ECOAGENT
ECOLOGY & BIODIVERSITY CONSULTANTS

An evaluation of the biodiversity for the proposed development on the Remainder of the Farm Boschhoek 3345, Newcastle, KwaZulu-Natal

March 2011

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Commissioned by

LEAP Landscape Architect & Environmental Planner

Contributors:

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

General

A new development is planned for an area of about 202 ha on the Farm Boschhoek 3345 south of Newcastle. This report addresses the baseline biodiversity and wetlands and potential ecological impact of the new development.

Vegetation

Seven plant communities were identified. The primary vegetation has a Medium sensitivity, while the secondary vegetation and disturbed areas have a Low sensitivity. Most of the area is therefore suitable for development. The wetlands and spruits are protected by law and no development should take place within the 1:100 year flood line or within 32 m from the edge of the spruit or wetland. It is furthermore suggested that the Shrubland of the Hills be at least partly conserved in an open space that remains natural.

Mammals

Planning the new residential development as an immediate extension to existing suburbs is laudable and accepted as a best-case scenario for the inevitable consequence of a burgeoning population. The rocky ridges and the streams with their wetlands should be regarded as sensitive areas. Wetland systems are ranked as very sensitive and will thus require special intervention. The proposed mitigation measures address ways to deal with stormwater runoff that, if left unattended, could cause damage to the wetland systems. Wetlands should primarily be protected by means of 50 meter wide buffer zones measured from either edge of the streams. This will allow for bio-filtering and allow for connectivity. It will also accommodate the possible occurrence of the “Critically Endangered” rough-haired golden mole, the “Near Threatened” African marsh rat, as well as the confirmed presence of sensitive vlei rats. Should at least part of the rocky ridges are deemed as sensitive and excluded from development, passive conservation will be sufficient. By preserving part of the rocky ridges as well as the two streams (each with its collective 50+50=100 meter-wide conservation buffer), habitat for most Red Data and sensitive

small mammals will be preserved and connectivity will be enhanced. The proposed development will in all likelihood be concentrated on the terrestrial habitat (i.e. the grasslands). This will displace terrestrial mammals, which is of little consequence considering the extensive nature of surrounding undeveloped grasslands, especially to the west and south.

Birds

I do not foresee any significant impacts on birds of conservation concern from a residential development on the farm Boschhoek, just south of Newcastle, KwaZulu-Natal. I base this conclusion on an 8-hour site visit integrated with a desktop study of the necessary reference literature. However, the site does contain important drainage systems on clay-based soils, including springs, streams, dams, riparian vegetation and alluvial flats, that require protection. This protection could be in the form of a green area to service the needs of both ecosystem functioning and recreation for the residents. It must ensure that the drainage habitats are maintained as a natural corridor for those species largely confined to these habitats. In addition, the development site also supports important patches of woodland on the crest and western slopes of two rocky ridges and these deserve protection for the diversity of bird species they support, as both habitat and as transit sites for these species between patches. Suggestions on how best to implement these protective activities, and to generally mitigate the impacts of the development are included.

Herpetofauna

Of the 21 Red Data herpetofauna species of KwaZulu-Natal Province, only one species may occur on the site for the proposed development. The distribution of almost all of the other known Red Data species does not overlap with the study site. The soil composition on site consists mostly of clay, with the result that species that may occur in the area have no suitable habitat. There is almost no chance that the Striped Harlequin Snake may occur on the study site, because of the total absence of the moribund termitaria where this species is most likely to be found. The temporary manmade dams on the southern section of the study site are potential breeding habitats for Giant Bullfrogs. However, the clay soil of the surrounding areas and the lack of sand or loam soil, which giant bullfrogs need to migrate to for aestivation, resulted in their absence. The Sungazer Girdled Lizards also need mostly sand or loam soil for self-excavated burrows. This, and the almost total lack

of termite mounds, at which they feed during the summer rainfall period, resulted in their absence on the study site. Only Spotted Shovel-nosed Frogs have been recorded in a nearby quarter degree. The study site provides the pans and marshy ground in grassland that this species requires.

A: PART 1: VEGETATION AND FLORA

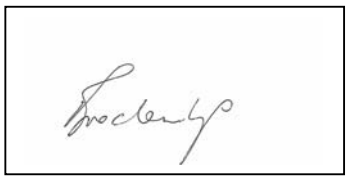
An evaluation of the vegetation for the proposed development on the Remainder of the Farm Boschhoek 3345, Newcastle, KwaZulu-Natal

GJ BREDENKAMP DSc PrSciNat

DECLARATION OF INDEPENDENCE

I, George Johannes Bredenkamp, Id 4602105019086, declare that I:

- Am the owner of Eco-Agent CC, CK 95/37116/23
- Act as an independent specialist consultant in the field of ecology, vegetation science and botany
- Am assigned as specialist consultant by LEAP Landscape Architect & Environmental Planner for the proposed project "An evaluation of the vegetation for the proposed development on the Remainder of the Farm Boschhoek 3345, Newcastle, KwaZulu-Natal" described in this report
- I Do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work performed
- Have or will not have any vested interest in the proposed activity proceeding
- Have no and will not engage in conflicting interests in the undertaking of the activity
- Undertake to disclose to the client and the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2006
- Will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.



GJ Bredenkamp

SUMMARY

Seven plant communities were identified. The primary vegetation has a Medium sensitivity, while the secondary vegetation and disturbed areas have a Low sensitivity. Most of the area is therefore suitable for development. The wetlands and spruits are protected by law and no development should take place within the 1:100 year flood line or within 32 m from the edge of the spruit or wetland. It is furthermore suggested that the Shrubland of the Hills be at least partly conserved in an open space that remains natural.

1. ASSIGNMENT

EcoAgent CC Ecology and Biodiversity Consultants was appointed by LEAP Landscape Architect & Environmental Planner to undertake an independent assessment of the vegetation and flora, the possible presence of wetlands and the vertebrate fauna of the site. In accordance with The Natural Scientific Professions Act (Act 27 of 2003) only a person registered with the Council may practice in a consulting capacity. Prof GJ Bredenkamp of EcoAgent CC undertook an independent assessment of the vegetation and flora that would be affected by the proposed development on the farm Boschhoek.3345, Newcastle, KwaZulu-Natal. A field survey was conducted on the 5th of March 2011.

This assignment is in accordance with the EIA Regulations (No. R. 385, Department of Environmental Affairs and Tourism, 21 April 2006) emanating from Part 5 of the National Environmental Management Act 1998 (Act No. 107 of 1998).

The assignment is interpreted as follows:
Compile a study on

- Vegetation with special emphasis on the possible presence red data species on the alignment of the pipeline,

In order to compile the vegetation and flora study, the following had to be done:

1. **Initial preparations:**

- Obtain all relevant maps, aerial photographs and information on the natural environment of the concerned area. This includes a red data species list for the Flora.

2. Vegetation and habitat survey: In each vegetation type / plant community on site:

- Determine relatively homogeneous potential ecological units / plant communities / ecosystems on recent aerial photographs.
- Determine the broad habitat features within each homogeneous unit.
- List the plant species (trees, shrubs, grasses and herbaceous species of special interest) present in each ecological unit for plant community and ecosystem description.
- Identify potential red data plant species, possible encroacher species and exotic plant species.
- Identify potential habitat for the red data species that may be present in the area.

3. Plant community delimitation and description

- Process data (vegetation and habitat) to determine vegetation types / ecosystems on an ecological basis.
- Describe the habitat and vegetation
- Prepare a vegetation map of the area if more than one plant community is present.
- Prepare an ecosystem sensitivity map for the planning of the development.

4. General

- Identify and describe ecologically sensitive areas.
- Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, degraded areas, reclamation areas.
- Make recommendations on aspects that should be monitored during development.

2. RATIONALE

It is widely recognised that it is of utmost importance to conserve natural resources in order 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 the environment is considered before relevant authorities approve any development. This led to legislation protecting the natural environment. 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 in the natural environment. It also ensures the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes or products or human activities. A draft list of Threatened Ecosystems was published (Government Gazette 2009) as part of the National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). These Threatened Ecosystems are described by SANBI & DEAT (2009).

All components of the ecosystems (physical environment, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include the development, utilisation and where necessary conservation of the given natural resources in 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 and biodiversity on the site, in order to evaluate the biodiversity and possible rare species. This inventory should then serve as a scientific and ecological basis for the planning exercises.

3. STUDY AREA

3.1 Location

The site is approximately 202 ha in size and is located south of the suburb Fairleigh and east of Boundary Road in Newcastle (Figure 1)

The following applies:

- The site does not fall within a conservancy.
- The site does not fall within a protected area.
- There are wetlands on the site.
- The site is topographically complex with ridges, valleys, plains and stream present.

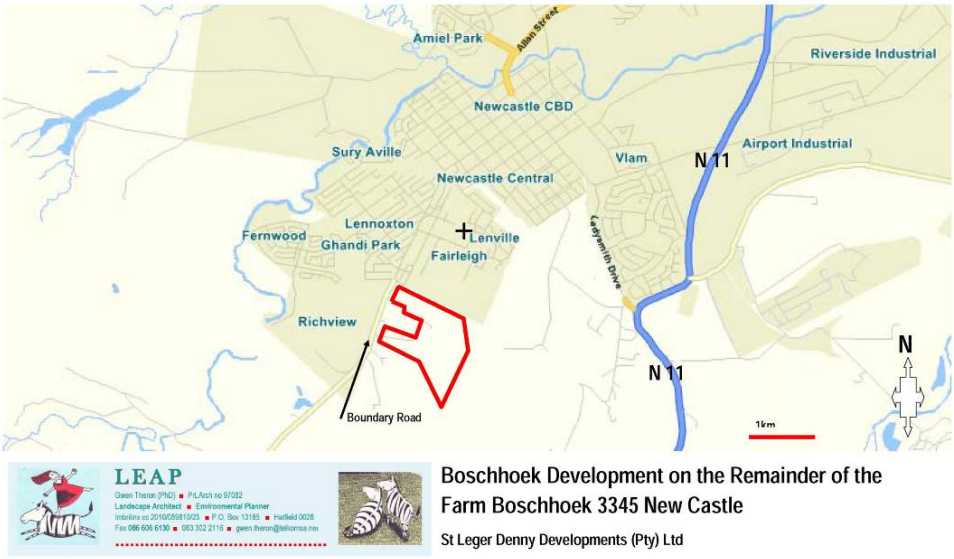


Figure 1: The locality of the site.

The site falls within the Sub-Escarpment Grassland Bioregion of Mucina & Rutherford (2006) but is relatively complex topographically. It slopes and drains towards the town in the north, with two main quartzite ridges running approximately north-south across the site and two deeply incised streams running in the valleys between the ridges. There was a clear division between the sandy and gravely slopes, with exposed rocks on the ridges and slopes, and the dark clay soils in the valley bottoms. There are at least four dwelling areas on the site (and more in the excised areas east of Boundary Road). There are signs of old croplands on the

alluvial soils around the northern ends of the streams, but most of the site and surrounding habitats are natural grasslands that have been used for grazing livestock. There are also various other human impacts, such as small dams on the streams, vehicle tracks and foot paths, and a series of borrow pits in the elevated southwest corner. Woody vegetation is found mainly along the two ridges, mainly as scattered trees and bushes but forming dense clumps on the crest and western aspects of the ridges. Apart from a patch of alien wattle trees planted at the head of the more eastern stream, most of the areas have low alien infestation, except around the dwellings, including pine, syringe, eucalyptus, willow and mesquite trees.

3.2 Vegetation Types

The site is located directly south of Newcastle. The regional geology is dominated by Mudstone and shale of the Ecca and Beaufort Groups of the Karoo Supergroup. The deep red structureless soils of the plains are of the Hutton from while shallower soils on the ridges and rocky outcrops are of the Mispah or Glenrosa forms.

The site is situated within the Natal Sour Sand Veld as described by Acocks (1988), but North-eastern Sandy Highveld is also prominent in the area. Low & Rebelo (1996) described the vegetation of the area as North Eastern Moist Grassland.

According to the most recent vegetation map of South Africa the vegetation on the study site is Low Escarpment Moist Grassland, though the site is close to the border of Northern KwaZulu-Natal Moist Grassland (Mucina & Rutherford, 2006). Within this vegetation type about 6% have been transformed by plantations or cultivated land and only 2% is statutorily conserved.

In general the area is covered by primary grassland, mainly dominated by *Hyparrhenia hirta,* but the rocky areas have an open shrubby component. Some areas were ploughed in the past and are now covered by *Hyparrhenia hirta.*

Wetlands, forming part of the drainage systems of two larger spruits, are prominent features of the landscape.

4. METHODS

4.1 Vegetation and Flora

The site was visited on 5 March 2011 by Prof GJ Bredenkamp accompanied by the EcoAgent team, including Dr IL Rautenbach (Mammologist), Dr A Kemp (ornithologist) and Mr JCP van Wyk (herpetologist).

The vegetation was stratified into relatively homogeneous units on recent aerial photographs of the area. At several sites within each homogeneous unit a description of the dominant and characteristic species 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 included a list of the plant species present, including trees, shrubs, grasses and forbs. Comprehensive species lists were therefore derived for each plant community / ecosystem present on 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. Notes were additionally 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.

Red data plant species for the area were obtained from the SANBI data bases, with updated threatened status, (Raimondo *et al* 2009). These lists were then evaluated in terms of habitat available on the site, and also in terms of the present development and presence of man in the area.

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

Medicinal plants are indicated according to Hutchings *et al.* (1996), Van Wyk, Van Oudthoorn & Gericke (1997) and Arnold *et al.* (2002).

The field observations were supplemented by literature studies from the area (Smit 1992; Smit *et al.* 1992, 1993a, 1993b, 1993c, 1995a, 1995b).

4.2 Conservation Value

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.

4.3 Sensitivity

High and Low sensitivity is indicated 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. Portions of vegetation with a Medium conservation priority should be conserved**.**

Medium Medium conservation priority category mentioned above are considered to have a Medium sensitivity

Low: , Medium-Low and Low conservation priority categories mentioned above are considered to have a Low sensitivity and development may be supported.

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

4.4 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.

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

5. RESULTS: VEGETATION AND FLORA

5.1 Vegetation Classification

Two different plant communities / ecosystems were identified:

Plant Community	Species Richness	Sensitivity
1 Tall Grassland	High	Medium
2.Shrubby Grassland of rocky areas	High	Medium
3. Shrubveld of the Hills	High	Medium
4. Secondary Grassland on Old Fields or disturbed areas	Low	Low
5. Spruits		High
6. Wetland Drainage and Seepage Systems		High
7. Homesteads	Low	Low

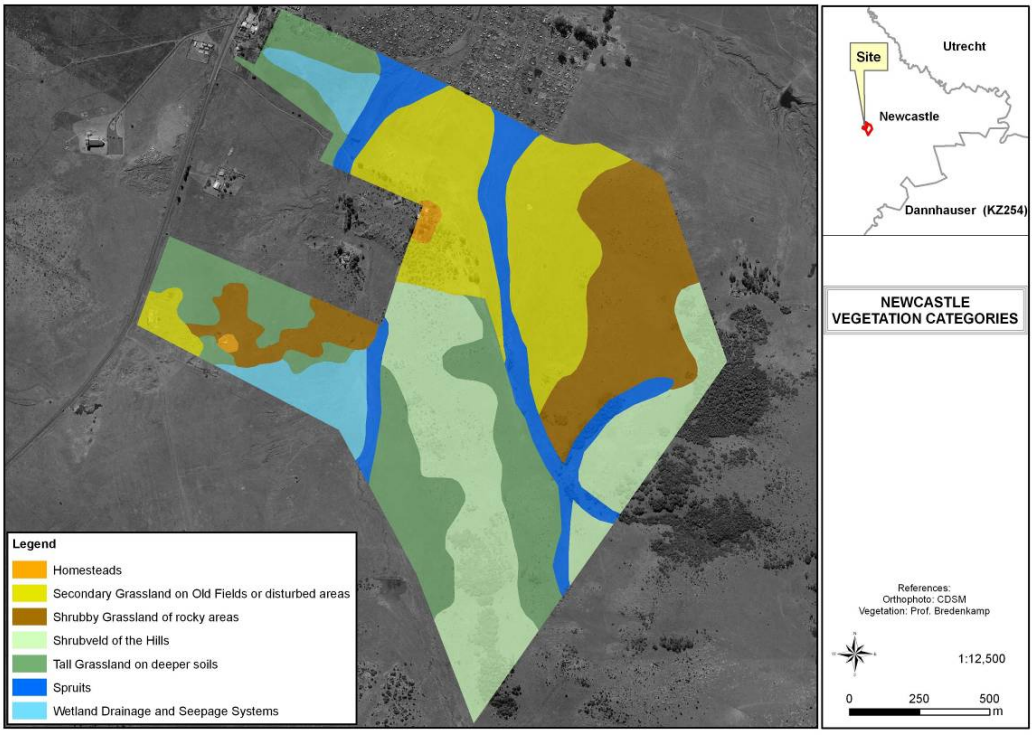


Figure 2: Vegetation map of the site

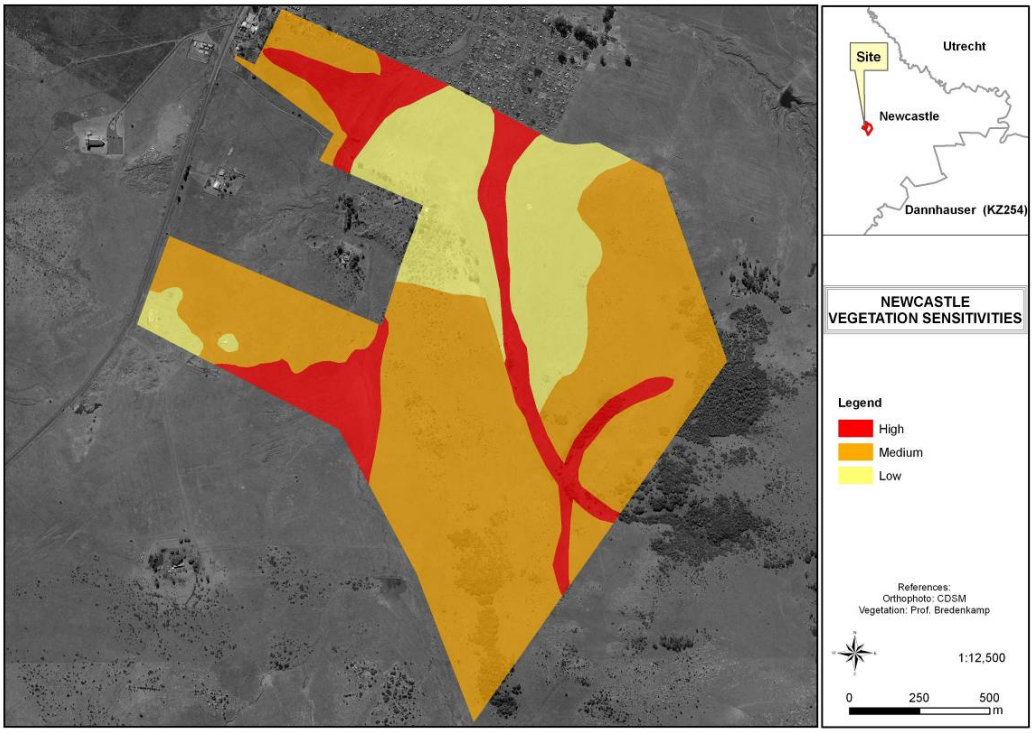


Figure 3: Sensitivity map of the site

5.2 Description of the Plant Communities

1. Tall Grassland

Tall grassland, grazed by cattle, occurs scattered in the southern parts of the site, notably along the south-western boundary of the site. The vegetation is considered primary grassland, though extensively grazed by cattle. The tall-growing grass, *Hyparrhenia hirta* is mostly dominant. Other prominent, abundantly present species include *Eragrostis chloromelas, Cymbopogon excavatus, Cynodon dactylon* and *Aristida congesta,* indicating some disturbance. Several forb species are present, though they are scattered and never dominant.

