly.

12.2.3 Impact on Wetlands

All water courses in South Africa are protected by law (National Water Act 1998, National Environmental Management Act 1998). Therefore the wetland and its buffer zone of at least 32 m are therefore excluded from the proposed residential development. The development should therefore not have any direct impact on the vegetation (or functions) of the wetland. The wetland on site includes plant communities 3 and 4. The wetland is quite small and is disturbed and degraded as a result of the previous mining activities. A rehabilitation of the wetland will have a positive effect on the wetland ecosystem and will also be beneficial to the people who will live in the residential area.

Table 12.4: Impact on wetland: Loss of natural vegetation due to clearing and trenching.

Nature: The proposed development implies removal of vegetation and trenching through the spruit banks and spruit bed. The spruits are both very small and the trenching will be of very short duration and if rehabilitated quickly, should not have a big effect in the spruits.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Improbable	2	Very improbable	1
Duration	2-5 years	2	2-5 years	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Low	4	Low	2
Significance	**Minor**	**14**	**Minor**	**5**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Permanent	5	Permanent	5
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Moderate	5	Low	3
Significance	**Moderate**	**55**	**Moderate**	**45**
Status (positive or negative)	Negative		Negative	

Reversibility	Low	Low
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Mitigation: • Restrict all development outside the 32 m buffer; • The construction must be completed as quickly as possible • Disturbed areas in the buffer zone must be rehabilitated immediately after construction has been completed in that area by planting appropriate indigenous grass species; • During the construction phase workers must be limited to areas under construction and access to the wetland areas must be strictly controlled;		
Cumulative impacts: Limited.		
Residual Risks: None anticipated.		

A connection between the development north and south of the wetland is possible by

1. Connection road west of the wetland through the current highly disturbed mining area
2. By repairing the current dam wall and build a road over the dam wall. This will imply a connection road through the buffer zone with impacts as given in Table 10.3 above.

12.2.4 Impact due to increase in alien plant species

All cleared areas within the development sites may be prone to increase of alien trees an weed species.

Table 12.5: Increase of alien invasive plant species.

Nature: Alien invasive plant species and weeds may encroach into disturbed areas.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	4	Probable	2
Duration	Medium-term	3	Medium-term	1
Extent	Limited to site	1	Limited to Site	1
Magnitude	Moderate	5	Low	2
Significance	**Low**	**36**	**Minor**	**8**
Status (positive or negative)	Negative		Positive	
OPERATIONAL PHASE				
Probability	Improbable	2	Very Improbable	1
Duration	Permanent	5	Permanent	5
Extent	Limited to site	1	Limited to Site	1
Magnitude	Low	2	Low	1
Significance	**Minor**	**16**	**Minor**	**7**
Status (positive or negative)	Negative		Positive	
Reversibility	Moderate		High	
Irreplaceable loss of resources?	Moderate		Moderate	
Can impacts be mitigated?	Yes			

Mitigation: • An alien invasive management programme must be incorporated into the Environmental Management Programme; • Ongoing alien plant control must be undertaken; • Areas which have been disturbed will be quickly colonised by invasive alien species. An ongoing management plan **must** be implemented for the clearing/eradication of alien species. • Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. • Avoid planting of exotic plant species, use indigenous species.
Cumulative impacts: Moderate, should mitigation measure not be implemented. Alien invader plant species pose an ecological threat as they alter habitat structure; lower biodiversity, change ecosystem services and processes e.g. change nutrient cycling and productivity, and modify food webs.
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

12.3 Impacts on mammals and herpetofauna

The conservation rating of the plains section (prior to land clearing) of the site or mammals and herpetofauna is considered to be **Low**. As the proposed project involves development of a residential area, the faunal impacts will largely be restricted to the const ruction phase, and fauna will be largely eliminated when people occupy their new homes. The two broad categories of impacts will be habitat loss and disturbance related to construction activities. Since the construction activities will take place over the entire site (excluding the wetland and it buffer zone), the spatial extent of the impacts will be significant.

The impact of the envisaged development is tabulated below

Table 12.6: Direct impact on mammal and herpetofauna communities and loss of faunal habitat.

Nature: The proposed project involves the development of a residential area, the faunal impacts will largely be restricted to the construction phase. The two broad categories of impacts will be habitat loss and disturbance related to construction activities. Since the construction activities will be take place over the entire site, the spatial extent of the impacts will be significant.

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	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	Short duration	2	Short duration	1.
Extent	Limited to site	1	Limited to site	1
Magnitude	Low	4	Low	2.
Significance	**Low**	**35**	**Low**	**25**
Status (positive or negative)	Negative			
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Permanent	5	Permanent	5

Extent	Site	1	Site	1
Magnitude	Low	2	Low	1
Significance	**Moderate**	**40**	**Low**	**35**
Status (positive or negative)	**Negative**		**Negative**	
Reversibility	No		No.	
Irreplaceable loss of resources?	Yes		Yes	
Can impacts be mitigated?	Yes			
Mitigation: • .The clearing of vegetation must be kept to a minimum and remain within the footprint of the development; • The construction must be completed as quickly as possible - fauna species may be killed • Disturbed areas must be rehabilitated immediately after construction has been completed in that area by planting appropriate indigenous plant species; • During the construction phase workers must be limited to areas under construction and access to the undeveloped areas must be strictly controlled; • Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas.				
Cumulative impacts: No				
Residual Risks**:** No.				

12.4 Impacts on birds

11.4.1 General comments

The impacts on avifauna will occur during both the construction and operational phases. The two broad categories of impacts will be habitat loss and disturbance related to construction activities and finally the increased presence of many residents during the operational phase.

Avian habitats In the areas where buildings, roads and other infrastructure are constructed, avian habitats will be permanently lost. The movement and activities of personnel and residents on site and the associated noise, pollution and litter all having a negative effect on birds. In addition, the presence of people will increase the probability of activities such as illegal killing of birds. Pollution associated with construction activities (e.g., fuel spills, use of cleaning chemicals) could have negative impacts on avifauna, particularly if such chemicals were to make their way into drainage lines and wetlands, even off-site. Electrical infrastructure such as distribution lines, as well as electric fences, pose a potential collision risk to flying birds, and a potential electrocution risk to perching birds.

12.4.2 Specific impacts

Table 12.7: Avian habitat loss.

Nature: A very small area of avian habitat will be destroyed during excavation of the trench and construction of the residential area.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	Short duration	1	Short duration	1
Extent	Site specific	1	Site specific	1
Magnitude	Very low	2	Very low	2
Significance	**Low**	**20**	**Low**	**20**
Status (positive or negative)	Negative			
OPERATIONAL PHASE				
Probability	Improbable	1	Improbable	1
Duration	Short duration	2	Short duration	2
Extent	Site specific	1	Site specific	1
Magnitude	Very low	1	Very low	1
Significance	**Minor**	**4**	**Minor**	**4**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes			

Mitigation:

- The spatial extent of construction activities must be minimized, and as far as possible must be restricted to the areas on which buildings, roads etc will actually be located. Particular care must be taken to minimize activities in the areas of natural grasslands in the eastern half of the site..
- The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area.
- Disturbance by residents of birds breeding and foraging in the area should be minimized.
- Provide adequate briefing for site personnel and residents.
- Any bird nests that are found during the construction period must be reported to the Environmental Control Officer (ECO).

Cuculative Impacts: Expected to be minimal. The habitat is however already largely transformed and fragmented due to the adjacent mining agricultural and residential activities and the site is not a unique habitat within the landscape. It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction and operation of the proposed development. Birds are very mobile and may migrate to adjacent suitable habitat. It should be noticed that the newly created town forms habitat for specific bird species.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 12.8: Impact on birds due to disturbance associated with construction activities and with increased human presence in the area.