These features indicate that this grassland is disturbed, though still rich in plant species, therefore regarded as having Medium Conservation Value and Medium Sensitivity.

The following plant species were recorded from this plant community:

Trees and Shrubs

Acacia karroo	M

Grasses

Aristida congesta	d	*Eragrostis gummiflua*	
Brachiaria eruciformis		*Eragrostis plana*	M
Cymbopogon excavatus	M	*Hyparrhenia hirta*	D
Cynodon dactylon	d	*Melinis repens*	
Eragrostis chloromelas	d	*Microchloa caffra*	
Eragrostis curvula		*Themeda triandra*	

Forbs

Acalypha punctata	M	*Ipomoea obscura*	
Anthospermum hispidulum		*Ledebouria ovatifolia*	M
Berkheya onopordifolia		*Monsonia angustifolia*	
Blepharis integrifolius		*Phyllanthus maderaspatensis*	
Corchorus schimperi		*Plectranthus hadiensis*	M
Crabbea angustifolia		*Pygmaeothamnus chamaedendrum*	
Elephantorrhiza elephantina	M	*Rhynchosia adenodes*	
Helichrysum nudifolium	M	*Rhynchosia cooperi*	
Helichrysum rugulosum	M	*Rhynchosia minima*	
Hermannia depressa	M	*Schkuhria pinnata*	MW
Hermannia gerrardii		*Searsia discolor*	
Hibiscus trionum		*Senecio* sp	
Hypoxis sp		*Sida alba*	M
Indigofera hedyantha		*Solanum panduriforme*	M
Indigofera hilaris	M	*Trachyandra asperata*	
Ipomoea crassipes	M	*Vernonia oligocephala*	M

1. Tall Grassland			
Status	Primary grassland grazed by cattle		
Soil	deep sandy-loam	**Rockiness % cover**	2
Conservation priority:	Medium	**Sensitivity:**	Medium
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Hyparrhenia hirta, Aristida congesta, Cynodon dactylon*		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	4	<1
Shrubs	0.5-3	<1
Grass	1.3	60
Forbs	0.4	5

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	1	0	1	0	0	1
Grasses	12	0	12	0	0	2
Forbs	31	1	32	0	0	13
Total	44	1	45	0	0	16

Discussion

The area of this plant community represents tall grassland, fairly well utilised but still primary, high in species richness and with no red data species present.

The proposed development can be supported in this area.

Figure 4: The Tall Grassland

2. Shrubby Grassland of rocky areas

Short Grassland that is restricted to rocky areas with shallow soil occurs in the south-western and north-eastern parts of the site. These areas are also grazed by cattle. The vegetation is primary grassland with scattered low shrubs and small trees. The shrubs *Diospyros lycioides, Searsia rigida, Searsia pyroides* and *Euclea crispa* are prominent, while *Eragrostis chloromelas* is the most abundant grass species. Several forb species are present, though they are scattered and never dominant.

Although somewhat disturbed, the primary status of this grassland results in it having a Medium Conservation Value and Medium Sensitivity.

The following plant species were recorded from this plant community:

Trees and Shrubs

Acacia karroo	M	*Gymnosporia buxifolia*	M
Celtis africana	M	*Helinus integrifolius*	M
Cussonia paniculata		*Searsia dentata*	
Diospyros lycioides	dM	*Searsia pyroides*	
Euclea crispa	M	*Searsia rigida*	

Grasses

Aristida adscensionis		*Eragrostis curvula*	
Aristida congesta	d	*Eragrostis plana*	M
Brachiaria eruciformis		*Hyparrhenia hirta*	D
Cymbopogon excavatus	M	*Melinis repens*	
Cynodon dactylon	d	*Microchloa caffra*	
Eragrostis chloromelas	D	*Themeda triandra*	

Forbs

Acalypha punctata	M	*Berkheya onopordifolia*	
Aloe maculata	M	*Crassula alba*	M
Anthospermum hispidulum		*Elephantorrhiza elephantina*	M

Euphorbia pulvinata	M	*Pellaea calomelanos*	M
Helichrysum nudifolium	M	*Plectranthus hadiensis*	M
Helichrysum rugulosum	M	*Pygmaeothamnus chamaedendrum*	
Hermannia betonicifolia		*Rhynchosia minima*	
Hermannia depressa	M	*Rhynchosia monophylla*	
Hermannia gerrardii		*Rhynchosia villosa*	
Hibiscus trionum		*Schkuhria pinnata*	MW
Hypoxis sp		*Searsia discolor*	
Indigofera hedyantha		*Selago densiflora*	
Indigofera hilaris	M	*Senecio* sp	
Ipomoea crassipes	M	*Solanum panduriforme*	M
Ledebouria ovatifolia	M	*Trachyandra asperata*	
Monsonia angustifolia		*Vernonia oligocephala*	M

2. Shrubby Grassland			
Status	Primary grassland on rocky soils		
Soil	shallow rocky	**Rockiness % cover**	5-10
Conservation priority:	Medium	**Sensitivity:**	Medium
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Diospyros lycioides, Eragrostis chloromelas*		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	4	1
Shrubs	0.5-3	3
Grass	1.3	60
Forbs	0.4	5

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	10	0	10	0	0	6
Grasses	12	0	12	0	0	2
Forbs	32	0	32	0	0	16
Total	54	0	54	0	0	24

Discussion

Although this rocky area is fairly disturbed, mainly by (over)grazing, it still has high species richness. No red data species were found during the field survey. The area is therefore regarded to have a Medium sensitivity.

The proposed development can be supported in this area

Figure 5: Shrubby Grassland of rocky areas

3. Shrubveld of the hills

A rocky hill, covered with short trees and shrubs, runs approximately north-south through the centre of the site, separating two valleys. The vegetation is a shrubland with species such as *Searsia pyroides, Gymnosporia buxifolia Searsia dentata* and *Diospyros lycioides* prominent. The grasses *Hyparrhenia hirta, Cymbopogon excavatus* and *Eragrostis curvula* are the most abundant grass species. Several forb species are present, though they are scattered and never dominant.

Rocky hills are often rich in species and are therefore considered to have a Medium Conservation Value and Medium Sensitivity.

The following plant species were recorded from this plant community:

Trees and Shrubs

Acacia karroo	M	*Opuntia ficus-indica*	A
Celtis africana	M	*Pinus* sp	A
Cussonia paniculata		*Pittosporum viridiflorum*	M
Diospyros lycioides	dM	*Searsia dentata*	
Euclea crispa	M	*Searsia pyroides*	
Gymnosporia buxifolia	M	*Searsia rigida*	
Helinus integrifolius	M		

Grasses

Aristida adscensionis		*Hyparrhenia hirta*	D
Aristida congesta		*Melinis repens*	
Cymbopogon excavatus	dM	*Microchloa caffra*	
Eragrostis chloromelas		*Themeda triandra*	
Eragrostis curvula	d		

Forbs

Acalypha punctata	M	*Anthospermum hispidulum*	
Aloe maculata	M	*Asparagus africanus*	M

Berkheya onopordifolia		*Monsonia angustifolia*	
Chaetacanthus burchellii		*Pellaea calomelanos*	M
Cheilanthes hirta	M	*Phymaspermum athanasioides*	
Crassula alba	M	*Plectranthus hadiensis*	M
Elephantorrhiza elephantina	M	*Rhynchosia minima*	
Euphorbia pulvinata	M	*Rhynchosia monophylla*	
Euryops tysonii		*Richardia braziliensis*	W
Gladiolus crassifolius		*Scabiosa columbaria*	M
Helichrysum aureum		*Schkuhria pinnata*	MW
Helichrysum nudifolium	M	*Selago densiflora*	
Helichrysum rugulosum	M	*Senecio* sp	
Hermannia depressa	M	*Solanum panduriforme*	M
Hypoxis sp		*Stachys aethiopica*	M
Indigofera hedyantha		*Stachys natalensis*	
Indigofera hilaris	M	*Vernonia oligocephala*	M
Ipomoea crassipes	M		

3. Shrubveld on hills			
Status	Primary veld on hill		
Soil	shallow rocky	**Rockiness % cover**	5-10
Conservation priority:	Medium	**Sensitivity:**	Medium
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Diospyros lycioides, Eragrostis chloromelas*		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	4	5
Shrubs	0.5-3	10
Grass	1.3	50
Forbs	0.4	5

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	11	2	13	0	0	7
Grasses	9	0	9	0	0	1
Forbs	33	2	35	0	0	19
Total	53	4	57	0	0	27

Discussion

The area of this plant community represents primary vegetation on a hill, high in species richness and with no red data species present.

The proposed development can be supported partly in this area, though it is suggested that some parts of this ecosystem be zoned as open space, with the vegetation remaining in the natural condition.

Figure 6: The shrubveld on the hill

Figure 7: The rocky hill with shrubs and small tree

4. Secondary Grassland, Old Fields and Disturbed areas

Extensive old field and disturbed areas occur on the site. The old fields on the northern part of the site are now covered with secondary, tall grassland. Disturbed areas occur around the houses in the central part of the site, while a disturbed, excavated area is present in the south-western corner. Here is also a borrow pit, currently filled with water, housing several hygrophilous plant species. In the excavated area, some of the ditches are also filled with water, with hygrophilous species growing in the water. The tall-growing grass, *Hyparrhenia hirta* is mostly dominant. A patch with *Acacia karroo* is present in the south-western corner. Other prominent, abundantly present species include *Eragrostis chloromelas, Eragrostis curvula, Cymbopogon excavatus, Cynodon dactylon* and *Aristida congesta,* indicating the disturbance.

The areas have Low Conservation Value and Low Sensitivity.

The following plant species were recorded from this plant community:

Trees and Shrubs

Acacia karroo	M	*Opuntia ficus-indica*	A
Diospyros lycioides		*Searsia pentheri*	
Lippia javanica	M	*Searsia pyroides*	

Grasses

Aristida bipartita		*Eragrostis micrantha*	
Aristida congesta	d	*Eragrostis plana*	M
Brachiaria eruciformis		*Hyparrhenia hirta*	D
Cymbopogon excavatus	M	*Melinis repens*	
Cynodon dactylon	d	*Microchloa caffra*	
Eragrostis chloromelas	d	*Paspalum dilatatum*	
Eragrostis curvula		*Paspalum urvillei*	
Eragrostis gummiflua		*Sporobolus africanus*	

Forbs

Anthospermum hispidulum	*Aponogeton* sp

Bidens bipinnata	WM	*Persicaria serrulata*	M
Blepharis integrifolius		*Schkuhria pinnata*	MW
Cyperus spp		*Schoenoplectus corymbosus*	
Helichrysum nudifolium	M	*Senecio* sp	
Helichrysum rugulosum	M	*Sida alba*	
Hermannia depressa	M	*Solanum panduriforme*	WM
Hibiscus trionum		*Tagetes minuta*	W
Juncus sp		*Verbena bonariensis*	W
Kyllinga erecta		*Vernonia oligocephala*	M
Monsonia angustifolia		*Zinnia peruviana*	W

4. Secondary Grassland, Old Fields and Disturbed areas			
Status	Secondary grassland highly disturbed / transformed		
Soil	sandy-loam	**Rockiness % cover**	2
Conservation priority:	Low	**Sensitivity:**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Hyparrhenia hirta, Aristida congesta, Cynodon dactylon*		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	4	<1
Shrubs	0.5-3	<1
Grass	1.3	40
Forbs	0.4	5

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	5	1	6	0	0	2
Grasses	16	0	16	0	0	2
Forbs	14	7	21	0	0	8
Total	35	8	43	0	0	12

Discussion

The area of this plant community represents disturbed and transformed vegetation, medium in species richness and with no red data species present.

The proposed development can be supported in this area.

Figure 8: An old field now covered with secondary tall grassland

5. Spruits

The two deeply incised streams run along the floor of the two valleys between the ridges and elevated edges of the site. At certain localities small dams occur in the streams. In their lower reaches, the streams spill out into temporary wetlands. The streams are fed by runoff from the surrounding valleys, including seepage from the southern edge of the site and from the valley sides. At the time of the survey both the major streams were strongly flowing, as a result of good rains during the season. The grassy vegetation on the banks was relatively tall with grassland species. Dense stands of *Typha capensis occur* mainly in the dams, and with scattered sedges most prominent along the edge of the water. Very few, if any, woody species occur on the spruit banks, except for a few single plants locally. However, a few alien woody species occur in the higher reaches of the spruits.

The following plant species were recorded from this plant community:

Trees and Shrubs

Acacia mearnsii	A	*Searsia pyroides*	
Diospyros lycioides	M		

Grasses and Sedges

Aristida junciformis		*Kyllinga alata*	
Cymbopogon excavatus	M	*Leersia hexandra*	
Cynodon dactylon		*Mariscus congestus*	
Cyperus spp (several)		*Miscanthus capensis*	
Eragrostis bicolor		*Paspalum dilatatum*	
Eragrostis curvula		*Schoenoplectus corymbosus*	
Eragrostis plana	dM	*Setaria nigrirostris*	
Hyparrhenia dregeana		*Setaria sphacelata*	
Imperata cylindrica	M	*Themeda triandra*	
Juncus sp		*Typha capensis*	dM

Forbs

Berkheya onopordifolia		*Haplocarpha scaposa*	
Berkheya radula		*Ranunculus multifidus*	M

Senecio inornatus	M	*Verbena bonariensis*	W

5. Spruits			
Status	Watercourse/ Wetland		
Soil	Clay	**Rockiness**	0-2%
Conservation priority:	High	**Sensitivity:**	High
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis plana, Typha capensis*,		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	-	-
Shrubs	1-3	<1
Grass and sedge	0.4-2	70
Forbs	0.3	3

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	2	1	3	0	0	1
Grasses sedges	20	0	20	0	0	4
Forbs	5	1	6	0	0	2
Total	27	2	29	0	0	7

Discussion

The species richness is medium along the spruit. All water courses have high conservation value and are therefore considered to be sensitive.

Figure 9: Upper reaches of the eastern spruit – the channel very narrow and grassland growing to the spruit edge

Figure 10: The western spruit with rocks and with grassland growing to the spruit edge

6. Wetlands

The large wetland occurs within the site, both draining into the western spruit. A large and important wetland originates from springs and drainage of rainfall water on the southern boundary of the site. This wetland drains north-eastwards towards the western spruit. This wetland is densely covered with hygrophilous grass and sedges, the most prominent being *Eragrostis plana, Hemarthria altissima* and *Leersia hexandra.* A further wetland originates on the north-western boundary and drains south-eastwards towards the spruit. An area between the localities where the two spruits exit the site is also quite wet, but is included in the spruit systems.

The following plant species were recorded from this plant community:

Trees and Shrubs

No woody species are present

Grasses and Sedges

Aristida junciformis		*Imperata cylindrica*	M
Cymbopogon excavatus	M	*Kyllinga alata*	
Cyperus esculentus		*Leersia hexandra*	d
Cyperus spp (several)		*Mariscus congestus*	
Eragrostis bicolor		*Paspalum dilatatum*	
Eragrostis plana	DM	*Setaria nigrirostris*	
Hemarthria altissima	d	*Setaria sphacelata*	

Forbs

Berkheya onopordifolia		*Pachycarpus* sp	
Berkheya radula		*Ranunculus multifidus*	M
Drosera natalensis		*Rhynchosia* sp	
Gladiolus crassifolius	M	*Senecio inornatus*	M
Haplocarpha scaposa		*Striga elegans*	M
Oenothera rosea		*Verbena bonariensis*	W

6. Wetlands			
Status	Wetland		
Soil	Black clay	**Rockiness**	0%
Conservation priority:	High	**Sensitivity:**	High
Agricultural potential:	Low	**Need for rehabilitation**	Medium
Dominant spp.	*Eragrostis plana*, *Hemarthria altissima, Leersia hexandra*		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	-	-
Shrubs	-	-
Grass and sedge	0.4-1	80
Forbs	0.2	3

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	0	0	0	0	0	0
Grasses sedges	14	0	14	0	0	3
Forbs	11	1	12	0	0	4
Total	26	1	26	0	0	7

Discussion

The species richness is medium in this wetland. All wetlands have high conservation value and are therefore considered to be sensitive.

Figure 11: The seepage wetland in the centre, draining towards the spruit

7. Homesteads

At least four houses are present on the site, while further houses are present on the piece of land on the western boundary that is excluded from the site. Several alien trees are found close to the houses. Some indigenous species are also present, though these areas are generally quite disturbed and degraded. These areas are not of any significance, as far as vegetation is concerned. No detailed vegetation surveys were made at the houses. The following plant species were listed from this plant community:

Trees and Shrubs

Acacia karroo	M	*Eucalyptus* sp	A
Acacia mearnsii	A	*Populus* sp	A

Grasses and Sedges

Aristida congesta		*Eragrostis curvula*	
Cymbopogon excavatus	M	*Eragrostis plana*	
Cynodon dactylon		*Hyparrhenia hirta*	

Forbs

Amaranthus hybridus	W	*Datura stramonium*	W
Bidens bipinnata	W	*Tagetes minuta*	W
Chenopodium album	W	*Verbena bonariensis*	W

7. Homesteads			
Status	Transformed		
Soil	Loam	**Rockiness**	0-3%
Conservation priority:	Low	**Sensitivity:**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Medium
Dominant spp.	*Eragrostis curvula*, *Hyparrhenia hirta*, *Acacia mearnsii, Eucalyptus* sp		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	15	10
Shrubs	5	5
Grass and sedge	0.4-1	50
Forbs	0.2	10

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	1	3	4	0	0	1
Grasses sedges	6	0	6	0	0	1
Forbs	0	6	6	0	0	0
Total	7	9	16	0	0	2

Discussion

The area is transformed and have no conservation value and low sensitivity. Development can be supported.

5.3 Red Data Species

Red Listed species of concern include the following species POSA database for grid 2729DD (March 2011)(Raimondo *et al*. 2009).

Species	Status
Merwilla plumbea (Lindl.) Speta	NT
Acalypha caperonioides Baill. var. *caperonioides*	DDT
Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.	Declining
Hypoxis hemerocallidea Fisch., C.A.Mey. & Avé-Lall.	Declining

Suitable habitats occur on the site for all these species, though none were seen during the survey. This does not exclude their possible presence.

5.4 Medicinal Plants

The many medicinal plants are listed under the individual plant communities and not repeated here.

5.5 Alien Plants

Very few alien woody plants were found on the site. Locally, especially at the old homesteads, are stands or individuals of *Acacia mearnsii / Acacia dealbata* and also *Eucalyptus* sp and *Pinus* sp, while a few ornamental trees and shrubs remained. A few individuals of *Acacia mearnsii / Acacia dealbata* occur at the higher reaches of the spruits, these should be removed as a matter of urgency.

6. IMPACT ASSESSMENT

6.1 Methods

The following generic criteria drawn from published literature and general South African practise will be used to describe magnitude and significance of impacts in an objective, systematic manner.

These criteria are:

- Extent or scale of the impact (what size of the area will be affected?)
- Duration (how long will the impact last?)
- Intensity (the intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself.
- Probability (how likely is it that the impact will occur?)
- Significance (how severe will the impact be?)
- Mitigatory potential and mitigation measures

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.

The impacts are given in table form. Conventions and definitions used in these tables are described below:

Extent of impact

Site:	Effect confined to the development area
Local:	Effect limited to within 3-5km of the development area
Regional:	Effect extends beyond the borders of the development area to influence the area as a whole.

Duration of impact

Short:	Effect last for a period up to five years
Medium:	Effect continues for a period of between five and ten years

Long:	Effect continues for a period in excess of 10 years
Permanent:	Effect lasts permanently

Intensity

Low:	Will have no or little effect on the vegetation and fauna
Medium:	Will have some effect but parts of vegetation will remain in tact
High:	Will destroy the vegetation or habitat for fauna completely

Probability of occurrence

Low:	Less than 33% chance of occurrence
Medium:	Between 33 and 66% chance of occurrence
High:	Greater than 66% chance of occurrence

Significance

Low:	Where the impact will have a relatively small effect on the environment which does not need to be accommodated
Medium:	Where the impact can have an influence on the environment that might require modification of the project
High:	Where the impact definitely has an impact on the environment and needs mitigation

Status

Positive:	Impact will be beneficial to the environment
Negative:	Impact will not be beneficial to the environment
Neutral:	No positive or negative impact

Confidence

Low:	It is uncertain whether the impact will occur
Medium:	It is likely that the impact will occur
High:	It is relatively certain that the impact will occur

6.2 Results

Impact Table

Impact on Vegetation	Extent	Duration	Intensity	Probability	Significance	Status	Conf
Communities 1,2 & 3	Site	Permanent	High	High	Medium	Neg	High
Communities 4 & 7	Site	Permanent	Low	High	Low	Neg	High
Communities 5 & 6	Regio nal	Permanent	High	Medium	High	Neg	High
Impact on Plant species							
Indigenous species	Site	Permanent	Medium	High	Low	Neg	High
Alien woody plant species	Site	Permanent	Low	High	High	Pos	High

6.3 Discussion

Vegetation

1. Communities 1, 2 and 3

The impact on natural vegetation is only of Medium significance. Although development will take place in these areas, and the vegetation will be destroyed in most cases, this vegetation is of Medium sensitivity, mainly because it is primary vegetation. Although it is fairly disturbed by grazing and former and present habitation, the species richness is still High.

Mitigation measures

- The significance in Community 3 (Shrubveld of the Hills) can be lowered by conserving at least part of this vegetation in natural open space.
- During the planning phase as much larger trees as possible could be avoided and saved.
- Use only indigenous trees and shrubs in the gardens and

- Avoid erosion at all times

2. Communities 4 and 7

These areas were transformed either for agriculture or for homesteads on the farm. Consequently the natural vegetation had been destroyed before and is regarded as secondary with Low species richness and Low sensitivity. The significance of the development impact is therefore regarded as being Low.

Mitigation measures

- Use only indigenous trees and shrubs in the gardens and
- Avoid erosion at all times

3. Communities 5 and 6

These are the Wetland and Spruit ecosystems. The wetlands are protected ecosystems and no development should be allowed within the 1:100 year flood line, or 32 m from the edge of the wetland / spruit. However, it is recommended that this buffer be even larger wherever possible. A special, additional impact assessment will be needed at the localities where the spruits have to be crossed. Properly designed bridges allowing absolute free flow of water must be used to cross the spruits. In this case special mitigation measures will be needed.

Mitigation measures

- Construct proper bridges over streams.
- Avoid erosion at all times.
- Rehabilitate and stabilise the stream banks immediately after construction.
- Use only indigenous grasses and other species for the rehabilitation.
- Avoid all pollution at all times.

7. GENERAL DISCUSSION AND CONCLUSION: VEGETATION STUDY

Seven plant communities were identified. The primary vegetation has a Medium sensitivity, while the secondary vegetation and disturbed areas have a Low sensitivity. Most of the area is therefore suitable for development. The wetlands and spruits are protected by law and no development should take place within the 1:100 year flood line or within 32 m from the edge of the spruit or wetland. It is furthermore suggested that the Shrubland of the Hills be at least partly conserved in an open space that remains natural.

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• Wildlife Management Society of Southern Africa
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- Veld Condition and Grazing Capacity Assessments,
- Red data analysis (plants and animals).

B: PART 2: MAMMALS

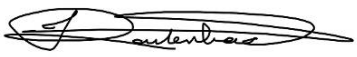
A MAMMAL HABITAT ASSESSMENT OF THE REMAINDER OF FARM BOSCHHOEK 3345, NEWCASTLE

I.L. RAUTENBACH Ph.D. PrSciNat

DECLARATION OF INDEPENDENCE

I, Ignatius Lourens Rautenbach (421201 5012 00 5) declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Profession
- act as an independent specialist consultant in the field of zoology
- am subcontracted as specialist consultant by Eco-Agent CC for the proposed project “A Mammal Habitat Assessment of the Remainder of Farm Boschhoek 3345, Newcastle” described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to the Eco-Agent CC and its client(s) as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2006



I.L. Rautenbach

SUMMARY

Planning the new residential development as an immediate extension to existing suburbs is laudable and accepted as a best-case scenario for the inevitable consequence of a burgeoning population. The rocky ridges and the streams with their wetlands should be regarded as sensitive areas. Wetland systems are ranked as very sensitive and will thus require special intervention. The proposed mitigation measures address ways to deal with stormwater runoff that, if left unattended, could cause damage to the wetland systems. Wetlands should primarily be protected by means of 50 meter wide buffer zones measured from either edge of the streams. This will allow for bio-filtering and allow for connectivity. It will also accommodate the possible occurrence of the "Critically Endangered" rough-haired golden mole, the "Near Threatened" African marsh rat, as well as the confirmed presence of sensitive vlei rats. Should at least part of the rocky ridges are deemed as sensitive and excluded from development, passive conservation will be sufficient. By preserving part of the rocky ridges as well as the two streams (each with its collective 50+50=100 meter-wide conservation buffer), habitat for most Red Data and sensitive small mammals will be preserved and connectivity will be enhanced. The proposed development will in all likelihood be concentrated on the terrestrial habitat (i.e. the grasslands). This will displace terrestrial mammals, which is of little consequence considering the extensive nature of surrounding undeveloped grasslands, especially to the west and south.

1. ASSIGNMENT

Eco-Agent CC Ecological Consultants were appointed by LEAP Landscape Architect & Environmental Planner to assess the vegetation and undertake a mammal, bird, reptile, and amphibian diversity scan on the Remainder of the Farm Boschhoek 3345, Newcastle (the site) proposed for urban development. The quality of mammal habitats were assessed and used as a mechanism to deduce the likelihood of mammal occurrences. This assignment is in accordance with the EIA Regulations (No. R. 385, Department of Environmental Affairs and Tourism, 21 April 2006) emanating from Chapter 5 of the National Environmental Management Act 1998 (Act No. 107 of 1998).

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

1. **Initial preparations:**
   - Obtain all relevant maps and information on the natural environment of the concerned area.
   - This includes information on Red Data mammals that may occur in the area.
2. **Fauna assessment**
   - Compile lists of the Red Data mammals 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 mammals to be present on the study site
3. **General**
   - Identify and describe particular ecologically sensitive areas.
   - Identify problem 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.

2. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the mammal habitat components and current general conservation status of the property;
- Comments on ecological sensitive areas;
- Comments on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of mammals which occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the mammals of the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. RATIONALE

Environmental conservation is no longer the prerogative of vocal, green activist NGOs. Instead, it is now universally appreciated that a rapidly growing and more demanding human population is continuing to place exponential stress on the earth's resources, with irredeemable costs to ecosystems. It is also recognized that ecosystems are in fact nature's 'engine room' to manufacture fundamental life-support products for plants, animals and humans. Environmental degradation ranges from mega-problems, such as global warming, demand for power and land-use practices, to indiscriminate use of household chemicals.

The new conservation awareness is emerging at all levels, ranging from consumers, school curricula and communities to governments. This new consciousness is typified by vigorous debate and empathy, and sometimes by decisiveness (*viz*. new legislation).

In South Africa a number of acts (viz. 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 of 2004]', and the National Environmental Management Act [Act 107 of 1998]: Environmental Impact Assessment Regulations, 2010: Environmental Management Framework Regulations, 2010 (Gazette No 33306 – Regulation 547)) call developers (and by implication consumers), the scientific community and conservation agencies to task to minimise environmental impact. The conduct of natural scientists is directed by the 'The Natural Scientific Professions Act [Act 27 of 2003]. Nowadays, a development prerogative is to precede new constructions by a multidisciplinary environmental investigation that assesses the conservation costs. This is to ensure that best conservation practices are applied during the planning, construction and operational phases of new developments.

4. STUDY AREA

4.1 General

The Remainder of the Farm Boschhoek 3345 is intended for residential development, which would in fact be a direct south-westerly extension of Newcastle suburbia.

The 202 hectares site is located immediately south-west of an informal settlement, which is part of the larger Newcastle town to its north-east. Bar a homestead near the informal settlement, the site is undeveloped and is presently used for grazing cattle. To the north-west the site borders onto the P39-1 Road.

The site is composed of rolling grassland plains, rocky randjies, shrubs along the ridges, and aquatic and wetland habitat in and along the streams. During the site visit the grass cover was visually at the peak of its seasonal growth, which manifested itself in a dense and high stand growing on compacted brown soil imbedded with gravel and rocks.

The main feature of the site is two perennial streams that flow from west to east on either side of a low randjie. At places, the streams have been dammed, where reeds and bulrushes grow on the banks. Along the streams, wetlands have been formed at places. The basins of both streams consist of heavy clay.

Adjacent land to the south, west and north beyond the P39-1 Road are all used for cattle husbandry. As result of grazing cattle on the site it would appear that veld fires are avoided. As a consequence the conservation status of the site is ranked as above average.

There are no bat roosting caves, but it is likely that cave-dependent bats may have found suitable daytime roosts in the vicinity such as in culverts, old buildings, mine adits, etc.

The following GPS coordinates spatially define the site:

Near the access gate near the quarry:	27º 47.396;S; 29º 54.734'E
At the base of the rocky slope north of stream:	27º 47.430'S; 29º 54.986'E
At the dam in the northern perennial stream:	27º 47.451'S; 29º 55.112'E

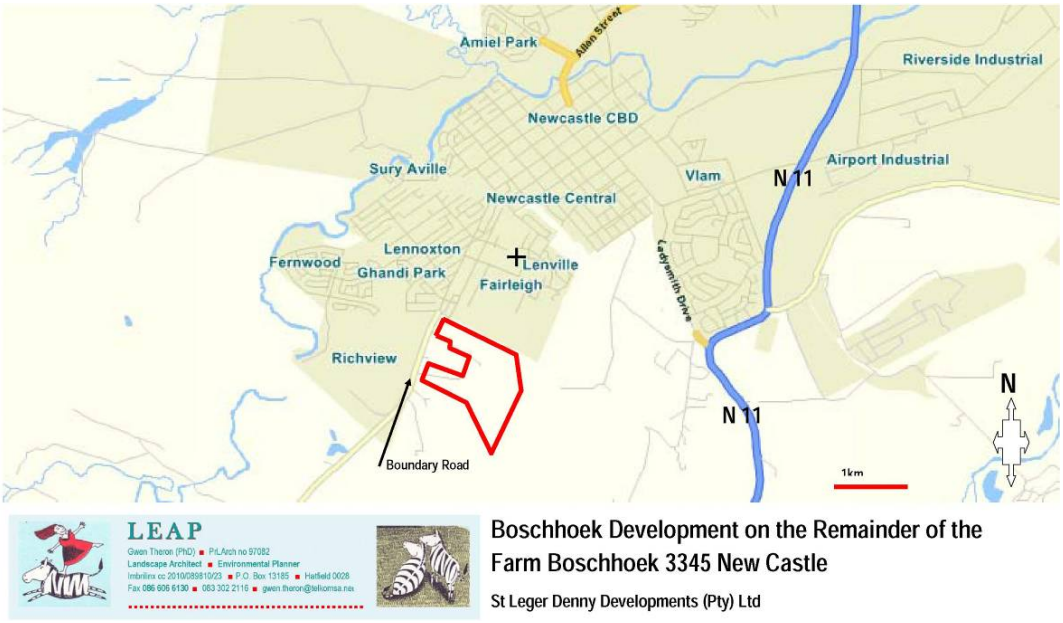


Figure 1: A locality map of the site relative to the Town of Newcastle to its north. It is clear that the site will be a direct extension of the town.

4.2 Vegetation Types

The site is floristically and topographically varied, and falls in two veld types namely Northern KwaZulu-Natal Moist Grassland and Kwazulu-Natal Highland Thornveld (Mucina and Rutherford, 2006). The former consists of undulating grassy plains with few woody plants, and the latter of rocky randjies with dense scrub. The floral diversity and composition is discussed in an accompanying report.

Figure 2: A satellite image of the site illustrating the informal settlement to the north-east. The two streams are discernable on either side of the ridge in the middle of the image. To the left is the P39-1 Road.

5. METHODS

5.1 Mammal Survey

A site visit was conducted on 5 March 2011. During this visit the observed and derived presence of mammals 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, coupled to the qualitative and quantitative nature of recognized habitats.

The 500 meters of adjoining properties was scanned for important faunal habitats.

5.2 Field Survey

During the site visit mammals were identified by visual sightings through random transect walks and patrolling with a vehicle. 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. Locals were interviewed to confirm occurrences or absences of species.

Three criteria were used to gauge the probability of occurrence of vertebrate species on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

5.3 Desktop Survey

As many mammals are either secretive, nocturnal, hibernators 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 **mammal** 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.

- **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.

5.4 Specific Requirements

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 nember 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*), etc.

6. RESULTS

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) and Knobel and Bredenkamp (2006).

The local occurrences of mammals are, on the other hand, 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 mammal 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.

6.1 Mammal Habitat Assessment

From a mammal habitat perspective, it should thus be reported that all four of the major habitats are present on the site. However, no bat caves were found, but it is likely that cave bats have found other modern structures suitable for daytime roosting in the vicinity (disused barns, culverts, attics, mine adits, etc.).

The conservation status of mammal habitats is deemed above average. This is due to the fact that the property is used for cattle grazing, as a consequence of which veld fires are normally avoided to conserve winter fodder.

The terrestrial habitat is extensive, and at the time of the site visit was covered by a good stand of mature grass. This condition is conducive to the seasonal expansion of mammal populations as cover and nourishment are abundant. The substrate of the terrestrial habitat is generally a compacted red/brownish soil imbedded with rocks and gravel. The latter is not favourable to burrowing mammals such as springhares, gerbils and aardvarks.

Some of the randjies have ridges with large boulders which provide nooks and crannies as refuges for rupiculous small mammals. On the randjies the dense grass growing close to rocks furthermore offer excellent daytime cover for red rock rabbits.

Arboreal habitat is regarded as sub-optimal, since it consists mainly of scrub largely restricted to the randjies. The sub-optimal ranking is also derived in view of the fact that most arboreal small mammals prefer large *Acacia* trees, which is absent on the study site.

The aquatic / wetland systems on the site are regarded as sensitive. These two systems consist of two perennial streams running from west to east through the site and eventually through the informal settlements where water is used for domestic purposes. The latter has a bearing on the eco-functionality of the system, such as connectivity. In reality, the dispersal opportunities offered by the two streams is only operational in an upstream direction (away from the town). A few dams have been constructed, whose banks are overgrown by bulrushes. Wetlands are formed upstream from the dam walls, and also at places where the stream banks are low.

The 500 meters of adjoining properties are rather similar to the agricultural conditions described for the study site.

Both the terrestrial habitat (as represented by the grassland plains) and the wetlands are extensive, and provide excellent connectivity and thus opportunities for near-natural migration. However, following decades of farming the conservation status of these habitats is rated as no more than average. It is submitted that this condition is reflected in the disappearance of sensitive species such as rough-haired golden moles, African marsh rats and white-tailed rats.

The 500 meters of adjoining property are rather similar that the conditions described for the study site and general area.

Figure 3: A north-easterly view over the site showing the typical grassland in the foreground and the adjoining informal settlement in the distance.

Figure 4: A southerly view over the site, illustrating grassland and wetland in the foreground, and particularly the randjie with rocky outcrops and scrub in the distance. The pine on the horizon is one of very few exotic trees on the site.

Figure 5: One of the two perennial streams running through the site in a westerly to easterly direction.

6.2 Observed and Expected Mammal Species Richness

All large mammals have decades ago been extirpated to benefit cattle ranching, such as baboons, large herbivores and large carnivores. Some medium-sized mammals have by now most likely also succumbed (viz. monkeys, pangolin, serval). However, the rural character and the relatively large size of the site and of neighbouring properties, especially to the west and south, allows for the occurrence of a number of remaining medium- and many of the smaller mammals reliant on one of the four major habitat types.

Of the 56 mammal species expected to occur on the study site (Table 1), no less than eight were confirmed during the site visit (Table 2). It should be noted that potential occurrences is interpreted as possible over time resulting from expansion and contractions of population densities and ranges that stimulate migration.

All feral mammal species expected to occur on the study site (e.g. house mice, house rats, dogs and cats) were omitted from the assessment since these species normally associate with human settlements.

Most of the species of the resident diversity (Table 1) are common and widespread (viz. scrub hares, mole rats, grass mice, multimammate mice, gerbil, the vespertilionid bats listed, genets, yellow and slender mongooses, duiker, steenbok and others). However, others can not be regarded as common, such as the Red Data species whose conservation rankings are denoted in red in Table 1 (see 6.3 below).

Some endangered species can be accepted to be at least infrequent occupants considering the near-pristine condition of the various habitats. As such the white-tailed rat and the rough-haired golden moles are listed as occupants over time.