Nature: The presence of vehicles and construction workers will cause disturbance to avifauna, with the movement and activities of personnel on site and the associated noise, pollution and litter all having a negative effect on birds. In addition, the presence of construction workers will increase the probability of activities such as illegal hunting of birds. The permanent presence of a much larger number of people than presently occur at the site will result in greater disturbance of birds that use the area for foraging and breeding.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	Short term 2-5 years	2	Short term 2-5 years	2
Extent	Limited to Local Area	2	Limited to Local area	2
Magnitude	High	8	Medium	6
Significance	**High**	**60**	**Moderate**	**50**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Permanent	5	Permanent	5
Extent	Limited to Local Area	2	Limited to Local Area	2
Magnitude	High	8	High	6
Significance	**High**	**75**	**High**	**65**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	High		High	
Can impacts be mitigated?	Yes			

Mitigation:

- Movement of construction vehicles and workers beyond the boundary of the site must be minimized. In addition, workers must be instructed to minimize disturbance of birds at all times, and steps must be taken to ensure that no illegal hunting occurs.
- The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area.
- Disturbance by residents of birds breeding and foraging in the area should be minimized.
- Provide adequate briefing for site personnel and residents.
- Any bird nests that are found during the construction period must be reported to the Environmental Control Officer (ECO) and residents should always be aware of the importance of birds in their built environment.

Cumulative impacts: Expected to be minimal. The habitat is however already largely transformed and fragmented due to the adjacent agricultural and residential activities and the site is not a unique habitat within the landscape. It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction and operation of the proposed development. Birds are very mobile and may migrate to adjacent suitable habitat. It should be noticed that the newly created town forms habitat for specific bird species.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 12.9: Pollution associated with construction or residential activities

Nature: Pollution associated with construction activities and residents (e.g., fuel spills, use of cleaning chemicals) could have negative impacts on avifauna.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Improbable	2	Very Improbable	1
Duration	Short term 2-5 years	2	Short term 2-5 years	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Low	4	Minor	2
Significance	**Minor**	**14**	**Minor**	**5**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Improbable	2	Very Improbable	1
Duration	Medium term	3	Medium term	3
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Low	4	Minor	2
Significance	**Minor**	**16**	**Minor**	**6**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation:

- Great care must be taken that no pollutants or other waste pollute the area or enter local water systems during the construction or operational phases. Measures to rapidly deal with spills of fuel, cleaning chemicals or any other potential pollutants must be put in place before construction commences.
- Construction workers must be suitably trained to deal with any such spills.
- Facilities to handle pollution and waste must be provided to residents.

Cumulative impacts: Expected to be minimal. The habitat is already largely transformed and fragmented due to the adjacent agricultural and residential activities and the site is not a unique habitat within the landscape. It is not envisaged that any Red Data species will be displaced. Birds are very mobile and may migrate to adjacent suitable habitat. It should be noticed that the newly created town forms habitat for specific bird species.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 12.10: Electrocution and collision hazards

Nature: Electrical infrastructure such as distribution lines, as well as electric fences, pose a potential collision risk to flying birds, and a potential electrocution risk to perching birds. The magnitudes of these risks are much lower than the corresponding risks associated with large overhead transmission lines. Assuming that the electrical infrastructure comprising part of the proposed development is typical of housing developments, no specific mitigation measures are required.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Very Improbable	1	Very Improbable	1
Duration	Short term 2-5 years	2	Short term 2-5 years	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Low	4	Minor	2
Significance	**Minor**	**7**	**Minor**	**5**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Improbable	2	Very Improbable	1
Duration	Medium term	3	Medium term	3
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Low	4	Minor	2
Significance	**Minor**	**16**	**Minor**	**6**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation:

- Normal safety measures for electrical installations as used by Eskom

Cumulative impacts: Expected to be minimal. The habitat is already largely transformed and fragmented due to the adjacent agricultural and residential activities and the site is not a unique habitat within the landscape. It is not envisaged that any Red Data species will be displaced. Birds are very mobile and may migrate to adjacent suitable habitat. It should be noticed that the newly created town forms habitat for specific bird species.