Some species (like the carnivores, duiker and steenbok) have large home ranges and are likely to wander on and off the site depending on life-supporting mechanisms (viz. prey), or population dynamics (viz. breeding opportunities). It should also be recognized that the two streams with their riparian zones act as dispersal corridors for individuals searching for new territories.

The site offers no or few daytime roosting opportunities. However, it has been shown that bats are prepared to commute for considerable distances from elsewhere to hawk over lucrative prey sites (such as insect swarms rising over such wetlands as on the site during summer sunsets) to balance their energy budgets with the minimum of expenditure. It is therefore reasonable to expect the species listed in Table 1 to at times visit the wetlands of the site.

Relative high species richness is due to the extensive size of the remaining natural areas on the site, and of adjoining natural areas. The high species richness of the combined surface areas are enhanced by a high connectivity allowing near-to-natural migration. Veld fires are avoided and this means that the quality of environmental conservation from a mammal perspective can be ranked a good. Connectivity with neighbouring areas is high and migration is virtually unhindered. The many drainage lines and especially the streams function as important dispersal corridors.

5.3 Red Listed Mammals

All Red Data species listed in Table 1 ranked as Critically Endangered, Rare, Near Threatened or Data Deficient are discerning species and nationally became endangered as result of the deterioration of their preferred habitats. The habitat scenario on the site is good and therefore most or all of the listed endangered species are deemed as likely candidates to be part of the species assemblage over time.

The listed shrews are not necessarily endangered. None have been adequately studied to provide quantitative field data and accurately assign a conservation ranking, and are thus as a precaution considered as 'Data Deficient'. The same situation applies to other 'Data Deficient' species such as the Hottentot golden mole and the African weasel. Shrews, golden moles and carnivores operate at the apex of the food pyramid, which means that their population numbers are significantly lower than that of their prey species or of similar-sized herbivores/granivores. Because of their diet, they are furthermore not readily trapped with conventional bait or traps, which may mean that their numbers are under-estimated.

The rough-haired golden mole, the African marsh rat and the white-tailed rat have very specific habitat requirements, and these have largely been jeopardized on a

national scale. The rough-haired golden mole and the African marsh rat have a predilection for moist and overgrown areas near water, which are generally heavily grazed by domestic stock. However, the wetlands along the streams on the site provide suitable habitats and the presence of these species should be considered. The white-tailed rat is found in a variety of habitat conditions, but a common denominator is pristine grassveld.

The three "Near Threatened" bats in Table 1 are all cave-dwellers and hibernators. It is obvious that in South Africa caves with the prerequisite temperature and humidity are at a premium. Unfortunately, cavers, furthermore, are unwittingly responsible for causing undue physiological stress on hibernating bats when they disturbed colonies during winter. Bats consume a lot of stored energy to 'wake up' by means of shivering, and if this process is repeated too often the bats consume all fat reserves and simply starve before the end of winter. Fortunately, cave-dwelling bats often find suitable daytime roosts in manmade structures and it is likely that colonies of Schreiber's long-fingered bat, Temmink's hairy bat and Geoffroy's horsehoe bat have artificial roosts in the district.

Brown hyenas ("Near Threatened") are exceptionally reserved and mobile, and are often found close to settlement provided adequate prey / carrion are available. They do not respond well to conservation, but are probably more numerous than estimated. It will come as no surprise that a wandering brown hyena occasionally scavenges on the site.

Although not formally ranked as endangered, vlei rats are considered as sensitive considering their close reliance on moist conditions in wetland vegetation.

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).

Table 1: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al [2003] and Skinner and Chimimba [2005])

	SCIENTIFIC NAME	ENGLISH NAME
CE?	*Chrysospalax villosus*	Rough-haired golden mole
DD?	*Chlorotalpa sclateri*	Sclater's golden mole
DD?	*Amblysomus hottentotus*	Hottentot golden mole
√	*Elephantulus myurus*	Eastern rock elephant shrew
*	*Orycteropus afer*	Aardvark
√	*Lepus saxatilis*	Scrub hare
√	*Pronolagus rupestris*	Smith's red rock rabbit
√	*Pronolagus crassicaudatus*	Natal red rock hare
√	*Cryptomys hottentotus*	African mole rat
*	*Hystrix africaeaustralis*	Cape porcupine
?	*Thryonomys swinderianus*	Greater cane rat
?	*Graphiurus murinus*	Woodland dormouse
√	*Rhabdomys pumilio*	Four-striped grass mouse
NT?	*Dasymys incomtus sensu lato*	African marsh rat
√	*Mus minutoides*	Pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
√	*Mastomys coucha*	Southern multimammate mouse
√	*Aethomys ineptus*	Tete veld rat
√	*Aethomys namaquensis*	Namaqua rock mouse
?	*Otomys laminatus*	Laminate vlei rat
√	*Otomys angoniensis*	Angoni vlei rat
√	*Otomys irroratus*	Vlei rat
*	*Gerbilliscus brantsii*	Highveld gerbil
En?	*Mystromys albicaudatus*	White-tailed mouse
√	*Saccostomus campestris*	Pouched mouse
√	*Dendromus melanotis*	Grey pygmy climbing mouse
√	*Dendromus mesomelas*	Brants' climbing mouse
√	*Dendromus mystacalis*	Chestnut climbing mouse
?	*Steatomys pratensis*	Fat mouse

DD√	*Myosorex varius*	Forest shrew
DD?	*Crocidura mariquensis*	Swamp musk shrew
DD√	*Crocidura cyanea*	Reddish-grey musk shrew
DD*	*Crocidura flavescens*	Greater red musk shrew
√	*Tadarida aegyptiaca*	Egyptian free-tailed bat
NT?	*Miniopterus schreibersii*	Schreibers' long-fingered bat
NT?	*Myotis tricolor*	Temminck's hairy bat
√	*Neoromicia capensis*	Cape serotine bat
?	*Nycteris thebaica*	Egyptian slit-faced bat
NT?	*Rhinolophus clivosus*	Geoffroy's horseshoe bat
?	*Proteles cristatus*	Aardwolf
NT?	*Parahyaena brunnea*	Brown hyena
?	*Caracal caracal*	Caracal
*	*Felis silvestris*	African wild cat
*	*Genetta genetta*	Small-spotted genet
√	*Genetta tigrina*	SA large-spotted genet
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
*	*Ichneumia albicauda*	White-tailed mongoose
*	*Atilax paludinosus*	Marsh mongoose
?	*Vulpes chama*	Cape fox
√	*Canis mesomelas*	Black-backed jackal
*	*Aonyx capensis*	African clawless otter
DD*	*Poecilogale albinucha*	African weasel
*	*Ictonyx striatus*	Striped polecat
*	*Sylvicapra grimmia*	Common duiker
*	*Raphicerus campestris*	Steenbok

√ ***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.

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.

Table 2: Mammal species positively confirmed from the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
E. myurus	Rock elephant shrew	Sight record	Rocky environment
L. saxatilis	Scrub hare	Faecal pellets	Short grassveld
P. rupestris	Smith's red rock rabbit	Faecal pellets	Rocky environment
C. hottentotus	African mole rat	Tunnel systems	Universal
A. namaquensis	Namaqua rock mouse	Grass nests	Rocky environment
P. crassicaudatus	Natal red rock hare	Faecal pellets	Rocky environment
O. angoniensis	Angoni vlei rat	Grass cuttings	Wetlands
O. irroratus	Vlei rat	Grass cuttings	Wetlands

All eight species are zoo-geographically widespread and ecologically robust. All are narrowly adapted to their specific habitat predilections, but within these constraints they are common. They have reticent habits rendering them difficult to detect, and in the case of rock rabbits, being cryptic and alert, renders them difficult to hunt. Although vlei rats are robust rodents, they must be regarded as secondarily sensitive as result of the sensitivity of their semi-aquatic habitat.

7. FINDINGS AND POTENTIAL IMPLICATIONS

7.1 Impact Assessment

It is unambiguously accepted that residential development is unavoidable. Therefore an extension of the existing Newcastle suburbia is considered as the best-case scenario.

The rocky ridges and the streams with their wetlands should be regarded as sensitive.

The proposed development will in all likelihood be concentrated on the terrestrial habitat (i.e. the grasslands). This implies that these terrestrial mammals will all be displaced.

The proposed mitigation measures (9 below) suggest that the rocky ridges and the streams with their wetlands are deemed as sensitive and therefore excluded from any form of development or disturbance. The proposed mitigation measures also address stormwater runoff, which if left unattended could cause damage to the wetland systems.

Should the proposal be accepted that the rocky ridges are deemed sensitive and excluded from development, passive conservation will suffice. Wetland systems are ranked as very sensitive and will thus require special intervention, which is addressed under Subheading 7.2 and Mitigation Measures (9) below. Wetlands should primarily be protected by means of 50-meter buffer zones measured from either of the edges of the streams. This will allow for bio-filtering of runoff water and allow for connectivity.

7.2 Potential Impacts

Loss of exotic species, declared weeds and invader plants

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Decrease of exotic plants and weeds	Wetland systems and ridges	Medium-term	Probable	Low	Low

From a conservation perspective, reducing the alien trees and plants will be advantageous, especially in an area with a high mammal species richness profile. However, it should be kept in mind that alien invaders are robust plants with variable habitat requirements, and it is quite likely that some aliens will strengthen their hold on the systems, especially if the ecosystem is further disturbed. If exotics happen to be high consumers of water (viz. wattles) it will be even more detrimental to the streams and wetlands.

Loss of ecological sensitive and important vegetation units

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Riparian zones	Stream systems	Long term	High	High	High

Fluctuating water levels will be artificially amplified by the development and may result in undue erosion and damage to wetlands (see mitigation measures below). In addition, water contamination of wetlands and streams ex stormwater flowing from hard surfaces will result in severe damage to the ecosystems within the riparian zones on the site and further downstream. As such it will deleteriously affect connectivity, species richness and diversity, food chains and breeding success / cycles.

Loss of ecosystem function (e.g. reduction in water quality, soil pollution)

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Damage to ecosystem function	Stream systems	Long-term	High	High	High

Predicting the effect of chemical and sediment contamination on the wetland and stream systems is largely speculative, and will require a more comprehensive overview. However, it is anticipated that contaminants and sediments deposited on hard surfaces will wash into the streams, unless the proposed mitigation measures are accepted.

Loss of faunal habitat

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Loss of faunal habitat	Stream systems	Long-term	High	High	High

A reduction in water flow / cessation of flow or of flush floods on site will inevitably result in damage to the wetlands in the riparian zones. This in turn will cause a quantitative and qualitative reduction in the life-support systems (habitats) of animals.

It is predicted that damage to the wetland systems may have a cumulative effect on faunal diversity and richness, unless the proposed mitigation measures are heeded.

Loss/displacement of threatened or protected fauna

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Loss of species	Stream systems	Long-term	High	High	High

Given a significant damage to wetlands caused by a decreased water flow or the scouring effect of flush floods, a decrease of population densities can be expected as concomitant to decreasing life-support systems. If decreased natural availability of water is prolonged or water is contaminated, the possibility of local species loss must be entertained, and following that more unacceptable effects such as a cumulative loss of inter-reliant species.

7.3 Impact Assessment Summation

	High	**Medium**	**Low**
Extent / Spatial Scale of Impacts	X		
Intensity / Severity of Impacts	X		
Duration of Impacts	X		
Magnitude and Significance of Impacts	X		

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The EcoAgent team is confident that its collective experience, knowledge and information sources are sufficient to express a suitably accurate opinion re the presence or absence of endangered and sensitive mammals by thorough field investigations. A more intensive trapping / netting survey would be lucrative, but it is unlikely to add to the accuracy of the offered opinions and mitigation measures proposed.

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. Eco-Agent CC can thus not accept responsibility for conclusions and mitigation measures made in good faith based on its 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.

9. RECOMMENDED MITIGATION MEASURES

- The contractors must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Out of concern for the possible releases of noxious substances on water quality of the extensive wetland / water system on the site and further downstream, it is suggested that the contracted hydrologist adopt a wide research approach to address all the ecological issues raised in this report.
- The hydrologist should, if possible, also attend to the fact that where the streams later flow through the town physical impediments and contamination will act as ecological bottlenecks. The new development will magnify such effects and will require amelioration of downstream conditions. This proposal resorts under the precondition that the effect of the development must be interpreted in a wider context.

NOTE: The main text below cites the enlightened mitigation measures developed by GDACE (Directorate of Nature Conservation, GDACE, 2008 and 2009) (now

GDARD) and since they are universal in content are deemed applicable to the study site. Eco-Agent remarks are in italics and in brackets.

Developments

- An appropriate management authority (e.g. the municipality) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system *(i.e. the rocky ridges and the streams with their wetlands – see floral report*). Development should be located on the areas of lowest sensitivity (*i.e. the grasslands*).
- The open space systems should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
    - include a fire management programme to ensure persistence of wetlands along the stream and scrub on the ridges
    - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
    - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
    - ensure the persistence of all Red Listed and sensitive species
    - include a monitoring programme for all Red Listed and sensitive species
    - facilitate/augment natural ecological processes
    - provide for the habitat and life history needs of important pollinators
    - minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
    - include a comprehensive plan for limited recreational development (trails, bird hides etc.) within the open space system
    - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site. (*The latter remark pertains to the streams' courses through the town*)
    - result in a report back to the Directorate of Nature Conservation on an annual basis
    - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)

- The open spaces *(= sensitive*) systems should be fenced off prior to construction commencing (including site clearing and pegging). All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity) should be excluded from the open space system. Access of vehicles to the open space *(= sensitive*) systems should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- A comprehensive surface runoff and storm water management plan should be compiled, indicating how all surface runoff generated as a result of the road development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions. This plan should form part of the EMP.
- In order to minimize artificially generated surface stormwater runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.
- Information boards should be erected within the development to inform residents of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements.
- Outside lighting should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.
- Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for landscaping in communal areas. As far as possible, plants naturally growing on the development site, but would otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should also be planted in landscaped areas.
- The crossing of natural drainage systems should be minimized and only constructed at the shortest possible route, perpendicular to the natural drainage system. Where possible, bridge crossings should span the entire stretch of the buffer zone (see *Sensitivity Mapping Rules for Biodiversity Assessments for buffer zone* requirements).
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Where a road / pipeline / power line is to traverse the streams and wetlands, measures are required to ensure that the road / pipeline / power line has minimal effect on the flow of water through the wetland, e.g. by using a high level clear span bridge or box culverts rather than pipes.
- Sealing of surfaces under a bridge or gabion construction should be avoided.
- Disturbance to any wetlands during construction should be minimized. A plan for the immediate rehabilitation of damage caused to wetlands should be

compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science. This rehabilitation plan should form part of the EMP and a record book should be maintained on site to monitor and report on the implementation of the plan.

Reference: Directorate of Nature Conservation, GDACE. 2008 and revised on February 2009. GDACE Requirements for Biodiversity Assessments, Version 2. Gauteng Provincial Government.

10. CONCLUSIONS

Planning the new residential development, as an extension to existing suburbs, is laudable and accepted as an inevitable consequence of a burgeoning population.

The planned development will replace terrestrial mammals, which is of little consequence considering the extensive nature of surrounding undeveloped land to especially the west and south. However, this report argues that the rocky ridges (or at least partly) should be excluded from the development, and conserved by means of passive management.

The two streams and their associated wetlands must be regarded as very sensitive, and exclude from development and actively protected, firstly by means of 50-meter wide buffer zones measured from each of the banks of the streams, and secondly by a number of mitigation measures. This would be important especially considering the possibility of the occurrence of the “Critically Endangered” rough-haired golden mole. It will also accommodate the possible presence of the “Near Threatened” African marsh rat, as well as the confirmed presence of sensitive vlei rats.

By including both the rocky ridges as well as the two streams each with its collective 100 meters-wide conservation buffer, habitat for most Red Data and sensitive small mammals will be preserved and connectivity will be enhanced.

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The National Environment Management Act, 1998 (Act No. 107 of 1998)

The National Forest Act of 1998 (Act 84 0f 1998, amended in 2006)

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Former position Retired Director: Planning, Northern Flagship Institute

Present position Consultant – Specialist Environmental Assessments,

Project management Research –EIAs, writing, woodworking, photo-recording

Qualifications **B.Sc**. (UP), **T.H.E.D** (Pta TTC), **M.Sc.** (UP), **Ph.D**.(Un. Natal)

Honours

Associate of the Photographic Society of South Africa

Master photographer at club level

Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05

Notable Research Contribution

In-depth survey of the Mammals of the Transvaal

Notable Literary Contribution

Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.

Formal Courses

Computer Literacy, Project Management, Contract Design, Senior Management

Employment history

May 2001 - Present Self-employed, collaborator with du Plessis & Associates [display design and construction], Galago Ventures [environmental impact assessment], 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 Specialist 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 as part of 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

1992 - 2001 Founder member and non-executive director of the Board of Trustees of the Museum Park Section 21 Company

1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund

1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievement

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 Transvaal Museum. Conceptualised and managed 12 display programmes.

Research:

Author and co-author of 85 scientific publications on 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

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

C: PART 3: AVIFAUNA

AN ASSESSMENT FOR BIRDS OF IMPACTS EXPECTED FROM RESIDENTIAL DEVELOPMENT ON THE REMAINDER OF THE FARM BOSCHHOEK 3345, NEWCASTLE, KWAZULU-NATAL

ALAN C. KEMP PhD PrSciNat

DECLARATION OF INDEPENDENCE

I, Dr Alan Charles Kemp (Ph.D., Pr. Sci. Nat. Zoology # 400059/09; ID 440507 5033 081) declare that:

- I am committed to biodiversity conservation but also recognize the need for responsible economic development. While I appreciate constructive criticism and debate, I reserve the right to form and hold my own opinions, and not change my statements to appease the interests of other parties,
- I abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions,
- I act as an independent specialist consultant in the field of zoology,
- **I** am subcontracted as a specialist consultant by EcoAgent CC to assess impacts on the avifauna from proposed residential developments at Boschhoek Farm just south of Newcastle, KwaZulu-Natal, as described in this report,
- I have no financial interest in the proposed development other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2005,
- I do not nor will have any vested or conflicting interests in the proposed development,
- I undertake to disclose to EcoAgent CC, its client and the competent authority any information at my disposal regarding the application, whether such information is favourable to the applicant or not, that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations 2006

A.C. Kemp

ABSTRACT

I do not foresee any significant impacts on birds of conservation concern from a residential development on the farm Boschhoek, just south of Newcastle, KwaZulu-Natal. I base this conclusion on a site visit integrated with a desktop study of the necessary reference literature. However, the site does contain important drainage systems on clay-based soils, including springs, streams, dams, riparian vegetation and alluvial flats, that require protection. This protection could be in the form of a green area to service the needs of both ecosystem functioning and recreation for the residents. It must ensure that the drainage habitats are maintained as a natural corridor for those species largely confined to these habitats. In addition, the development site also supports important patches of woodland on the crest and western slopes of two rocky ridges and these deserve protection for the diversity of bird species they support, as both habitat and as transit sites for these species between patches. Suggestions on how best to implement these protective activities, and to generally mitigate the impacts of the development are included.

1. ASSIGNMENT

Eco-Agent CC Ecological Consultants were appointed to assess the vegetation and undertake a mammal, bird, reptile, and amphibian study of potential impacts from a proposed residential development on the Farm Boschhoek, just south of the town of Newcastle, KwaZulu-Natal. For birds, a sample of the species present and subjective assessment of the diversity, extent and quality of avian habitats were obtained during a site visit and then integrated with desktop studies of the species expected and their conservation status. This protocol is in accordance with EIA Regulations (No. R. 385, Department of Environmental Affairs and Tourism, 21 April 2006) emanating from Chapter 5 of the National Environmental Management Act 1998 (Act No. 107 of 1998).

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

1. **Initial preparations:**
    - Obtain all relevant maps and information on the natural environment of the concerned area.

- This includes information on Red Data birds that may occur in the area.

2. **Fauna assessment**
   - Compile lists of the Red Data birds that can be expected in the area
   - Assess the quantitative and qualitative condition of suitable habitat for the Red Listed birds that may occur in the area
   - Assess the possibility of Red Listed birds to be present on the study site
3. **General**
   - Identify and describe particular ecologically sensitive areas.
   - Identify problem 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.

2. RATIONALE

It is now universally appreciated that a rapidly growing and more demanding human population is placing exponential stress on the earth's resources with irredeemable costs to ecosystems. It is also recognized that ecosystems are nature's 'engine room', providing fundamental live-support systems and products for plants, animals and humans. Environmental degradation ranges from such mega-problems as global warming and demand for power to poor land-use practices and indiscriminate use of household chemicals. The new conservation awareness at all levels, ranging from consumers, school curricula, communities to governments, is typified by vigorous debate and empathy, and sometimes by decisiveness (*viz*. new legislation).

In South Africa, a number of Acts (viz. the Environmental Conservation Act [Act 73 of 1989], National Environmental Management Act, 1998 [NEMA] [107 of 1998], National Environmental Management Biodiversity Act, 2004. [10 of 2004], and National Environmental Management Act (107 of 1998): Environmental Impact Assessment Regulations, 2010: Environmental Management Framework Regulations, 2010 (Gazette No 33306 – Regulation 547)) require developers (and by implication consumers), the scientific community and conservation agencies to minimise environmental impact. A development prerogative now precedes new construction with a multidisciplinary environmental investigation to assess

conservation costs. This ensures that best conservation practices are applied during the planning, construction and operational phases of new developments.

3. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of avifaunal habitat components and current general conservation status of the property;
- To comment on ecological sensitive areas;
- To comment on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of bird species that occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on birds at the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts, should the proposed development be approved.

4. STUDY AREA

4.1 General

The overall avian habitats identified will be similar to those delimited in the botanical survey, but with greater emphasis on those structural features of plants that affect avian diversity more than composition of plant communities. The assessment will also include habitats that occur within 500 m from the development boundaries, since these also indicate possible access to the development by flighted avian species.

The site of the proposed development is an approximate rectangle with a section excised, forming a complex polygon of ~202 ha in extent to the east of Boundary Road (P39-1, Fig. 1). It lies adjacent to the current southern border of densely occupied residential land on the south side of the town of Newcastle, mainly an

informal settlement with some older houses on small plots along the northwest edge. The excised sections comprise at least two smallholdings/farms and a further farm or two are included within the development together with two small rural settlements.

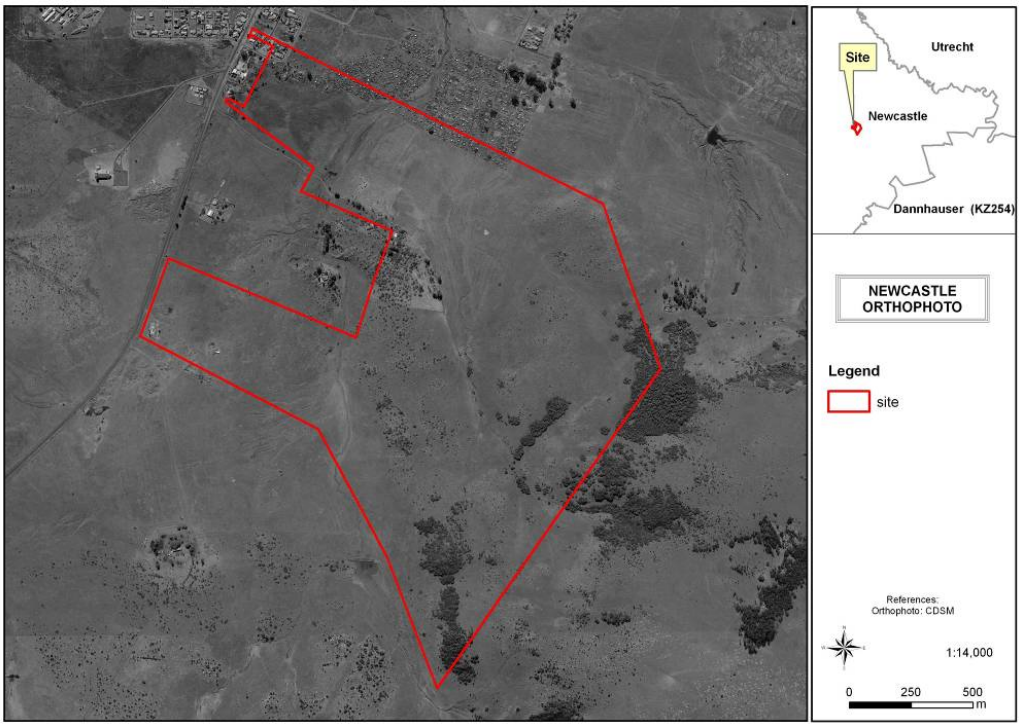

Figure 1: Orthophoto indicating the boundaries of the proposed residential development on the farm Boschhoek, just south of the town of Newcastle in KwaZulu-Natal. The red polygon marking the site has been placed a few mms too far north, hence not quite matching the boundaries as found on the ground.

The site falls within the Sub-Escarpment Grassland Bioregion of Mucina & Rutherford (2006) but is relatively complex topographically. It slopes and drains towards the town in the north, with two main quartzite ridges running approximately north-south across the site and two deeply incised streams running in the valleys between the ridges (Figs. 2-4). There was a clear division between the sandy and gravely slopes, with exposed rocks on the ridges and slopes, and the dark clay soils in the valley bottoms. There are at least four dwelling areas on the site (and more in the excised areas east of Boundary Road). There are signs of old croplands on the alluvial soils around the northern ends of the streams, but most of the site and

surrounding habitats are natural grasslands that have been used for grazing livestock. There are also various other human impacts, such as small dams on the streams, vehicle tracks and foot paths, and a series of borrow pits in the elevated southwest corner. Woody vegetation is found mainly along the two ridges, mainly as scattered trees and bushes but forming dense clumps on the crest and western aspects of the ridges. Apart from a patch of alien wattle trees planted at the head of the more eastern stream, most of the areas have low alien infestation, except around the dwellings, including pine, syringe, eucalyptus, willow and mesquite trees.

4.2 Vegetation Types

The site falls on the interface between Northern KwaZulu-Natal Moist Grassland (Gs4) and Kwazulu-Natal Highland Thornveld (Gs 6, Mucina *&* Rutherford 2006). Details are provided in an accompanying report.

Figure 2: Satellite image showing the location of the farm Boschhoek south of Newcastle, where residential development is proposed (purple polygon). The main features of ridges, streams and dwelling houses (H) are indicated.

Figure 3: Satellite image showing more detail of the northern end of the farm Boschhoek where residential development is proposed (purple polygon), including the ridges, stream exits, springs (S), dams (D) and dwelling houses (H). Points 1 and 2 are the highest elevations on the site and point 3 indicates a broad clay flatland between the two streams.

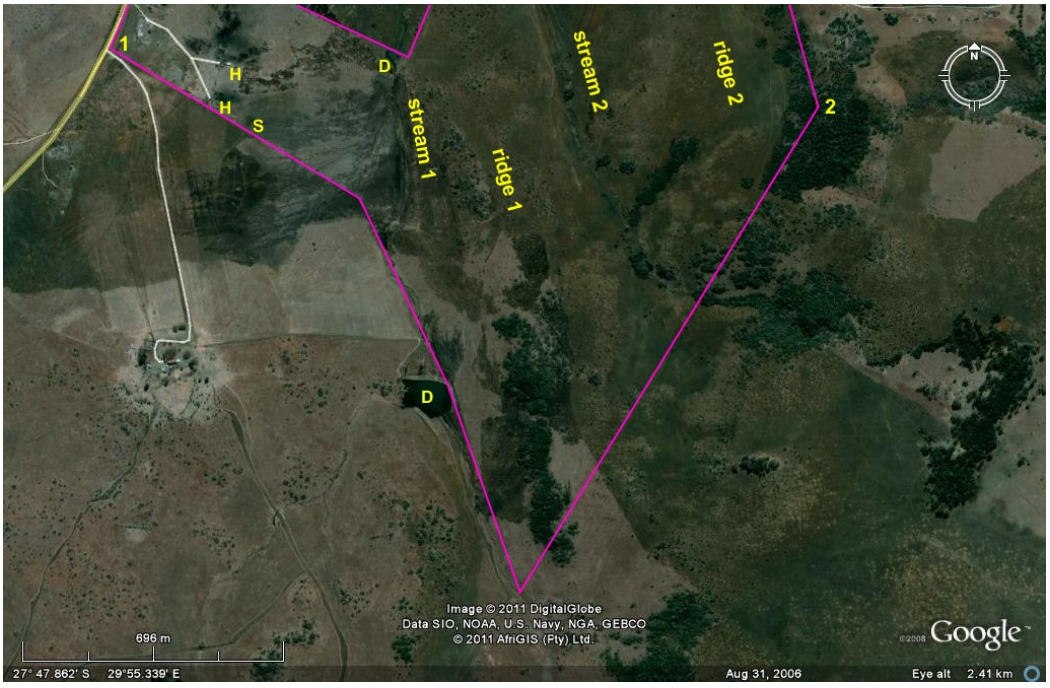

Figure 4: Satellite image showing more detail of the southern end of the farm Boschhoek where residential development is proposed (purple polygon), including the ridges, streams, springs (S), dams (D) and dwelling houses (H). Points 1 and 2 are the highest elevations on the site. The main 'forest' patches are obvious.

5. METHODS

5.1. Field Survey

I conducted a site visit on 5 March 2011, in the company of botany, mammal and herpetology specialists. During this visit, I recorded the presence of bird species or assessed the probability of their occurrence, based mainly on the habitat types recognized at the study site. This was done with due regard to the well-recorded distributions of southern African birds, coupled to the qualitative and quantitative nature of the recognized habitats and the relative extent. Given the mobility of birds, I also scanned at least 500 m of adjoining properties for important faunal habitats and avian species.

During the site visit, birds were identified by visual sightings during random transect walks and drives across the development. I covered the entire site, but did not conduct any trapping or mist netting since the terms of reference did not require such intensive work. In addition, I identified the presence of some species by their calls, old nests, food remains and/or moulted feathers.

5.2. Desktop Survey

Initially, I derived and compared lists of bird species expected to occur on the development from the quarter-degree grid cell (QDGC, 2729DD) records presented in atlases of the ex-Natal and southern African birds (Cyrus & Robson 1980; Harrison *et al*. 1997). Based on an assessment of the habitats present on the development, the list was then reduced to those species that were judged as 'possible' or 'likely' to occur within those habitats, as either resident species or regular visitors. Due to the considerable aerial mobility of birds, one might expect a number of additional species as either infrequent nomads or rare vagrants but I judged that the habitats available would offer no significant material support or conservation assistance to these species, and that even if they did occur it would only be temporarily and in insignificant numbers.

Possible refers to species that might use their mobility to make significant intermittent use of the habitats available. This only may intermittent, when they are in a particular condition (e.g. during or after rain, flood, drought, burning, grazing, seeding, flowering) or season (e.g. regional, intra-African or inter-continental

summer/winter migrants and nomads), and then offer particular resources (food, perch, roost and/or nest sites).

Likely refers to species that I expect to make regular use of the development for feeding, roosting and/or breeding. Species actually recorded on the development during the field survey are included within 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, birds being capable of arriving or departing as conditions change, and our ability to detect them varying seasonally. I paid particular attention to species considered as threatened internationally or nationally, so-called Red Data species (DEAT 2007; Barnes, 2000). For any threatened species expected even to visit the area, I elevated the category assigned to them based on the precautionary principle. I also extended my assessment of the extent, qualities, and limits of the various habitat types, both on the development and on adjacent properties, by study of satellite images from Google Earth.

5.3. Specific Requirements

No directives were received to search for particular species or their habitats.

6. RESULTS

6.1 General observations

The habitats occupied by flighted birds differ from those of most terrestrial animals in being three-dimensional, especially for aerial-feeding species and those regularly using the airspace above landscapes with low relief and short vegetation. In the two horizontal dimensions, most birds are 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 requirements of wood, foliage, flowers, fruit or seeds. Although plant species composition is the main criterion used to delimit most vegetation biomes and units described for South Africa, the most recent analysis also takes into account and offers good synopses of abiotic factors

that underlie these divisions, such as topography, geology, soil types, and such general structural features as landscapes (Mucina & Rutherford, 2006). The natural habitat at the development occurs within Northern KwaZulu-Natal Moist Grassland (Gs4) and Kwazulu-Natal Highland Thornveld (Gs6, 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 development and sinks for those breeding on the development. In this regard, the Chelmsford Dam and Ncandu Game Reserves about 20 km to the south are relevant.

Birds are a relatively visible and audible group of homoeothermic vertebrates, active throughout the day/night and year, and with habitat preferences that we can evaluate both by reference to the comprehensive literature available and by the subset of species detected during a field survey done at a particular season and time of day/night. Such information plus personal experience also informs searches for particular species of conservation concern. I conducted the present site visit in late summer, after good rains had fallen, and under clear warm conditions with only a slight breeze.

6.2 Bird Habitat Assessment

The principal habitat types detected on or adjacent to the development and considered most relevant to bird ecology and community structure were:

1. Natural Grassland.

Most of the site is covered in natural grassland, but of variable quality and generally degraded by grazing, trampling, over-burning and patches of cropping, especially around the residences. The grasslands on the shallow sandy quartzite-derived soils, dominated by *Hyparrhenia*, are shorter and sparser compared to those on clay soils in the valley bottoms, with more *Eragrostis*. Generally, the grasslands were of poor quality as reflected by the low diversity and density of birds encountered.

Figure 5: View north from the top of ridge 1 towards ridge 2, showing grassland with scattered woody vegetation (including a wattle clump on the right), with the base of the escarpment on the left horizon.

Figure 6: View north from the lower end of stream 2, showing moist grassland, the end of ridge 2 on the right and the informal settlement along the northern boundary in the middle distance.

2. Watercourses, Dams and associated Wetlands.

The two main aquatic features are the deeply incised streams running along the floor of the valleys between the ridges and elevated edges of the site. At points, these streams are restrained as small dams and, in their lower reaches, they spill out into temporary wetlands, especially around stream 2. The streams are fed by runoff from the surrounding valleys, including seepage from the quartzite strata that even forms springs at the southern edge of the site (Figs. 3 & 4), and a catena-like effect at the quartzite-clay junction on the valley sides. The area had received heavy rainfall earlier in the season, including flooding of the town, and so wetlands and springs were probably at their most extensive and productive during the site visit. The grassy vegetation along the immediate streambeds and -banks was relatively tall and dense,

with *Typha* bulrushes mainly in the dams, and with sedges most prominent on the flooded wetlands in the lower reaches. A few excavated pits in the southwest corner also formed their own ponds and seepage areas, complete with a few sedges and bulrushes.

Figure 7: View west from the top of ridge 1, looking across the upper reaches of the channel-like bed of stream 1, with the drainage lines from springs crossing the far slope, and the pits and their seepage patches on the distant crest alongside the southern boundary fence-line of the development.

Figure 8: View south at southwest corner of the site, showing a pond formed in an excavated pit and associated seepage/drainage to the left foreground.

Figure 9: View south from the lower end of stream 2, showing the incised bed and denser grassland that grade into the fallow land and ridges on either side.

Figure 10: View east across a small dam at on the lower reaches of stream 1, with a dwelling and the end of ridge 2 on the far right.

3. Rocky ridges and slopes.

The two main rocky ridges and a few outcroppings across the slopes supported most of the natural woody vegetation on the site. This varied from scattered single bushes

and trees to dense forest-like stands, augmented in a structural sense by alien species mainly in patches or clustered around dwellings. Species of both forest (*Celtis africana, Euclea natalensis, Leucosidea sericea*) and bushveld (*Acacia sieberiana, A. karroo, A. caffra, Searsia pyroides, Gymnosporia buxifolia*) affinities are evident, together with those favouring fire-protected rocky slopes (*Cussonia spicata, Diospyros lycioides, Canthium mundianum, Zanthoxylum capense, Searsia dentata*).

Figure 11: View north along the top of ridge 1, showing rock outcrops, scattered woody vegetation and in the distance a denser clump of trees.

Figure 12: View east from northern end of ridge 1, looking across the valley to ridge 2 and its larger patches of dense woody vegetation, some of which is alien wattle and eucalyptus, but much of which is indigenous.

6.3 Expected and Observed Bird Species Diversity

One hundred and fifty six species are expected or were recorded on the proposed development site (Table 1). Of these, 88 (50%) are scored as 'possible' to occur,

although this number would be much larger if other species expected as only rare vagrants to the area were not excluded from this analysis due to inadequate availability of their preferred habitat. I recorded 49 species during my 8-hour visit (56% of the total 'possible' species), although the number would surely have been higher if I spent more time in search of species, if the survey had started earlier and extended later in the day, and if I had covered every sector in detail. The 49 species recorded also represent 56% of the 88 species that were judged as 'likely' for the habitats available, and so offer a good sample in support of any species:habitat correlations.

Out of 198 habitat preferences, the greatest diversity of species, 80 (40%) preferred the wooded habitats and/or the rocky ridges, 59 (30%) the grasslands and 47 (24%) the watercourses, dams and wetlands, with 12 (6%) feeding aerially and likely to be found over any of the habitats. Only 11 of the 156 species expected as 'possible' or 'likely' for the site (7%) were generalists that might use any habitat, 22 (14%) might use two habitats (usually grass- and wetlands), but the majority of species, 123 (79%), are only expected regularly in a single habitat.

Table 1: Bird species diversity expected as 'possible' (+), and 'likely' (++) and/or observed (in bold), on and around the proposed residential development on the farm Boschhoek south of Newcastle. Names and systematic order after 'Roberts VII' (Hockey *et al*. 2006), preferred habitats as above, estimated probability of occurrence (Cyrus & Robson 1980; Harrison *et al*. 1997), and Red Data, non-resident and endemism categories (Barnes 2000, Birdlife South Africa Checklist 2009).