Residual Risks: None.

13. GENERAL CONCLUSIONS

Vegetation and Flora

From a vegetation and flora point of view, and also a conservation point of view, the area is already highly disturbed, degraded and transformed. A population of a single red data plant species occurs within the Transformed and Degraded Grassland,

It is suggested that the several individuals of *Hypoxis hemerocallidea* be rescued and donated to the Walter Sisulu National Botanic Garden, or planted in the gardens of the retirement village. Care should be taken with the rescue operation, as these plants may have huge bulbs.

No development will be supported within the wetland and its 32 m buffer zone, as this is controlled by law (National Water Act 1998, National Environmental Management Act, 1998).

It is concluded that the planned development can be supported.

Mammals

The ecologically petite site has no value as conservation asset and its conservation status is rated as Low. The impact of the development is calculated as **High** since the development is irreversible and will be fundamentally permanent. Geographically the site is ideally situated to develop for the proposed development.

From the perspective of the remaining mammals or, there is no reason to argue against the development.

Birds

From an avifaunal perspective, the conservation status of this site is medium-low – the grassland may still represent significant foraging and/or breeding habitat for some species of conservation significance. At a broader spatial scale, the site is located in a highly transformed urbanized and agricultural landscape with most of the surrounding area consisting of agricultural fields, disturbed grassland, and urban areas. Therefore, although avian habitats will be destroyed, the ultimate impact of the development on birds is considered to be insignificant and the development can be supported.

Herpetofauna

A slight possibility exists that some individuals of the giant bullfrog may occasionally occur on the study site.

From a herpetofauna perspective, no objection can be raised against the development.

Wetland

Seasonal and temporary wetlands occur on the site. A 32 m buffer into the adjacent Transformed and Degraded Grassland is applicable. No development should occur within the wetlands or buffer zone.

14. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. EcoAgent can therefore not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

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16. DETAILS OF SPECIALIST CONSULTANTS

GEORGE JOHANNES BREDENKAMP

Born: 10 February 1946 in Johannesburg, South Africa.
Citizenship: South African
Marital status: Married, 1 son, 2 daughters

Present work address
Extra-ordinary Professor
Department of Plant Science, University of Pretoria, Pretoria, 0002, South Africa
Tel:(27)(12)420-3121 Fax: (27)(12)362 5099
E-Mail: george.bredenkamp@up.ac.za

or

EcoAgent CC, or Ecotrust Environmental Services CC
PO Box 25533, Monument Park, 0105, South Africa
Tel and Fax: (27)(12) 460 2525
Cell 082 5767046
E-Mail: ecoagent@mweb.co.za or ecoagent@mile.co.za

Qualifications:

1963 Matriculation Certificate, Kemptonpark High School
1967 B.Sc. University of Pretoria, Botany and Zoology as majors,
1968 B.Sc. Hons. (cum laude) University of Pretoria, Botany.
1969 T.H.E.D. (cum laude) Pretoria Teachers Training College.
1975 M.Sc. University of Pretoria, Plant Ecology .
1982 D.Sc. (Ph.D.) University of Pretoria, Plant Ecology.

Theses: (M.Sc. and D.Sc.) on plant community ecology and wildlife management in nature reserves in South African grassland and savanna.

Professional titles:

• MSAIE&ES South African Institute of Ecologists and Environmental Scientists
- 1989-1990 Council member
• MGSSA Grassland Society of Southern Africa
- 1986 Elected as Sub-editor for the Journal
- 1986-1989 Serve on the Editorial Board of the Journal
- 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
- 1993 Elected as professional member
• Pr.Sci.Nat. South African Council for Natural Scientific Professions **Reg No 400086/83**
- 1993-1997 **Chairman** of the Professional Advisory Committee: Botanical Sciences

- 1993-1997: **Council** Member
- 1992-1994: Publicity Committee
- 1994-1997: Professional Registration Committee

Professional career:

• Teacher in Biology 1970-1973 in Transvaal Schools
• Lecturer and senior lecturer in Botany 1974-1983 at University of the North
• Associate professor in Plant Ecology 1984-1988 at Potchefstroom University for CHE
• Professor in Plant Ecology 1988-2008 at University of Pretoria.
• Founder and owner of the Professional Ecological Consultancy firms Ecotrust Environmental Services CC and Eco-Agent CC, 1988-present.