English name	Scientific name	Afrikaans name	Habitat preference*	Probability of occurrence**	Red Data status***	Non-resident status****	Endemic status*****
Red-winged Francolin	***Scleroptila levaillantii***	**Rooivlerkpatrys**	**1**	**++**			
Shelley's Francolin	*Scleroptila shelleyi*	Laeveldpatrys	1	+			
Natal Spurfowl	***Pternistis natalensis***	**Natalse Fisant**	**3**	**++**			
Red-necked Spurfowl	*Pternistis afer*	Rooikeelfisant	1	+			
Swainson's Spurfowl	*Pternistis swainsonii*	Bosveldfisant	1	++			
Common Quail	*Coturnix coturnix*	Afrikaanse Kwartel	1	+			
Helmeted Guineafowl	*Numida meleagris*	Gewone Tarentaal	1,2,3	++			
Greater Honeyguide	*Indicator indicator*	Grootheuningwyser	3	+			

Brown-backed Honeybird	*Prodotiscus regulus*	Skerpbekheuningvoël	1,2,3	+			
Red-throated Wryneck	*Jynx ruficollis*	Draaihals	1	+			
Cardinal Woodpecker	*Dendropicos fuscescens*	Kardinaalspeg	3	+			
Acacia Pied Barbet	*Tricholaema leucomelas*	Bonthoutkapper	3	++			
Black-collared Barbet	***Lybius torquatus***	**Rooikophoutkapper**	**3**	**++**			
Crested Barbet	*Trachyphonus vaillantii*	Kuifkophoutkapper	3	+			
African Hoopoe	*Upupa africana*	Hoephoep	1,3	++			
Green Wood-Hoopoe	*Phoeniculus purpureus*	Rooibekkakelaar	3	+			
Malachite Kingfisher	*Alcedo cristata*	Kuifkopvisvanger	2	++			
Brown-hooded Kingfisher	***Halcyon albiventris***	**Bruinkopvisvanger**	**1,3**	**++**			
Pied Kingfisher	*Ceryle rudis*	Bontvisvanger	2	+			
Speckled Mousebird	***Colius striatus***	**Gevlekte Muisvoël**	**3**	**++**			
Jacobin Cuckoo	*Clamator jacobinus*	Bontnuwejaarsvoël	3	+		B	
Red-chested Cuckoo	*Cuculus solitarius*	Piet-my-vrou	3	+		B	
Black Cuckoo	*Cuculus clamosus*	Swartkoekoek	3	+		B	
Diderick Cuckoo	*Chrysococcyx caprius*	Diederikkie	1,2,3	++		B	
Alpine Swift	*Tachymarptis melba*	Witpenswindswael	Aerial	+		B	
African Black Swift	*Apus barbatus*	Swartwindswael	Aerial	+			
Little Swift	*Apus affinis*	Kleinwindswael	Aerial	++			
Horus Swift	*Apus horus*	Horuswindswael	Aerial	+			
White-rumped Swift	*Apus caffer*	Witkruiswindswael	Aerial	++		B	
Barn Owl	*Tyto alba*	Nonnetjie-uil	3	+			
African Grass-Owl	*Tyto capensis*	Grasuil	2	+	VUL		
Spotted Eagle-Owl	***Bubo africanus***	**Gevlekte Ooruil**	**1,3**	**++**			
Marsh Owl	*Asio capensis*	Vlei-uil	2	+			
Rock Dove	*Columba livia*	Tuinduif	3	+			
Speckled Pigeon	***Columba guinea***	**Kransduif**	**3**	**++**			
Laughing Dove	***Streptopelia senegalensis***	**Rooiborsduifie**	**1,3**	**++**			
Cape Turtle-Dove	***Streptopelia capicola***	**Gewone Tortelduif**	**1,3**	**++**			
Red-eyed Dove	***Streptopelia semitorquata***	**Grootringduif**	**3**	**++**			
Namaqua Dove	*Oena capensis*	Namakwaduifie	1	+			
Denham's Bustard	*Neotis denhami*	Veldpou	1	+	VUL		
Blue Korhaan	*Eupodotis caerulescens*	Bloukorhaan	1	+	NT		(*)
White-bellied Korhaan	*Eupodotis senegalensis*	Witpenskorhaan	1	+	VUL		
Grey Crowned Crane	*Balearica regulorum*	Mahem	1,2	+	VUL		
Blue Crane	*Anthropoides paradiseus*	Bloukraanvoël	1	+	VUL		
African Rail	*Rallus caerulescens*	Grootriethaan	2	+			
Black Crake	*Amaurornis flavirostris*	Swartriethaan	2	+			
African Snipe	*Gallinago nigripennis*	Afrikaanse Snip	2	+			
Spotted Thick-knee	*Burhinus capensis*	Gewone Dikkop	1,3	++			
Three-banded Plover	*Charadrius tricollaris*	Driebandstrandkiewiet	2	+			
Blacksmith Lapwing	***Vanellus armatus***	**Bontkiewiet**	**2**	**++**			

African Wattled Lapwing	*Vanellus senegallus*	Lelkiewiet	2	+			
Crowned Lapwing	*Vanellus coronatus*	Kroonkiewiet	1	++			
Black-shouldered Kite	*Elanus caeruleus*	Blouvalk	1,2,3	++			
Yellow-billed Kite	*Milvus aegyptius*		Aerial	+		B	
African Marsh-Harrier	*Circus ranivorus*	Afrikaanse Vleivalk	2	+	VUL		
Steppe Buzzard	***Buteo vulpinus***	**Bruinjakkalsvoël**	**1,2,3**	**++**		**NB**	
Jackal Buzzard	*Buteo rufofuscus*	Rooiborsjakkalsvoël	1,3	+			(*)
Secretarybird	*Sagittarius serpentarius*	Sekretarisvoël	1	+	NT		
Lesser Kestrel	*Falco naumanni*	Kleinrooivalk	1	+	VUL	NB	
Rock Kestrel	*Falco rupicolus*	Kransvalk	1,3	+			
Amur Falcon	***Falco amurensis***	**Oostelike Rooipootvalk**	**1**	**++**		**NB**	
Lanner Falcon	*Falco biarmicus*	Edelvalk	1,2,3	+	NT		
Reed Cormorant	*Phalacrocorax africanus*	Rietduiker	2	+			
Black-headed Heron	***Ardea melanocephala***	**Swartkopreier**	**1**	**++**			
Cattle Egret	***Bubulcus ibis***	**Veereier (Bosluisvoël)**	**1,2,3**	**++**			
Hamerkop	*Scopus umbretta*	Hamerkop	2	+			
Hadeda Ibis	***Bostrychia hagedash***	**Hadeda**	**1,2**	**++**			
Southern Bald Ibis	*Geronticus calvus*	Kalkoenibis	1	+	VUL		(*)
African Sacred Ibis	*Threskiornis aethiopicus*	Skoorsteenveër	2	++			
African Spoonbill	*Platalea alba*	Lepelaar	2	+			
White Stork	*Ciconia ciconia*	Witooievaar	1,2	+		B/NB	
Black-headed Oriole	*Oriolus larvatus*	Swartkopwielewaal	3	+			
Fork-tailed Drongo	*Dicrurus adsimilis*	Mikstertbyvanger	3	+			
African Paradise-Flycatcher	*Terpsiphone viridis*	Paradysvlieëvanger	3	++			
Brubru	*Nilaus afer*	Bontroklaksman	3	+			
Southern Boubou	***Laniarius ferrugineus***	**Suidelike Waterfiskaal**	**3**	**++**			
Bokmakierie	***Telophorus zeylonus***	**Bokmakierie**	**1,3**	**++**			
Cape Batis	*Batis capensis*	Kaapse Bosbontrokkie	3	+			
Chinspot Batis	***Batis molitor***	**Witliesbosbontrokkie**	**3**	**++**			
Cape Crow	***Corvus capensis***	**Swartkraai**	**1**	**++**			
Pied Crow	*Corvus albus*	Witborskraai	1,2,3	++			
Common Fiscal	***Lanius collaris***	**Fiskaallaksman**	**1,3**	**++**			
Southern Black Tit	*Parus niger*	Gewone Swartmees	3	+			
Brown-throated Martin	*Riparia paludicola*	Afrikaanse Oewerswael	2,Aerial	+			
Banded Martin	***Riparia cincta***	**Gebande Oewerswael**	**1,Aerial**	**++**			
Barn Swallow	***Hirundo rustica***	**Europese Swael**	**Aerial**	**++**		**NB**	
Greater Striped Swallow	*Hirundo cucullata*	Grootstreepswael	Aerial	+			
S African Cliff-Swallow	*Hirundo spilodera*	Familieswael	Aerial	+			B(*)
Rock Martin	*Hirundo fuligula*	Kransswael	Aerial	+			
Dark-capped Bulbul	***Pycnonotus tricolor***	**Swartoogtiptol**	**3**	**++**			
Cape Grassbird	***Sphenoeacus afer***	**Grasvoël**	**2**	**++**			**(*)**

Little Rush-Warbler	*Bradypterus baboecala*	Kaapse Vleisanger	2	+		
African Reed-Warbler	*Acrocephalus baeticatus*	Kleinrietsanger	2	+	B	
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	Kaapse Rietsanger	2	++		
Willow Warbler	*Phylloscopus trochilus*	Hofsanger	3	++	NB	
Cape White-eye	***Zosterops virens***	**Kaapse Glasogie**	**3**	**++**		**(*)**
Levaillant's Cisticola	***Cisticola tinniens***	**Vleitinktinkie**	**2**	**++**		
Neddicky	***Cisticola fulvicapilla***	**Neddikkie**	**3**	**++**		
Zitting Cisticola	***Cisticola juncidis***	**Landeryklopkloppie**	**1**	**++**		
Cloud Cisticola	***Cisticola textrix***	**Gevlekte Klopkloppie**	**1**	**++**		**(*)**
Wing-snapping Cisticola	*Cisticola ayresii*	Kleinste Klopkloppie	1	+		
Tawny-flanked Prinia	***Prinia subflava***	**Bruinsylangstertjie**	**2,3**	**++**		
Drakensberg Prinia	*Prinia hypoxantha*	Drakensberglangstertjie	3	+		(*)
Rufous-naped Lark	***Mirafra africana***	**Rooineklewerik**	**1,3**	**++**		
Spike-heeled Lark	*Chersomanes albofasciata*	Vlaktelewerik	1	+		
Eastern Long-billed Lark	*Certhilauda semitorquata*	Grasveldlangbeklewerik	3	+		(*)
Red-capped Lark	***Calandrella cinerea***	**Rooikoplewerik**	**1,2**	**++**		
Cape Rock-Thrush	*Monticola rupestris*	Kaapse Kliplyster	3	+		(*)
Groundscraper Thrush	*Psophocichla litsitsirupa*	Gevlekte Lyster	3	+		
Olive Thrush	*Turdus olivaceus*	Olyflyster	3	++		
Fiscal Flycatcher	***Sigelus silens***	**Fiskaalvlieëvanger**	**3**	**++**		**(*)**
Spotted Flycatcher	*Muscicapa striata*	Europese Vlieëvanger	3	+	NB	
Cape Robin-Chat	*Cossypha caffra*	Gewone Janfrederik	3	++		
White-browed Scrub-Robin	*Cercotrichas leucophrys*	Gestreepte Wipstert	3	+		
African Stonechat	*Saxicola torquatus*	Gewone Bontrokkie	2	++		
Mountain Wheatear	*Oenanthe monticola*	Bergwagter	3	+		
Familiar Chat	*Cercomela familiaris*	Gewone Spekvreter	3	++		
Ant-eating Chat	***Myrmecocichla formicivora***	**Swartpiek**	**1,3**	**++**		
Mocking Cliff-Chat	*Thamnolaea cinnamomeiventris*	Dassievoël	3	+		
Red-winged Starling	*Onychognathus morio*	Rooivlerkspreeu	3	+		
Cape Glossy Starling	*Lamprotornis nitens*	Kleinglansspreeu	3	++		
Pied Starling	***Spreo bicolor***	**Witgatspreeu**	**1**	**++**		**(*)**
Common Myna	***Acridotheres tristis***	**Indiese Spreeu**	**1,2,3**	**++**	**I**	
Amethyst Sunbird	*Chalcomitra amethystina*	Swartsuikerbekkie	3	+		
Malachite Sunbird	*Nectarinia famosa*	Jangroentjie	3	+		
Greater Double-collared Sunbird	*Cinnyris afer*	Groot-rooibandsuikerbekkie	3	+		(*)
White-bellied Sunbird	*Cinnyris talatala*	Witpenssuikerbekkie	3	+		
Cape Weaver	*Ploceus capensis*	Kaapse Wewer	2	+		(*)
Southern Masked-Weaver	***Ploceus velatus***	**Swartkeelgeelvink**	**1,2,3**	**++**		
Village Weaver	*Ploceus cucullatus*	Bontrugwewer	3	+		

Red-billed Quelea	*Quelea quelea*	Rooibekkwelea	1	+			
Yellow-crowned Bishop	***Euplectes afer***	**Goudgeelvink**	**2**	**++**			
Southern Red Bishop	***Euplectes orix***	**Rooivink**	**2**	**++**			
Fan-tailed Widowbird	***Euplectes axillaris***	**Kortstertflap**	**2**	**++**			
White-winged Widowbird	*Euplectes albonotatus*	Witvlerkflap	1,2	++			
Red-collared Widowbird	*Euplectes ardens*	Rooikeelflap	2	++			
Long-tailed Widowbird	***Euplectes progne***	**Langstertflap**	**1,2**	**++**			
Orange-breasted Waxbill	*Amandava subflava*	Rooiassie	2	+			
African Quailfinch	***Ortygospiza atricollis***	**Gewone Kwartelvinkie**	**1**	**++**			
Red-headed Finch	*Amadina erythrocephala*	Rooikopvink	3	+			
Common Waxbill	*Estrilda astrild*	Rooibeksysie	2	++			
African Firefinch	*Lagonosticta rubricata*	Kaapse Vuurvinkie	3	+			
Pin-tailed Whydah	***Vidua macroura***	**Koningrooibekkie**	**1,2,3**	**++**			
House Sparrow	*Passer domesticus*	Huismossie	1,3	++		I	
Cape Sparrow	***Passer melanurus***	**Gewone Mossie**	**1,3**	**++**			
Southern Grey-headed Sparrow	*Passer diffusus*	Gryskopmossie	3	+			
Cape Wagtail	***Motacilla capensis***	**Gewone Kwikkie**	**2**	**++**			
Cape Longclaw	***Macronyx capensis***	**Oranjekeelkalkoentjie**	**1,2**	**++**			
African Pipit	***Anthus cinnamomeus***	**Gewone Koester**	**1**	**++**			
Long-billed Pipit	***Anthus similis***	**Nicholsonse Koester**	**3**	**++**		**NB?**	**W*?**
Cape Canary	*Serinus canicollis*	Kaapse Kanarie	1,3	++			
Yellow-fronted Canary	*Crithagra mozambicus*	Geeloogkanarie	3	+			
Black-throated Canary	*Crithagra atrogularis*	Bergkanarie	1	++			
Streaky-headed Seedeater	***Crithagra gularis***	**Streepkopkanarie**	**3**	**++**			
Cinnamon-breasted Bunting	*Emberiza tahapisi*	Klipstreepkoppie	3	++			
Golden-breasted Bunting	*Emberiza flaviventris*	Rooirugstreepkoppie	3	+			

*** Habitats (see above):** 1 – Grasslands, 2 – Rocky wooded ridges, 3 – Watercourses.
**** Probability of occurrence (see text)**: + - possible; ++ - likely; bold type – detected.
***** Red Data status:** NT – Near Threatened, Vul – Vulnerable, E – endangered, CE – Critically Endangered.
****** Non-resident status:** B – breeding migrant, NB – non-breeding migrant, V – vagrant, I – introduced, R – rare.
******* Endemic status:** * - endemic, (*) – near endemic, B* - breeding endemic, B(*) – breeding near endemic, W* - winter endemic.

6.4 Threatened and Red-Listed Bird Species

I considered all 11 species of national conservation concern (Red Data species, Barnes 2000) as only 'possible' to occur on the development (Near Threatened: Blue Korhaan, Secretarybird, Lanner Falcon; Vulnerable: African Grass-Owl, Denham's Bustard, White-bellied Korhaan, Grey Crowned Crane, Blue Crane, African Marsh-Harrier, Lesser Kestrel and Bald Ibis). All these 'possible' species were included in the list under the Precautionary Principle, because they may be able to use the habitat on site in transit, even though the extent, quality and surrounding development at the site would not enable them to make important and regular use of its resources.

The habitats on site are less than ideal for each species because some prefer moister, taller and/or denser grasslands (Blue Korhaan, Denham's Bustard, White-bellied Korhaan and Bald Ibis), and others prefer more extensive and permanent wetlands (African Grass-Owl, Grey Crowned Crane and African Marsh-Harrier). The site would also be too close to dense habitation, and too disturbed by residents and pedestrians for most of the previous species, as well as Secretarybird and Blue Crane that also require grassland that is more productive. Lanner Falcon and Lesser Kestrel may visit the site to feed, when adequate prey is available, but the site does not offer nest or roost sites for either species.

7. FINDINGS AND POTENTIAL IMPLICATIONS

7.1 Impact Assessment

The proposed development site is a large, 202 ha area of mainly natural habitat that might be useful for conservation were it not adjacent to a densely populated township, and previously transformed by various historical treatments (over-grazing and burning, cropping, settlement, traverse tracks and patches of alien vegetation). The site in its present state does not appear to have any habitats especially important to threatened species, and even for common bird species the numbers and densities appear subjectively to be rather low, further supporting the contention that the habitats are already degraded.

7.2 Potential Implications

Loss of exotic species, declared weeds and invader plants

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Decrease exotic plants and weeds	Grass-, wet- and woodland systems	Medium-term	Probable	Low	Low

From a conservation perspective, reducing the alien trees and plants will be advantageous in improving the natural habitats, especially if combined with a development policy of only replanting with species indigenous to the area. Removal of aliens will also counter the spread of pioneer species, some of which will be aliens, that is likely to occur on patches disturbed by development. Removal of aliens that are high consumers of water (viz. wattles) will also enhance flows into the natural waterways on site.

Loss of ecological sensitive and important vegetation units

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Riparian zones	River systems	Long term	High	High	High
Woodland patches	Wooded clumps on ridges	Long term	Medium	Medium	High

Increased runoff from residential development (roofs, sealed roads) and wastewater will require proper control so that flushing and/or contamination of wetlands and streams does not damage ecosystems within the riparian zones on site and further downstream. Protection and improvement of the riparian vegetation will help to counter these impacts. Protection of wooded patches will enhance the diversity of birds likely to remain within the development, besides providing important transit areas for woodland species between adjacent patches.

Loss of ecosystem function

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Damage to ecosystem function	River systems	Long-term	High	High	High

The quantity and quality of water emanating from the development will impinge on all downstream communities, besides affecting water quality within the on site watercourses. Maintenance of the drainage systems on the site as well managed green areas, and careful planning of surplus (storm) and wastewater disposal will be imperative.

Loss of faunal habitat

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Loss of faunal habitat	River systems	Long-term	High	High	High
	Wooded clumps on ridges	Long-term	Medium	Medium	High

Drainage systems are by nature a series of interconnected linear habitats. The movements of any plant or animal species confined to these habitats are therefore restricted largely to linear patterns. Hence any damage leading to breaks in these systems imposes dispersal barriers to riparian and wetland species, leading to a reduction in species diversity and abundance. The same concept applies to patches of woody vegetation that provide a series of habitat patches across the landscape that facilitate movement of species. A number of species based in wetland or woodland habitats also visit adjacent habitats for some of their requirements (food, nest material), and so preservation of as much natural habitat as possible within the development should form a basis for initial planning.

Loss/displacement of threatened or protected fauna

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Loss of species	River systems	Long-term	High	High	High

Most of the threatened species of birds identified as possible visitors to the site prefer grassland habitats, and these will be inevitably be reduced given the nature of residential development. However, those species that prefer wetlands (African Grass-Owl, Grey Crowned Crane and African Marsh-Harrier) could have their habitats protected and even enhanced if the lower reaches of the streams and their associated riparian and 100-year flood zones are developed as a green reserve area within the development.

7.3 Impact Assessment Summation

	High	**Medium**	**Low**
Extent / Spatial Scale of Impacts		x	
Intensity / Severity of Impacts	X		
Duration of Impacts		X	
Magnitude and Significance of Impacts	X		

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The site visit was conducted at a suitable time of the year, under good weather conditions, and was of sufficient duration to visit all major sectors and habitats on the proposed development site. This information was then integrated with regional data sources on expected bird distribution, abundance, habitat preferences, conservation status and responses to human activities. The results in this report are therefore only as good as the extent and duration of the site visit and validity of the reference sources, even though every care was taken to ensure its accuracy. Obviously, more intensive site visits over longer periods and accession of further reference sources

might improve the report. However, more detail seems unnecessary at this initial stage of assessment and would demand larger budgets of time and funds.

Assessment of impacts and possible measures for mitigation are based on the site visit, study of ecosystems involved and personal ecological experience but, since one is dealing with dynamic natural systems, additional information from other sources may need to be integrated into the assessment. Thus, EcoAgent CC and I cannot accept responsibility for impact conclusions and mitigation measures made in good faith and based on our databases and information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

9. RECOMMENDED MITIGATION MEASURES

If the development proceeds, special attention should be given to protecting and restoring the drainage lines and their associated features (riparian zones, alluvial plains, feeder springs). Based on the seepage patterns encountered and geological features examined, a geo-hydrologist and wetland specialist may be required to determine any subterranean flow patterns within the quartzite and granite strata on the slopes and ridges, and to demarcate the riparian and wetland zones, and their 100-year flood lines.

Protection of woody plants (bushes and trees) on the ridges should also be encouraged, especially for the larger dense forest-like patches that support a few Afro-montane species of plants and birds. Such protected areas would help maintain the avian diversity on site and enhance connectivity with neighbouring patches, and their effect would be extended if planting of indigenous woody plants within the development were encouraged. The current collection of firewood on the site should also be controlled.

Other mitigation measures applicable to the study site are compiled mainly from guidelines offered by GDACE (now GDARD, Directorate of Nature Conservation, 2008, revised 2009), with additions drawn from other EIAs and personal experience.

- The appropriate agency should implement an ongoing monitoring and eradication programme for all invasive and weedy plant species growing within the site. Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for landscaping on the site. Wherever possible, plants naturally growing on the development site, that otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should be planted in landscaped areas.
- The crossing of natural drainage systems should be minimized via the shortest perpendicular route across the system. Where possible, bridge crossings should span the entire stretch of the buffer zone. Where a road/pipeline/powerline is to traverse a wetland, measures are required to ensure that it has minimal effect on the flow of water through the wetland, e.g. by using a high-level clear-span bridge or box culverts rather than pipes. Sealing of surfaces under a bridge or gabion construction should be avoided. A plan for the immediate rehabilitation of damage caused to wetlands should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science and form part of the EMP.
- A comprehensive surface runoff and storm water management plan should be compiled, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland. In addition, how surface runoff will be retained, outside of any demarcated buffer/flood zones, and then subsequently released to simulate natural hydrological conditions needs to be considered.
- The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- An appropriate management authority (e.g. the body corporate) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.
- Development structures should be clustered as close as possible to existing development.
- Prior to construction, fences should be erected in such a manner to prevent access and damage to any sensitive areas identified in a sensitivity mapping exercise. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- Outside lighting should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.
- A comprehensive surface runoff and storm water management plan should

be compiled to indicate how surface runoff generated as by the development (during both the construction and operational phases) will be managed (e.g. by artificial wetlands / storm water and flood retention ponds). Especially prior to entering any natural drainage system or wetland, retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions. This plan should form part of the EMP.

- Where roads/railways traverse streams/rivers, an underpass should provide for the movement of aquatic as well as terrestrial species. This should include provision of appropriate buffer zones within the underpass (a 32m buffer zone from the edge of the riparian zone recommended for rivers within the urban edge and a 100m buffer zone from the edge of the riparian zone recommended for rivers outside the urban edge).
- Suitable terrestrial underpasses should be provided and maintained to facilitate safe movement of animals, specifically where roads traverse important species corridors, ridges or habitats suitable for protected species. A barrier that will physically block animals from accessing the road surface should be constructed for a distance of 200m on either side of all aquatic and terrestrial underpasses and at any point where roads are associated with suitable habitat for African Grass-Owls. Road signs warning motorists to slow down on account of Grass Owls should be erected (in accordance with applicable legislation) and road margins should be regularly mowed to a distance of 5m from the hard edge of the road and/or regularly burned to prevent the accumulation of grass cover that could provide refuge for small mammals.
- Where roads traverse natural corridors such as streams and ridges, traffic control measures are recommended (e.g. 60km/h speed limits, speed traps, rumble strips and speed bumps).
- Where roads are associated with power lines and telephone lines (these provide an attraction for species that hunt from perches), road margins should be mowed and/or burned regularly to prevent the accumulation of grass cover that could provide refuge for small mammals.

10. CONCLUSIONS

I do not consider that the site provides habitats of particular importance to any bird species of conservation concern, other than patches of possible use to birds in transit. The more extensive grassland habitats might provide such habitat but are inevitably going to be significantly reduced if residential development proceeds. However, the drainage lines and associated features (springs, riparian vegetation, alluvial flats and wetlands), and the patches of forest-like woodland, are more restricted habitats that should be protected so that they can retain their function as important linear corridors or patches facilitating bird movements. Suggestions on how to delimit, protect and improve these restricted habitats are included together with their potential roles in assisting the development.

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- 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

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- 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), Honourary 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.

D: PART 4 HERPETOFAUNA

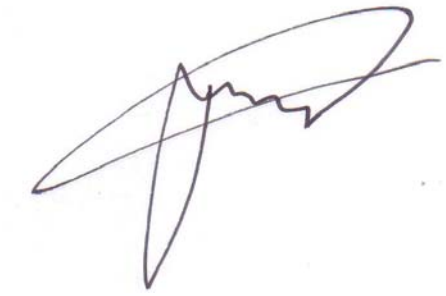
HERPETOFAUNA HABITAT ASSESSMENT OF THE REMAINDER OF THE FARM BOSCHHOEK 3345 NEWCASTLE, KWAZULU-NATAL

JCP VAN WYK MSc PrSciNat

DECLARATION OF INDEPENDENCE

I, Jacobus Casparus Petrus van Wyk, Id 6808045041084, declare that I:

- Act as an independent specialist consultant in the field of Zoology, specializing as a Herpetologist
- I am subcontracted as a specialist consultant by EcoAgent CC to assess the herpetofauna for the proposed project "Herpetofauna habitat assessment of the remainder of the Farm Boschhoek 3345 Newcastle, KwaZulu-Natal" described in this report
- I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work performed
- Have or will not have any vested interest in the proposed activity proceeding
- Have no and will not engage in conflicting interests in the undertaking of the activity
- Undertake to disclose to the client and the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2006
- Will provide the client and competent authority with access to all information at our disposal, regarding this project, whether favourable or not.



JCP van Wyk

SUMMARY

Of the 21 Red Data herpetofauna species of KwaZulu-Natal Province, only one species may occur on the site for the proposed development. The distribution of almost all of the other known Red Data species does not overlap with the study site. The soil composition on site consists mostly of clay, with the result that species that may occur in the area have no suitable habitat. There is almost no chance that the Striped Harlequin Snake may occur on the study site, because of the total absence of the moribund termitaria where this species is most likely to be found. The temporary manmade dams on the southern section of the study site are potential breeding habitats for Giant Bullfrogs. However, the clay soil of the surrounding areas and the lack of sand or loam soil, which giant bullfrogs need to migrate to for aestivation, resulted in their absence. The Sungazer Girdled Lizards also need mostly sand or loam soil for self-excavated burrows. This, and the almost total lack of termite mounds, at which they feed during the summer rainfall period, resulted in their absence on the study site. Only Spotted Shovel-nosed Frogs have been recorded in a nearby quarter degree. The study site provides the pans and marshy ground in grassland that this species requires.

1. INTRODUCTION

Eco-Agent CC was appointed to undertake a reptile and amphibian habitat survey for the Remainder of the Farm Bosch Hoek 3345 (elsewhere referred to as the study site), scheduled for residential development.

The objective was to compile a study on the herpetological fauna of the site, with special attention to Red Data species that occur or may occur on the site and their habitat requirements. This survey focuses on the current status of threatened herpetofauna species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

The objective was to compile a study on the herpetological fauna of the site, with special attention to Red Data species that occur or may occur on the site and their habitat requirements. This survey focuses on the current status of threatened

herpetofauna species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

2. OBJECTIVES OF THE HABITAT STUDY

The objectives of the study were to:

- assess the current status of the habitat component and current general conservation status of the property;
- highlight potential impacts of the development on the herpetofauna of the study site; and
- provide management recommendations to mitigate negative impacts and enhance positive impacts should the proposed development be approved.

3. SCOPE OF STUDY

This report:

- Is a survey of reptile and amphibian habitats, with comments on preferred habitats;
- Identifies and describes particular ecologically sensitive areas;
- Evaluates the conservation importance and significance of the site with special emphasis on the current status of resident threatened species;
- Offers recommendations to reduce or minimise impacts, should the proposed development be approved.

4. RATIONALE

As little as five decades ago, nature conservation was regarded largely as a luxury indulgence for developing societies. Then bio-conservation interests played a subservient role to development interests and capitalizing on natural resources (viz. uncontrolled or quasi-controlled harvesting of whales and hardwood forests). Naturalists and biologists were deemed harmless academics, spending tax money studying irrelevant trivia and not contributing to the national interests or fiscus.

The past 50 years has seen a major shift in emphasis as to how people exploit their expendable income and time. Enjoying nature in an infinite variety of options has become a major source of income. In South Africa, eco-tourism has become one of the greatest sources for earning foreign income. Locally, a variety of sub-economies evolved around our Great Outdoors, such as publications, off road vehicles, camping equipment, destinations in the Subcontinent, new careers (such as consulting, information, guiding, hunting, rentals, hospitality services). In short, pristine nature has developed a virtually incalculable monetary value.

It follows that measures are required to protect this National asset, and especially find manners in which a balance can be drawn between nature conservation and legitimate claims by the population for homes, transport and food (ex food production on farms).

In South Africa a number of acts (viz. 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 of 2004] and the National Environmental Management Act [Act 107 of 1998]: Environmental Impact Assessment Regulations, 2010: Environmental Management Framework Regulations, 2010 (Gazette No 33306 – Regulation 547)) call on and task developers (and by implication consumers), the scientific community and conservation agencies to minimise environmental impact. The Natural Scientific Professions Act (Act 27 of 2003) directs the conduct of natural scientists. Nowadays, a development prerogative is to precede new constructions by a multidisciplinary environmental investigation to assess the conservation costs. This is to ensure that best conservation practices are applied during the planning, construction and operational phases of new developments.

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
The Environmental Conservation Act, 1989 (Act No. 73 of 1989)
The National Environment Management Act, 1998 (Act No. 107 of 1998)
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

The National Forests Act, 2006 (Act 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062 , Cape Town, 8 Sept 2006.

The Natural Scientific Professions Act (Act 27 of 2003)

5. STUDY AREA

5.1 General

The study site is located on the Remainder of the Farm Boschhoek 3345, immediately south of an informal settlement for Newcastle, in KwaZulu-Natal Province. To the west, the site borders onto the P39-1 Road (Figure 1). The study site is 202 hectares in extent and lies in the quarter degree grid cell 2729 DD.

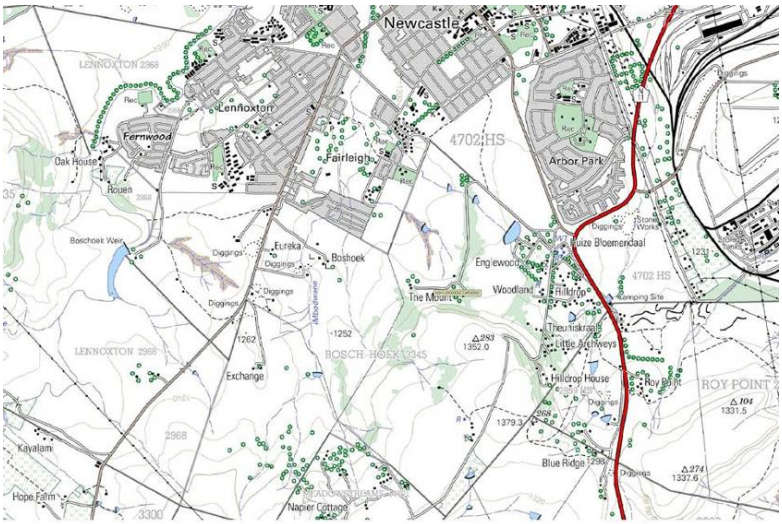


Figure 1: Locality map of the Boschhoek farm, south of Newcastle

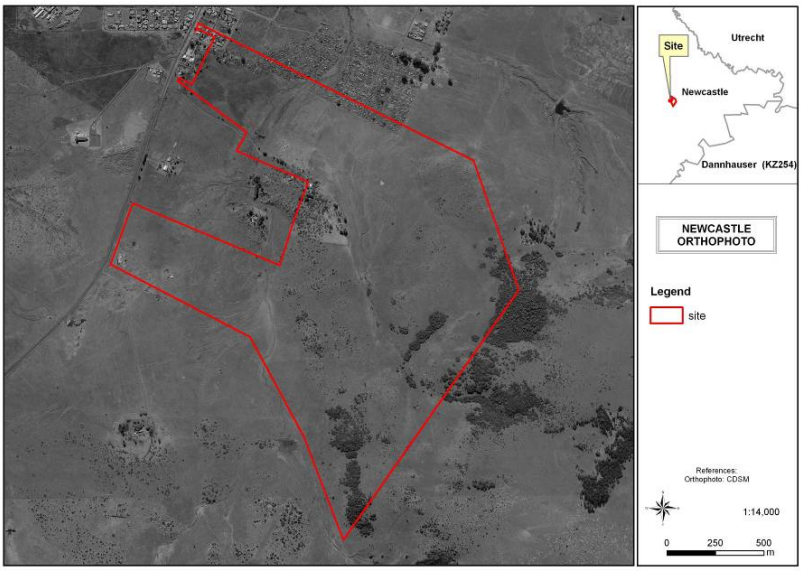


Figure 2: Orthophotograph of the study site.

Except for a few homesteads, the site is undeveloped and is presently used for grazing cattle. The site is composed of rolling grassland plains, rocky randjies, shrubs along the ridges, and aquatic and wetland habitat in and along the streams.

During the site visit, the grass cover was visually at the peak of its seasonal growth, which manifested itself in a dense and high stand growing on compacted brown soil imbedded with gravel and rocks.

An important feature of the study site is the two perennial streams that flow from south to north on either side of a low randjie.

At places, the western (iMbodwane) stream has been dammed, with reeds and bulrushes growing on the banks. Along the streams, wetlands have been formed at places. The basins of both streams consist of heavy clay. The eastern stream forms a wetland before flowing into the informal settlements north of the study site. In the southwest section of the study site, near the two informal dwellings, a number of small man-made diggings or quarries occur that are full of water.

Figure 3: Part of the western or iMbodwane Stream of the study site.

Figure 4: One of the man-made quarries on the study site, which creates excellent habitat for water-dependent herpetofauna.

South of the area, which does not form part of the study site (Figure 1), a rocky slope runs east towards the iMbodwane stream. From there, towards the east, lies a west-facing ridge with numerous indigenous trees. The rest of the study site consists of moist grassland.

Currently, the study site is used primarily for agricultural practices, like grazing cattle. It definitely has good agricultural potential for grazing.

Adjacent land to the south, east and west beyond the P39-1 Road are all used for cattle husbandry.

The following GPS coordinates spatially define the site:

Near the access gate near the quarry:	27º 47.396;S; 29º 54.734'E
At the base of the rocky slope north of the stream:	27º 47.430'S; 29º 54.986'E
At the dam in the northern perennial stream:	27º 47.451'S; 29º 55.112'E

5.2 Vegetation Types

The site is situated in Southern Tall Grassveld, as described by Acocks (1988), and Low & Rebelo (1996 &1998) described the vegetation of the area as Natal Central Bushveld. The site is floristically and topographically varied and falls in three veld types according to the new vegetation map of South Africa (Mucina & Rutherford 2006): Northern KwaZulu-Natal Moist Grassland (Gs 4), Northern KwaZulu-Natal Shrubland (Gs 5) and KwaZulu-Natal Highland Thornveld (Gs 6). The first veld type (Gs 4) consists of hilly and rolling landscapes supporting tall tussock grassland. The second veld type (Gs 5) consists of small dolerite koppies and steeper slopes or ridges with sparse grass cover. The third veld type (Gs 6) consists of hilly, undulating landscapes and broad valleys, supporting tall tussock grassland. The floral diversity and composition is discussed in an accompanying report.

6. METHODS

The site was visited by Prof GJ Bredenkamp (botanist), Dr A. Kemp (ornithologist), Dr IL Rautenbach (mammalogist) and Mr J van Wyk (herpetologist) on 5 March 2011. During this visit the observed and derived presence of reptiles and amphibians associated with the recognised habitat types of the study site were recorded. This was done with due regard to the well-recorded global distributions of Southern African vertebrates, coupled with the qualitative and quantitative nature of recognised habitats.

6.1 Field Surveys

During the site visits, reptiles and amphibians were identified by visual sightings through random transect walks. No trapping was conducted, as the terms of reference did not require such intensive work**.**

Three criteria were used to gauge the probability of reptiles and amphibian species occurring on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

6.2 Desktop Surveys

As the majority of reptiles and amphibians are either secretive, nocturnal, poikilothermic 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 accuracy irrespective of season.

The probability of the occurrence of **reptile and amphibian** 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 to the area, i.e. normally occurring at high population densities.

Medium probability pertains to a reptile or amphibian 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.

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

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 and Marais, 2007), A Guide to the Frogs of the Suikerbosrand Nature Reserve (Carruthers & Carruthers, 1979), Amphibians of Central and Southern Africa (Channing 2001), Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter, *et al*, 2004) and A Complete Guide to the Frogs of Southern Africa (Du Preez & Carruthers, 2009), a list of species which may occur on the site was compiled. The latest taxonomic nomenclature was used.

6.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of the 22 Red Data reptile and amphibian species in KwaZulu Natal Province (Alexander and Marais, 2007; Minter, *et al*, 2004 and Du Preez & Carruthers, 2009), such as:

- Spotted Shovel-nosed Frog (*Hemisus guttatus*);
- Natal Leaf-folding Frog (*Afrixalus spinifrons*);
- Pickersgill's Reed Frog (*Hyperolius pickersgill*);
- Long-toed Tree Frog (*Leptopelus xenodactylus*);
- Bilbo's Rain frog (*Breviceps bagginsi*);
- Whistling Rain Frog (*Breviceps sopranus*);
- Mistbelt Moss Frog (*Arthroleptella ngongoniesis*);
- Poyton's Caco (*Cacosternum poyntoni*);
- Striped Caco (*Cacosternum striatum*);
- Kloof Frog (*Natalobatrachus bonebergi*);
- Giant Bullfrog (*Pyxicephalus adspersus*);
- Plain Stream Frog (*Strongylopus wageri*);
- Natal Hinged Tortoise (*Kinixys natalensis*);
- Sungazer (*Gordylus giganteus*);
- Striped Harlequin Snake (*Homoroselaps dorsalis*);
- Yellow-bellied House Snake (*Lamprophis fuscus*);
- Setaro's Dwarf Chameleon (*Bradypodion setaroi*);

- Natal Midlands Dwarf Chameleon (*Bradypodion thamnobates*);
- Qudeni Dwarf Chameleon (*Bradypodion nemorale*);
- Gunther's Dwarf Burrowing Skink (Scelotes guentheri); and
- Breyer's Long-tailed Seps (*Tetradactylus africanus*).

7. RESULTS

7.1 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, rupiculous and wetland-associated habitat.

Noticeably absent from the study site are termitaria. The patches of indigenous trees and shrubs create a suitable habitat for arboreal reptiles and, due to the presence of indigenous and exotic trees on the study site, there are logs that could provide shelter and food for some herpetofauna.

Excellent natural rupiculous habitats are present on the study site at the ridge in the form of rocky outcrops and numerous scattered stones and rocks.

Good man-made rupiculous habitat exists in the form of buildings, ruins, graves and building rubble.

The natural grasslands of the study site are mostly transformed. The few remaining natural grasslands were heavily grazed in the past and are thus ecologically disturbed, but, at the time of the site visit, the basal cover was lush in some places and would provide adequate nourishment and cover for small terrestrial herpetofauna.

Figure 5: Part of the natural rupiculous habitat of the study site

There are two streams that flow from south to north through the study site, which provide water year-round for water-dependent herpetofauna. At places in the larger western (iMbodwane) stream has been dammed and throughout it contains fish, which include *Tilapia sparrmanii* (banded bream) and *Micropterus salmoides* (largemouth bass). The eastern stream forms an extensive wetland at the northern side of the study site.

Figure 6: A wetland area near the northern border of the study site.

The temporary small man-made diggings or quarries at the southwestern end of the study site provide excellent habitat for many frog species, due to the absence of fish predation.

Connectivity varies from fair to good and real opportunities for migration exist to the south and east of the study site. Informal settlements to the north of the study site influence the water quality and thus migration of water-dependent herpetofauna down steam.

Figure 7: A north-western view of the northern section of the study site. Note the informal settlements north of the study site in the background

7.2 Reptiles

The study site falls outside the natural range of the Natal hinged tortoise, yellow-bellied house snake, Setaro's dwarf chameleon, Natal Midlands dwarf chameleon, Qudeni dwarf chameleon, Gunther's dwarf burrowing skink and Breyer's long-tailed seps. Thus, these species should not occur on the study site.

The striped harlequin snake has not been recorded on this quarter degree square (TVL Museum Records and Branch, 1988) and no moribund termitaria (where this species is most likely to be found) were found on the study site. It is highly unlikely that this cryptic snake is present on the study site.

The sungazer or giant girdled lizard occurs marginally in the western parts of KwaZulu-Natal province (Branch, 1988). The majority of the study site consists of clay soil and there are almost no termitaria on the study site, except for very few small termitaria on a rocky outcrop. The sungazer needs mostly sand or loam soil for self-excavated burrows and, due to this habitat preference and the almost total lack of termite mounds, which sungazers need to consume large quantities of termites during the summer rainfall period, results in their absence on the study site.

7.3 Amphibians

The study site falls outside the natural range of the Natal leaf-folding frog, Pickersgill's reed frog, long-toed tree frog, Bilbo's rain frog, whistling rain frog, mistbelt moss frog, Poyton's caco, striped caco and kloof frog. These species should not occur on the study site.

The giant bullfrog has not been recorded on the quarter degree square of the study site (Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland [Miller *et al*. 2004]), but an old record (pre-1996) shows that the Giant Bullfrog was recorded in a quarter degree grid cell just south of the study site.

During our field study, several temporary man-made diggings or quarries, which giant bullfrogs prefer in order to avoid predation from fish, were observed on the study site. Breeding sites are very specific and only the shallow margins of temporary, rain-filled depressions are suitable. Giant bullfrogs need water bodies of which at least one side has a very gentle slope. A gentle slope allows for shallow water (less than 9cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise.

In order to develop rapidly, bullfrog tadpoles swim in schools and stay in the warm, shallow water during the day (Van Wyk *et al*., 1992). Most of these man-made diggings or quarry slopes are too steep for breeding.

Giant bullfrogs prefer sandy or loam soil, which is very suitable as a dispersal area and combines feeding and aestivation habitat. The majority of the study site consists

of clay soil, which is not ideal for aestivation and result in the bullfrog's absence from the study site.

The spotted shovel-nosed frog has been recorded in a nearby quarter degree grid cell [Newcastle (2729DB)] south of the study site (Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland [Miller *et al*. 2004]). That site provides the pans and marshy ground in grassland that this species requires.

Except for the informal settlement on the northern side of the study site and the P39-1 Road on the western border of the study site very few barriers might hinder frog movement.

7.4 Species list

Of the 40 reptile species that may occur on the study site (Table 1), three were confirmed during the site visit (Table 2) and of the possible 19 amphibian species that may occur on the study site (Table 1), four were confirmed during the site visit (Table 2).

Table 1 lists the reptiles & amphibians observed on or deduced to occupy the site. The American red-eared terrapin (*Trachemys scripta elegans*) is the only feral reptile or amphibian known to occur in South Africa (De Moor and Bruton, 1988), but with only a few populations, it is not expected to occur on-site.

The species assemblage is typical of what can be expected in a fairly natural environment, with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 1) are fairly common and widespread (viz. brown house snake, mole snake, common egg eater, puff adder, montane speckled skink, rock monitor, common platanna, guttural toad, raucous toad, red toad and Boettger's caco).

The relatively high species' richness is due to the presence of all four habitat types occurring naturally on the site, and the artificial creation of rupiculous habitats.

Table 1: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Branch (1998), Alexander and Marais (2007), Minter, *et.al* (2004) & Du Preez and Carruthers (2009).

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	**REPTILES**
	Order: TESTUDINES	**TORTOISES & TERRAPINS**
	Family: Pelomedusidae	**Side-necked Terrapins**
√	*Pelomedusa subrufa*	Marsh or Helmeted Terrapin
	Order: SQUAMATA	**SCALE-BEARING REPTILES**
	Suborder:LACERTILIA	**LIZARDS**
	Family: Gekkonidae	**Geckos**
*	*Pachydactylus vansoni*	Van Son's Thick-toed Gecko
	Family: Agamidae	**Agamas**
?	*Agama aculeate*	Ground Agama
√	*Agama atra*	Southern Rock Agama
	Family:Chamaeleonidae	**Chameleons**
√	*Chamaeleo dilepis*	Flap-neck Chameleon
	Family: Scincidae	**Skinks**
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Montane Speckled Skink
√	*Trachylepis varia*	Variable Skink
?	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink
	Family:Lacertidae	**Old World Lizards or Lacertids**

?	*Pedioplanis burchelli*	Burchell's Sand Lizard
?	*Nucras lalandii*	Delalande's Sandveld Lizard
	Family: Gerrhosauridae	**Plated Lizards**
?	*Gerhosaurus flavigularis*	Yellow-throated Plated Lizard
	Family: Cordyidae	
?	*Cordylus vittifer*	Transvaal Girdled Lizard
	Family: Varanidae	**Monitors**
√	*Varanus albigularis*	Rock Monitor
√	*Varanus niloticus*	Water Monitor
	Suborder: SERPENTES	**SNAKES**
	Family: Typhlopidae	**Blind Snakes**
?	*Typhlops bibronii*	Bibron's Blind Snake
	Family: Leptotyphlopidae	**Thread Snakes**
*	*Leptotyphlops conjunctus*	Cape Thread or Worm Snake
*	*Leptotyphlops scutifrons*	Peter's Thread or Worm Snake
	Family: Atractaspididae	African burrowing Snakes
?	*Aparallactus capensis*	Cape or Black-headed Centipede Eater
?	*Homoroselaps lacteus*	Spotted Harlequin Snake
	Family: Colubridae	Typical Snakes
√	*Lycodonomorphus rufulus*	Common Brown Water Snake
?	*Lycodonomorphus laevissimus*	Dusky-bellied Water Snake
√	*Lamprophis capensis*	Brown House Snake
*	*Lamprophis inornatus*	Olive House Snake
?	*Lamprophis aurora*	Aurora House Snake

?	*Lycophidion capense*	Cape or Common Wolf Snake
?	*Duberria lutrix*	Common Slug Eater
√	*Pseudaspis cana*	Mole Snake
?	*Amplorhinus mutimaculatus*	Many-spotted Snake
*	*Psammophylax rhombeatus*	Spotted Skaapsteker
√	*Psammophis crucifer*	Crossed Whip Snake
?	*Philothamnus natalensis*	Eastern or Natal Green Snake
?	*Philothamnus hoplogaster*	Green Water Snake
√	*Dasypeltis scabra*	Common or Rhombic Egg Eater
?	*Dasypeltis inornata*	Southern Brown Egg Eater
*	*Crotaphopeltis hotamboeia*	Herald Snake
	Family: Elapidae	**Cobras, Mambas and Others**
?	*Elapsoidea sunderwallii*	Sundevall's Garter Snake
√	*Hemachatus haemachatus*	Rinkhals
	Family: Viperidae	**Adders**
√	*Causus rhombeatus*	Rhombic Night Adder
√	*Brits arietans*	Puff Adder
	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**
?	*Hyperolius marmoratus*	Painted Reed Frog
√	*Kassina senegalesis*	Bubbling Kassina
?	*Semnodactylus wealii*	Rattling Frog
	Family Breviceptidae	**Rain Frogs**
*	*Breviceps adspersus*	Bushveld Rain frog
?	*Breviceps mossambicus*	Mozambique Rain Frog
	Family Hemisotidae	**Shovel-nosed Frog**
Vu?	*Hemisus guttatus*	Spotted Shovel-nosed Frog
	Family Phrynobatrachidae	**Puddle Frog**
*	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family Ptychadenidae	**Grass Frogs**
√	*Ptychadena porosissima*	Striped Grass Frog
	Family: Pyxicephalidae	
√	*Amietia angolensis*	Common River Frog
*	*Amieta fuscigula*	Cape River Frog
*	*Strongylopus grayii*	Clicking Stream Frog
√	*Cocosternum boettgeri*	Boettger's Caco or Common Caco
?	*Cocosternum nanum nanum*	Bronze Caco
*	*Tomopterna cryptotis*	Tremolo Sand Frog
√	*Tomopterna natalensis*	Natal Sand Frog

√ 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.

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 2: Reptile and Amphibian species positively confirmed from the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
Trachylepis punctatissima	Montane Speckled Skink	Sight record	On rocks and on wall of house
Agama atra	Southern Rock Agama	Sight record	Under rock
Pelomedusa subrufa	Marsh Terrapin	Sight record	In small dam
Amietia angolensis	Common River Frog	Sight record	Along small dam and stream
Xenopus laevis	Common Platanna	Sight record of adults, juveniles and tadpoles (Gosner stage 35 - 45) [Gosner, 1960]	In numerous small dams
Kassina senegalensis	Bubbling Kassina	Sight record of juvenile and tadpoles (Gosner stages 31 - 35 [Gosner, 1960]	Juvenile under building rubble and tadpoles in small dams
Ptychadena porosissima	Striped Grass Frog	Sight record	Along grass banks of stream

None of the species listed in Table 2 is rare.

8. FINDINGS AND POTENTIAL IMPLICATIONS

8.1 Impact Assessment

It is accepted that residential development is unavoidable. Therefore, an extension of the existing Newcastle suburbia is considered as the best-case scenario.

In the final decision of where to situate the development, it is recommended that it should be on the grassland areas (terrestrial habitat). This implies that terrestrial herpetofauna will be displaced. The rocky ridges and the streams with their wetlands are deemed as sensitive and are therefore excluded from any form of development or disturbance. Should the proposal that the rocky ridges are deemed as sensitive and excluded from development be accepted, it should benefit the rupiculous and arboreal reptile species.

The proposed mitigation measures also address storm water runoff, which, if left unattended, could cause damage to the wetland systems. Wetland systems are ranked as very sensitive and will thus require special intervention, which is addressed under 8.2 below.

The statement in the above paragraph takes it for granted that effective measures will be taken to prevent pollution of water resources embodied in drainage lines, the two streams, or any other body of water.

The protection of wetlands or watercourses on the study site should be a priority. Many reptile and amphibian species are dependent on water sources and their surrounding areas for breeding and foraging. The only red data listed frog species that might occur on the site is the Spotted Shovel-nosed Frog (*Hemisus guttatus*). If it occurs on the study site and the water sources and their surrounding areas are protected it can also be safely protected.

If the intended development adheres to the mitigation measures below, even an improvement can be made to some habitat units, for example the quarries.

8.2 Potential Impacts

Loss of exotic species, declared weeds and invader plants

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Decrease of exotic plants and weeds	Wetland systems and ridges	Medium-term	Probable	Low	Low

From a conservation perspective, reducing the alien trees and plants will be advantageous, especially in an area with a high herpetofauna richness profile. However, it should be kept in mind that alien invaders are robust plants with variable habitat requirements, and it is quite likely that some aliens will strengthen their hold on the system, especially if the ecosystem is further disturbed. If exotics happen to be high consumers of water (viz. wattles), it will be even more detrimental to the streams and wetlands.

Loss of ecological sensitive and important vegetation units

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Riparian zones	Stream systems	Long term	High	High	High

Artificially induced fluctuating water levels will be amplified and will result in undue erosion and damage to wetlands. In addition, water contamination of wetlands and streams ex storm water flowing from hard surfaces will result in severe damage to the ecosystems within the riparian zones on the site and further downstream. As such, it will deleteriously affect connectivity, species' richness and diversity, food chains and breeding success / cycles.

Loss of ecosystem function (e.g. reduction in water quality, soil pollution)

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Damage to ecosystem function	Stream systems	Long-term	High	High	High

Predicting the effect of chemical and sediment contamination of the wetland and stream systems is largely speculative, and will require a more comprehensive overview. However, it is anticipated that contaminants and sediments deposited on hard surfaces will wash into the streams, unless the proposed mitigation measures are accepted.

Loss of faunal habitat

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Loss of faunal habitat	Stream systems	Long-term	High	High	High

A reduction in water flow / cessation of flow or of flush floods of the site will inevitably result in damage to the wetlands in the riparian zones. This in return will cause a quantitative and qualitative reduction in the life-support systems (habitats) of animals. It is predicted that damage to the wetland systems will have a cumulative effect on faunal diversity and richness.

Loss/displacement of threatened or protected fauna

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Loss of species	Stream systems	Long-term	High	High	High

Given a significant damage to wetlands caused by a decreased water flow or the scouring effect of flush floods, a decrease of population densities can be expected because of concomitant decreasing life-support systems. If decreased natural availability of water is prolonged or water is contaminated, the possibility of local species' loss must be curtailed, and that more unacceptable effects such as a cumulative loss of inter-reliant species may follow.

8.3 Impact Assessment Summation

	High	Medium	Low
Extent / Spatial Scale of Impacts	X		
Intensity / Severity of Impacts	X		
Duration of Impacts	X		
Magnitude and Significance of Impacts	X		

9. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

EcoAgent CC is committed to conservation of biodiversity but concomitantly recognises the need for economic development. Whereas we appreciate the opportunity to learn through the processes of constructive criticism and debate, we reserve the right to form and hold our own opinions and therefore will not willingly submit to the interest of other parties or change statements to appease them.

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 become known at a later stage. Eco-Agent CC 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.

10. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist.

- Should any spotted shovel-nosed frog or other herpetological species be encountered during the development, these should be relocated to natural areas in the vicinity.

- The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Alien and invasive plants must be removed and indigenous trees should be planted to provide habitat for arboreal reptiles.
- If the development should go ahead, an important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality, but the effects could be ameliorated by the construction of retention ponds, which would retard discharge into the two streams and thus improve the water quality of the discharge.
- All draining lines, wetlands and artificial water bodies must be protected and even improved, for example the quarries at the southwestern side of the study site.
- Artificial wetlands/dams can be constructed for this runoff water to help create a habitat for water-dependent herpetofauna.

11.CONCLUSIONS

Of the 21 Red Data herpetofauna species of the KwaZulu-Natal Province, only one species may occur on the site for the proposed development. The spotted shovel-nosed frog has been recorded in a nearby quarter degree grid cell to the study site, where the site provided the pans and marshy ground in grassland that this species require.

From a herpetological perspective, one assumes that the 50m buffer zone for both streams within the urban edge will be implemented. The ridge area between the two streams should be included as far as possible within a green area or buffer zone. This will help with conductivity between the two streams, migration of species and habitat diversity. This will also improve the visual value of the proposed development and stability of the slope.

The man-made diggings or quarries in the south-western section of the study create suitable habitat for herpetofauna on the proposed site. Any development must try to

keep some of these temporary water bodies and may even try to improve the quality of this habitat.

Due to animal migration, it is vital for the adjacent properties to adopt a parallel management policy, for example along the southern border from where the streams enter the study site and the ridges to the east.

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Notable Research Contribution In-depth field study of the giant bullfrog

Notable Activities Field excursions for learners

Formal Courses Attended Outcomes Based Education, University of the Witwatersrand (2002)
Introductory Evolution (2008)
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Employment history

2000 – Present Co-Department Head for Environmental Education & Life Sciences, Waterkloof High School, Pretoria.

1995 - 1999 Teach biology (Grades 8 – 12) and physics / chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties include 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 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

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