Academic career:

• Students:
- Completed post graduate students: M.Sc. 53; Ph.D. 14.
- Presently enrolled post-graduate students: M.Sc. 4; Ph.D. 1.

• Author of:
- 175 scientific papers in refereed journals
- >150 papers at national and international congresses
- >300 scientific (unpublished) reports on environment and natural resources
- 17 popular scientific papers.
- 39 contributions in books

• Editorial Committee of
- South African Journal of Botany,

Journal Grassland Society of Southern Africa,
Bulletin of the South African Institute of Ecologists.
Journal of Applied Vegetation Science.(Sweden)
- Phytocoenologia (Germany)

• FRD evaluation category: C1 (=leader in South Africa in the field of Vegetation Science/Plant Ecology)

Membership:

• International Association of Vegetation Science.
• International Society for Ecology (Intecol)
• Association for the Taxonomic study of the Flora of Tropical Africa (AETFAT).
• South African Association of Botanists (SAAB)
1988-1993 Elected to the **Council** of SAAB.
1989-1990 Elected as **Chairman** of the Northern Transvaal Branch
1990 Elected to the Executive Council as **Vice-President**
1990- Sub-editor Editorial Board of the Journal
1991-1992 Elected as **President** (2-year period)
1993 **Vice-President** and Outgoing President
• Wildlife Management Society of Southern Africa

• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
(=South African Academy for Science and Art).
• Wildlife Society of Southern Africa
1975 - 1988: Member
1975 - 1983: Committee member, Pietersburg Centre
1981 - 1982: **Chairman**, Pietersburg Centre
• Dendrological Society of Southern Africa
1984 - present: Member
1984 - 1988: Committee member, Western Transvaal Branch
1986 - 1988: **Chairman**, Western Transvaal Branch
1987 - 1989: Member, Central Committee (National level)
1990 - 2000: Examination Committee
• Succulent Society of South Africa
1987 - present: Member
• Botanical Society of South Africa
2000 – present: Member
2001- 2008: Chairman, Pretoria Branch
2009-present Committee member Pretoria Branch
2002 – present: Chairman, Northern Region Conservation Committee
2002- 2007: Member of Council

Special committees:

• Member or past member of 10 special committees re ecology, botany, rangeland science in South Africa.
• Member of the International Code for Syntaxonomical Nomenclature 1993-1996.

Merit awards and research grants:

1968 Post graduate merit bursary, CSIR, Pretoria.
1977-1979 Research Grant, Committee re Research Development, Dept. of Co-operation and Development, Pretoria.
1984-1989 Research Grant, Foundation for Research Development, CSIR, Pretoria.
1986-1987 Research Grant, Dept. of Agriculture and Water Supply, Potchefstroom.
1990-1997 Research Grant, Dept. of Environmental Affairs & Tourism, Pretoria.
1991-present Research Grant, National Research Foundation , Pretoria.
Research Grant, Water Research Commission.
1999-2003 Research Grant, Water Research Commission.
2006 South African Association of Botanists Silwer Medal for outstanding contributions to South African Botany

Abroad:

1986 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom
Visits to Israel, Italy, Germany, United Kingdom, Portugal.
1987 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom.
Visits to Germany, Switzerland, Austria, The Netherlands, United Kingdom.
1990 Travel Grant, FRD.

Visit to Japan, Taiwan, Hong-Kong.
1991 Travel Grant, FRD.
Visits to Italy, Germany. Switzerland, Austria, France, The Netherlands, United Kingdom.
1993 Travel Grant, University of Pretoria.
Visits to the USA, Costa Rica, Czech Republic, Austria.
1994 Travel Grant FRD.
Visits to Switzerland, The Netherlands, Germany, Czech Republic.
1995 Travel Grant FRD, University of Pretoria
Visits to the USA
Travel Grant, University of Pretoria
Visit to the UK.
Travel Grant University of Pretoria, Visit Czech Republic, Bulgaria
Travel Grant, University of Pretoria, Visit Czech Republic, Italy, Sweden
Travel Grant, University of Pretoria, Visit Hungary, Spain, USA
Travel Grant, University of Pretoria, Visit Poland, Italy, Greece.
Travel Grant, NRF, Visit Brazil
2006 German Grant Invited lecture in Rinteln, Germany

Consultant

Founder and owner of Ecotrust Environmental Services CC and Eco-Agent CC
Since 1988 **>300** reports as consultant on environmental matters, including:
Game Farm and Nature Reserve planning,
Environmental Impact Assessments,
Environmental Management Programme Reports,
Vegetation Surveys,
Wildlife Management,
Veld Condition and Grazing Capacity Assessments,
Red data analysis (plants and animals).

ALAN CHARLES KEMP

Born: 7 May 1944 in Gweru, Zimbabwe
Citizenship: South African, British
Marital status: Married, 1 daughter, 1 son

Present work address:
Naturalists & Nomads, 8 Boekenhout Street, Navors, Pretoria, 0184, South Africa
Tel: (+27)(12)804-7637 Fax: (+27)(12)804-7637
E-Mail: leadbeateri@gmail.com
or
Naturalists & Nomads, Postnet Suite #38, Private Bag X19, Menlo Park, 0102, South Africa

Qualifications:
1965 B.Sc. Rhodes University, Zoology and Entomology majors
1966 B.Sc. Hons. Rhodes University, Zoology
1973 Ph.D. Rhodes University, Zoology of Pretoria

Thesis: (Ph.D.) The ecology, behaviour and systematics of *Tockus* hornbills (Aves: Bucerotidae), conducted mainly in the Kruger National Park

Professional titles:
• Pr.Sci.Nat. South African Council for Natural Scientific Professions Registration Number 400059/09, Zoological and Ecological Sciences.

Professional career:
- Field Research Assistant to Prof. Tom J. Cade, Section of Ecology and Systematics, Cornell University, in Kruger National Park, South Africa, Nov 1966 - Apr 1969.
- Department of Birds, Transvaal Museum, Pretoria, June 1969 – August 1999, Head of Department from 1971, rising to Senior Scientist and then Head Curator by 1974.
- Elected Manager, Transvaal Museum, September 1999 – July 2001, until voluntary early retirement.
- Edward Grey Institute of Ornithology, Oxford, December 2001 – April 2002, drafting specialist bird texts for Gale Publishing, USA and Andromeda Press, Oxford, UK.
- Berg 'n Dal & Pretoria, April 2002 - February 2003, presenting paper and later editorial assistant for book from the Mammal Research Institute, University of Pretoria, *The Kruger Experience: ecology and management of savanna heterogeneity.*
- Bangkok, March – June 2003, drafting research papers for colleague at Mahidol University; touring Laos.
- Pretoria, August-December 2003, editorial assistant for book from the Mammal Research Institute, University of Pretoria, a revision of *The Mammals of Southern Africa.*
- Hala-Bala Wildlife Reserve, January – December 2004, a one-year rainforest study of hornbills, raptors and owls in southern Thailand for their National Center for Genetic Engineering and Biotechnology (BIOTEC).
- Pretoria, January 2005 – July 2007, organizing 4th International Hornbill Conference at Mabula Game Lodge and editing and publishing CD-ROM proceedings, and consulting on ground hornbills to Mabula, University of Cape Town and Endangered Wildlife Trust.
- Bangkok, India, Singapore, Sarawak, September 2006 – April 2007. assisted colleagues

at Mahidol University, Bangkok, with compilation of research paper on molecular systematics of hornbills, and travelled to see other Asian habitats and meet with other colleagues.

- Singapore, March 2009, present opening address, paper and poster at 5th International Ornithological Conference

Academic career:

• Students:

- Supervise completed post graduate students: M.Sc. 14; Ph.D. 5.

• Author of:

- 104 scientific papers or notes in refereed journals
- 48 papers at national and international congresses
- 6 scientific (unpublished) reports on environment and natural resources
- 73 popular scientific papers.
- 15 contributions in or as books

• Editorial Roles

- Ostrich, African Journal of Ornithology (editor 1973-75).
- Bird Conservation (International (editorial committee 1995-present)

• FRD evaluation category: C2 (Avian Biology and Systematics)

● **Associate positions:**

- University of the Witwatersrand, Honourary lecturer, Department of Zoology (1988-2001)
- Percy FitzPatrick Institute of African Ornithology, University of Cape Town, research associate (2001 – present).
- Ditsong National Museum of Natural History (ex Transvaal Museum), Honorary curator (2004-present)
- Wildlife Conservation Society, New York, wildlife conservation associate (1996-present).

Membership:

- American Ornithologist's Union, Corresponding Fellow (1986- present)
- Birdlife South Africa (South African Ornithological Society), Ordinary Member (1969-present), President (1975-1993) of Northern Transvaal (Pretoria) Branch, Honourary Life Member of North Gauteng (Pretoria) Bird Club (2000 – present).

Special committees:

- International Ornithological Committee of 100, elected member (1989-present).
- Raptor Research Foundation, Grants assessor, Leslie Brown Memorial Fund (1985-present).

Merit awards and research grants:

- 1969-86. Annual research grants from South African Council for Scientific and Industrial Research (CSIR).
- 1974. Chapman Fund Award, American Museum of Natural History, for field research in Borneo and India.

- 1986-98. Annual research award from South African Foundation for Research Development (FRD) as "C"-graded national scientist.
- 1989-95. Team member of FRD Special Programme in Conservation Biology.
- 1989-95. Team member of FRD Special Programme in Molecular Systematics.
- 1991-95. Various private sector sponsorships.
- 1992, 1994. FRD merit award to museum scientists.
- 2000. Special NRF Science Liaison award to attend 10th Pan-African Ornithological Congress, Kampala, Uganda.
- 2001. Special NRF Science Liaison award to attend 3rd International Hornbill Workshop, Phuket, Thailand.
- 2004. One year's support from Thailand's National Center for Genetic Engineering and Biotechnology (BIOTEC) for rainforest survey research.
- 2007-2008. Six month's funding to enable specialist assistance at Department of Microbiology, Mahidol University, Thailand.
- 2010. Gill Memorial Medal of Birdlife South Africa

Consultant

- Sept-Oct 1994 – Kruger National Park, specialist consultant on ground hornbills to BBC Natural History Unit for filming of Wildife on One programme, 10 weeks.
- Oct-Nov 1996. Kruger National Park, specialist consultant on various birds to David Attenborough for BBC series Life of Birds, 3 weeks.
- Sep-Oct 1998. Kruger National Park, specialist hornbill consultant to National Geographic magazine team, 4 weeks
- October 2001 – Mala Mala, specialist consulting on ground hornbills for National Geographic film unit, 1 week.
- 2004-present - >15 specialist birding and nature tours as a National South African Tourist Guide, registration number GP0770.

  2005-present – >20 Biodiversity assessments for a Ramsar wetland proposal, Important Bird Area proposal, and general scoping, G20 and specialist avifaunal EIAs.

IGNATIUS LOURENS RAUTENBACH

Independent Environmental Consultant – MAMMALOGY; Ph.D., Prof. Nat. Sci. .

Identity Number 421201 5012 00 5
Gender Male
Date of Birth 1 December 1942; born Germiston, RSA
Nationality South African
Home Languages Bilingual (English & Afrikaans)
Postal Address 45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell +27 082 3351288. E-mail naasrauten@mweb.co.za
Former Position Retired Director: Planning, Northern Flagship Institute
Present Position Consultant – Specialist, Environmental Impact Assessments (Applied research), Photographing microstock for four agencies
Qualifications **B.Sc**. (UP) 1966, **T.H.E.D** (Pta TTC) 1967, **M.Sc.** (UP) 1971, **Ph.D**. (Un. Natal) 1971
Professional Honours 1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05
2. Fellow of the Photographic Society of South Africa
3. Master photographer at club level
4. Honorary life member of the S.A. Wildlife Management Association.
Notable Research Contribution In-depth survey of the Mammals of the Transvaal. 1982. 211pp. Ecoplan Monograph 1.
Notable Literary Contribution Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.
Formal Courses Attended Computer Literacy, Project Management, Contract Design, Senior Management
Employment history
May 2001 - Present Self-employed, collaborator with Eco-Agent CC Ecological Consultants as well as Galago Environmental [environmental impact assessments], technical writing, and photography
April 1999 - August 2001 Director: Planning, Northern Flagship Institution
Jan 1991 - April 1999 Executive Director, Transvaal Museum
July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Principal Scientist rank as of June 1985
March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria
July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams collectively partaking in the 'African Mammal Project'
1966: Part-time research assistant to Prof. J. Meester, University of Pretoria
1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services
1991 - 2002 Founder member and non-executive director of the Board of Trustees of
1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund
1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievements

Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at the Transvaal Museum. Conceptualised and managed 12 display programmes.

Research: Author and co-author of 85 scientific publications re mammalogy in peer reviewed subject journals, 18 popular articles, 10 books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B -rated by FRD as scientist of international status 1983 – 1995.

Students: Additional to museum manager duties, **c**o-supervised 5 B.Sc. (Hons.), 2 M.Sc. and 2 Ph.D. students.

Public Recognition:

Public speaking *inter alia* Enrichment Lecturer on board the 6* *SS Silver Wind*, radio talks, TV appearances.

Hobbies

Technical writing, photography, field logistics, biological observations, wood working, cooking, designs.

Personal Evaluation

I am goal-orientated, expecting fellow workers and associates to share this trait. I am an extrovert, sensitive to amicable interpersonal relations. I have a wide interest span ranging from zoological consulting, photography, cooking, sport, news, gardening and out of necessity, DIY. To compensate for my less than perfect memory, I lead a structured and organised life to deal with the detail of a variety of interests. Often to the chagrin to people close to me, I have an inclination to “Think Out of the Box”.

JACOBUS CASPARUS PETRUS (JACO)

Identity number 680804 5041 08 4
Gender Male
Date of birth 4 August 1968
Nationality South African
Home languages Afrikaans, fluent in English
Postal address P.O. Box 25085, Monument Park, Pretoria, 0105.
Tel no +27 12 347 6502, Cell +27 82 410 8871
E-mail **jcpvanwyk@absamail.co.za**
Present position Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof
Consultant Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications **B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.F.S.), **M.Sc.** (U.F.S.)
Honours Foundation of Research Development bursary holder
Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09
Notable Research Contribution In-depth field study of the giant bullfrog

Formal Courses Attended Outcomes Based Education, University of the South Africa (2002)
Introductory Evolution, University of the Witwatersrand (2008)
OBE, GET & FET training, 2002-2008, Education Department

Employment history
2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.
1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included teaching, mid-level management and administration.
July 1994 – Dec 1994 Teaching Botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research
1993 - 1994 Mammal Research Institute (University of Pretoria) research associate on the Prince Edward Islands: topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution
1991 - 1993 Laboratory demonstrator for Zoological and Entomological practical tutorials, and caring for live research material, University of the Free State
1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith
Professional Achievement **Research:** Author and co-author of 52 scientific publications in peer-reviewed and popular subject journals, and >60 contractual EIA research reports. Extensive field work and laboratory experience in Africa
Public Recognition: Public speaking *inter alia* radio talks, TV appearances
Hobbies: Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking.