SABIE GORGE NR 4 CC

DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE PROPOSED TOWNSHIP ESTABLISHMENT AND ASSOCIATED INFRASTRUCTURE ON PORTION 2 OF THE FARM COOYONG 1100-LS, HAENERTSBURG, LIMPOPO PROVINCE

REF: 16/1/7/1p-M2

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Contents

APPENDICES	
Appendix A:	Maps
Appendix B:	Site photographs
Appendix C:	Application form, LDEDET acknowledgement of receipt of application form, and LDEDET acceptance of Environmental Scoping Report
Appendix D:	Advertisement of commencement of EIA process and of Public Meeting
Appendix E:	Background Information Document and Comment and Registration Sheet
Appendix F:	I&AP and stakeholder correspondence :
Appendix G:	Public meeting – 17 July 2007
Appendix H:	Focus Group Meeting, DWA – 11 September 2007
Appendix I:	Ecological assessment report (AGES, 2007)
Appendix J:	Specialist vegetation assessment (Eco-Agent, 2008)
Appendix K:	Specialist faunal assessment (Faunal Specialists Incorporated, 2008)
Appendix L:	Specialist amphibian assessment (L Minter, 2008)
Appendix M:	Specialist reptile assessment (Bateleur Environmental Services, 2011)
Appendix N:	Phase 1 and 2 Heritage Impact Assessments (Stephan Gaigher)
Appendix O:	Phase 1 Engineering Geological Investigation (Mark Down Geoconsulting, 2007)
Appendix P:	Geohydrological investigation (Moonlight Enviro)
Appendix Q:	Slope stability investigation (Prof Louis van Rooy, 2012)
Appendix R:	Report on sewerage options (WSM Leshika, 2009)
Appendix S:	Advertisement of availability of Draft Environmental Scoping Report for public comment
Appendix T:	Advertisement of availability of Draft Environmental Impact Report for public comment
Appendix U:	Environmental Management Plan

ABBREVIATIONS	
AS	Audio Survey
BID	Background Information Document
CITES	Convention on the International Trade in Endangered Species
COD	Chemical Oxygen Demand
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMP	Environmental Management Plan
ESR	Environmental Scoping Report
FS	Factor of Safety
FROHG	Friends of the Haenertsburg Grasslands
GPS	Global Positioning System
GTM	Greater Tzaneen Municipality
Ha	Hectare
HADEF	Haenertsburg Development Forum
HEMAG	Haenertsburg Environmental Monitoring and Action Group
HIA	Heritage Impact Assessment
I&AP	Interested and/or Affected Party
IUCN	International Union for the Conservation of Nature
LDEDET	Limpopo Department of Economic Development, Environment and Tourism
LEMA	Limpopo Environmental Management Act
LLDPE	Linear low-density poly-ethylene
MTA	Magoebaskloof Tourism Agency
NEMA	National Environmental Management Act (1998)
NEMBA	National Environmental Management: Biodiversity Act
NEMWA	National Environmental Management: Waste Act (2008)
NWA	National Water Act (1998)
PET	Primary Effective Toilet
PT	Pitfall Trap
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
VES	Visual Encounter Survey
VIP	Ventilated Improved Pit latrine
WESSA	Wildlife and Environment Society of South Africa
WUL	Water Use Licence
WULA	Water Use Licence Application

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- BSc Environmental sciences – *cum laude* (University of Pretoria)
- Certificate: Implementation of Environmental Management Systems (North-West University, Potchefstroom campus)
- Courses: Water Use Authorisation (2012); Project Management (2010); Environmental Law (2009)

APPLICANT

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1. INTRODUCTION AND PROJECT DESCRIPTION

1.1. Introduction

Polygon Environmental Planning CC has been appointed by Sabie Gorge Nr 4 CC to conduct an Environmental Impact Assessment (EIA) for the proposed establishment of a mixed-use township and associated infrastructure on part of Portion 2 of the farm Cooyong 1100-LS, Haenertsburg, in the Mopani District of the Limpopo Province.

This draft Environmental Impact Report (EIR) is hereby made available for review and comment by registered Interested and/or Affected Parties (I&APs) and members of the general public. Following the comment period, which extends until 6 November 2012, all comments will be incorporated into the final EIR, which will then be submitted to the Limpopo Department of Economic Development, Environment and Tourism (LDEDET) for review and decision-making.

1.2. Project description

The proposed project, on a site of 12,6421 ha in extent, entails township establishment and associated service infrastructure. The following components are proposed to form part of the development (please also refer to the proposed layout map – Appendix A):

- Residential use:
  - 32 single-dwelling erven of 858 – 1 369 m^2 in extent, with a zoning of Residential 1.
  - 28 single-dwelling erven of 541 – 909 m^2 in extent, with a zoning of Residential 1.
  - 2 erven to cover a total area of approximately 5 873 m^2 in extent, earmarked for townhouses, with a zoning of Residential 3. Density is proposed to be one unit per 250m^2.
  - The existing overnight chalets are proposed to form part of a stand of 2 987 m^2, to be zoned as Residential 3.
  - 1 stand to be zoned as Residential 4, for frail-care facilities for elderly persons. The facility is proposed to resemble the frail-care unit at Macadamia Village in Tzaneen, and to be no more than two storeys high.

- Business use:
  - 14 erven to cover a total area of approximately 23 002 m^2 in extent, earmarked for businesses aimed mainly at the tourist market, such as restaurants. Zoning is proposed as Business 3.

- Private Open Space:
  - A conservation area extending over an area of approximately 12 911 m^2 is proposed around the 1:100 year flood line of the watercourse on the site. The drainage line is considered to be ecologically sensitive and may not be developed.

- Infrastructure:
  - Internal roads with a road reserve width of between 10 m and 13 m.
  - Calcamite wastewater treatment system due to the lack of municipal sewerage disposal and treatment infrastructure. Installed annual throughput capacity will exceed 15 000 m^3.
  - Water, sewerage and electricity reticulation.

The existing structures on the property consist of chalets as well as an historic building which has been converted to a private dwelling. Although the chalets and historic building form part of the township establishment and re-zoning application, no development is proposed on those sections of the site. These structures and the land on which they are situated will remain the property of the current owner of the whole of Portion 2 of Cooyong, whilst the rest of the property has been purchased by the applicant for the development of the proposed township. The chalets are proposed to continue to be operated as overnight accommodation, as is currently the case, and the historic building will be occupied by the owner as a private dwelling.

Access is proposed to be from the R71 (Tzaneen/Polokwane road) in the same position as the existing access. The access is proposed to be upgraded to meet the requirements of the South African National Roads Agency (SANRAL).

Water is proposed to be supplied by Lepelle Northern Water and electricity by the Greater Tzaneen Municipality. There are currently concerns with regards to the capacity for the bulk provision of water and electricity. Development is proposed to proceed only once confirmation has been given by the relevant service providers that there is sufficient capacity to accommodate this proposed development.

For a detailed description of the functioning of the proposed Calcamite wastewater treatment system, please refer to Section 2.4.5 of this report.

Solid waste is proposed to feed into the municipal waste stream. A waste transfer station is proposed to be established by the GTM at or near the site, from which solid waste can be collected at regular intervals. (The establishment of such a transfer station does not form part of this application).

1.3. Site description

The proposed development site, a part of Portion 2 of the farm Cooyong 1100-LS, is 12 6421ha in extent and is mostly vacant, containing only a private dwelling (an historic building which has been converted) and a small number of chalets that are rented out as overnight accommodation, along with gardens and a swimming pool which are associated with the chalets. The open, undeveloped portion of the site is proposed to be developed.

The site can be accessed via an existing access from the R71 (Tzaneen-Polokwane road), which is paved up to the chalets, after which it is a gravel road.

The portion of the property which is proposed to be developed was previously used for timber production in the form of pine plantations. Although pine is no longer commercially produced on the property, vegetation on that section of the property is significantly degraded and pine trees have re-grown on a large section of the site (please refer to the chapter on Vegetation).

Topographically, the proposed development site consists of a very steep southeast-dipping hill with a small ridge running east-to-west through the site. The general slope angle is between 20° and 30°. A drainage channel is situated in the southern section of the property, which drains southward onto the Remainder of the farm Cooyong by means of a culvert underneath the R71 road which separates these two properties. A drainage line not forming part of the proposed development site is also situated directly to the west of the site.

2. INVESTIGATION OF ALTERNATIVES

2.1. Project Alternatives

2.1.1. Project Alternative A: Forestry

The site was previously used for forestry, and the option existed of continuing this use. This alternative was, however, not considered financially viable by the applicant.

2.1.2. Project Alternative B: Township establishment

The proposed mixed-use development, comprising both residential and commercial land uses, is viewed by the applicant as the only financially viable development option for this property, due to the high capital cost of development of the site. The proposed project is described in Section 1.2 above.

2.2. Site Alternatives

No site alternatives were investigated. The proposed development site forms the northernmost boundary of the demarcated tertiary node of Haenertsburg (Jamela Consulting, 2008), and the other undeveloped properties falling within the demarcated area are already proposed to be developed for residential purposes by other developers. The remaining undeveloped land within the demarcated area consist of sensitive vegetation in the form of Woodbush Granite Grassland (Mucina & Rutherford, 2006), colloquially known in the area as the "Haenertsburg grasslands", and are therefore unsuitable for development. This proposed development site, Portion 2 of the farm Cooyong 1100-LS, was therefore selected by the project proponent as the only suitable available site around Haenertsburg.

2.3. Layout alternatives

Two layouts were investigated, both of which consisted broadly of business and residential land use together with a conservation area. The layout is constrained by the following factors:

- Steep slope;
- Existing facilities (overnight chalets and dwelling);
- Drainage line which cannot be developed;
- Internal streets have to be laid out in such a manner that they can serve as main storm water conduits because of the steep slope of the site;
- The access was determined both by the existing entrance and the fact that SANRAL will not give permission for the entrance at another point, due to issues of visibility and providing a safe access point;
- Road reserve and building line restriction along the existing R71 road;
- Need for business stands to be situated close to the entrance;
- Existing Eskom transmission power lines and servitudes along the northern and eastern boundaries of the property;
- Aesthetic concept – a "village" atmosphere with low density development is envisaged in keeping with the aesthetic of the existing Haenertsburg village.

The figures overleaf give an indication of the two layouts which were investigated.

Figure 2.1: Layout Alternative A (rejected due to slope stability concerns)

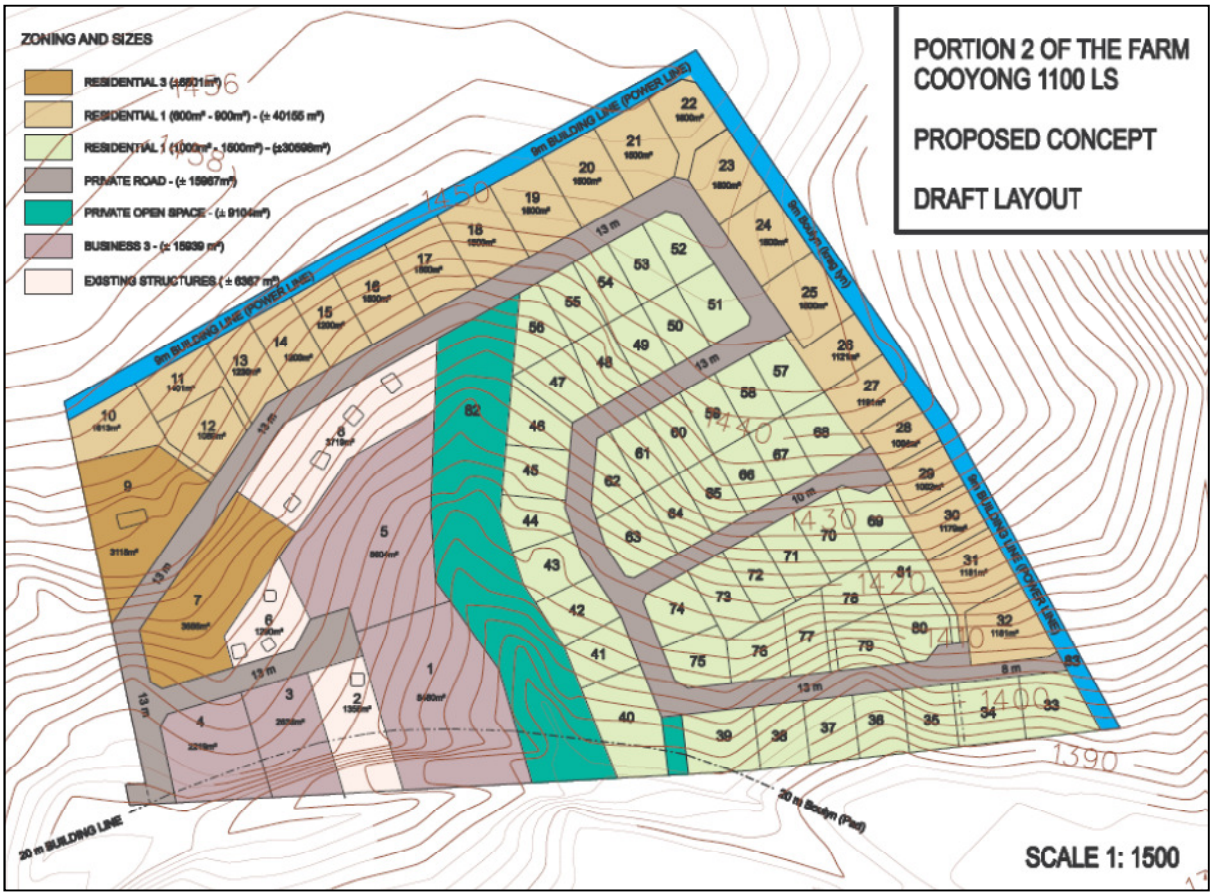
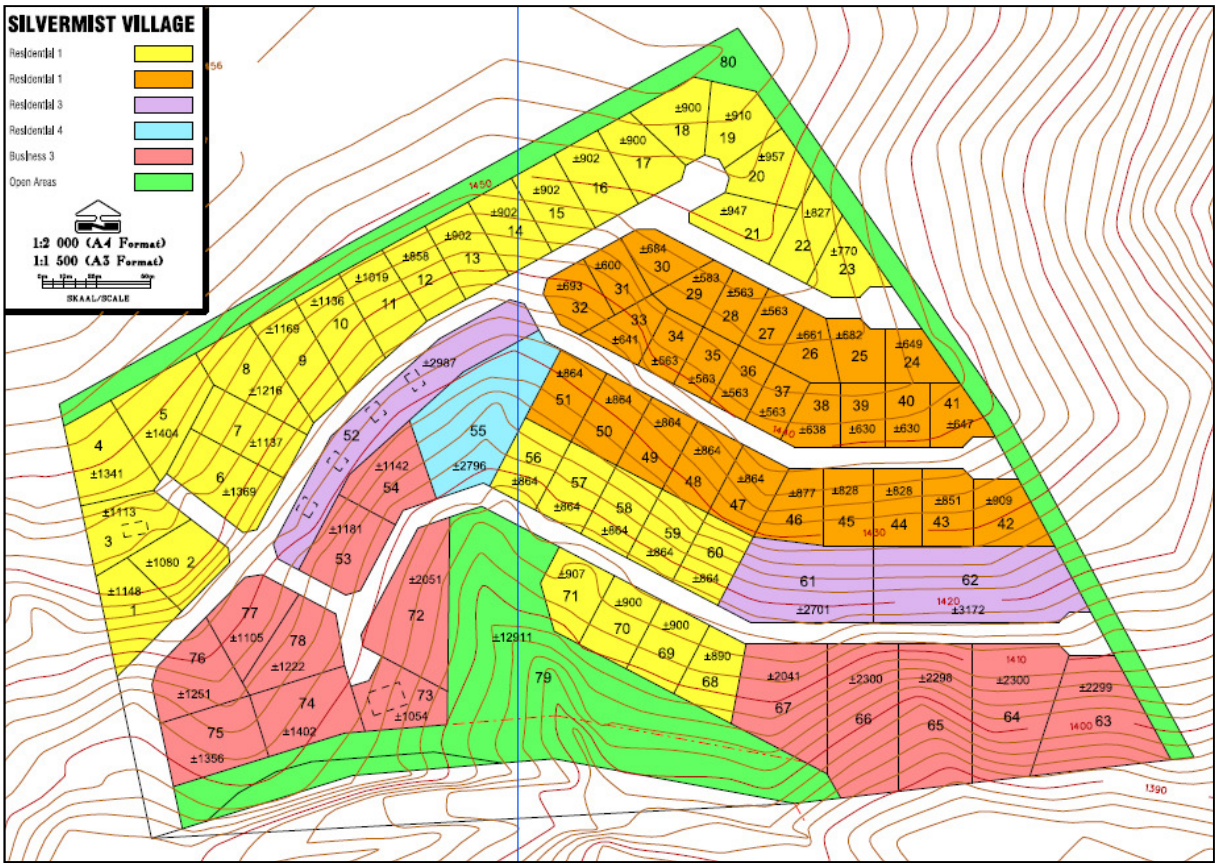


Figure 2.2: Layout Alternative B (preferred option)



Layout Alternative A has been rejected due to slope stability risks in the eastern portion of the site. At the recommendation of the relevant specialist (Prof JL van Rooy of the University of Pretoria) the layout has been amended so that internal streets in the eastern part of the site will align with the contours, reducing the risk of soil slip / slope failure. Prof Van Rooy has indicated that he is satisfied with ***Layout Alternative B***, which was developed in response to his slope stability report.

2.4. Alternative Sewerage Treatment Facilities

The following alternative sewerage options were assessed by WSM Leshika in their report on sewerage options for the proposed development (Appendix R) and the information in this section was obtained from said report. The concern with the implementation of a sewer system is to preserve the environment and to avoid the pollution of the groundwater and the surface water in the drainage line on the property, which is a feeder source to the Ebenezer Dam.

2.4.1. Sewerage Alternative A: Waterborne sewer reticulation

A full waterborne sewer system consists of a network of sewer pipes through which the sewage gravitates to the lowest point of a development, from where it should either be connected into a main sewer outfall pipeline, a tank from where the sewage shall be pumped to a purification plant or an oxidation pond system to be designed to ensure that the sewage eventually discharged into natural streams is meets the effluent quality standards set by the Department of Water Affairs (DWA).

This system was not investigated further because of the lack of a municipal sewer outfall pipeline, and because an oxidation pond system is not considered appropriate for this development, due to visual impacts, possible smells in case of malfunction, and because of the risk of overflowing in high rainfall conditions and subsequent potential pollution of water resources. A closed system is preferred, such as the systems described below.

2.4.2. Sewerage Alternative B: Conservancy tanks

This option entails the installation of a conservancy tank with a suction coupling at each stand. The local authority would then periodically empty the tank for treatment of the contents at the municipal sewerage treatment plant. However, the GTM does not render a support service to cater for the septic tank system within Haenertsburg, and this option is therefore not considered viable.

2.4.3. Sewerage Alternative C: Septic tank with French drain on each stand

In Haenertsburg, each stand is served by a septic tank and french drain system, due to the lack of water-borne sewerage infrastructure in the area. However, due to the risks that this type of sewerage poses in terms of potential contamination of surface and groundwater resources, this type of system is not considered appropriate for implementation in this proposed development.

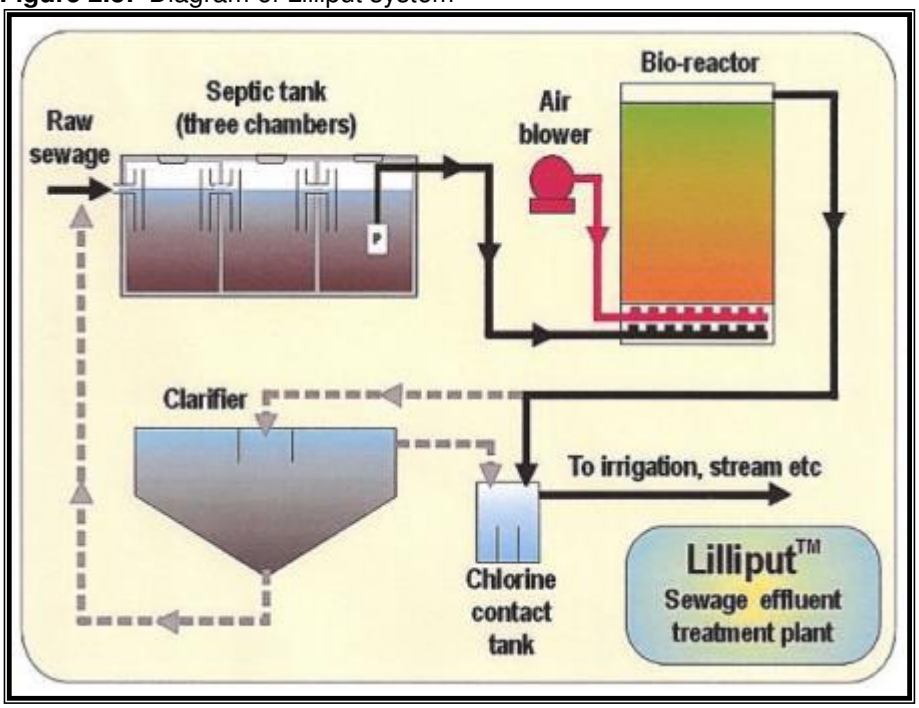
2.4.4. Sewerage Alternative D: Lilliput system

The Lilliput system allows for the pre-treatment of all waste water in an anaerobic, redigestion environment and is similar to the Calcamite system, which is discussed in more detail in 2.4.5.

The Lilliput system functions as follows: raw sewage is pre-digested in a septic tank (or in the case of the full kit plant, in Lilliput tanks) by anaerobic bacteria which convert most of the complex organic matter into simple but toxic chemicals. The solution produced is pumped into the Bio-reactor, which contains randomly packed media. Air is introduced and aerobic bacteria oxidize the harmful, malodorous chemicals, converting them to safe, clean salts. At times of surge flow, excess effluent is returned to the septic tank to ensure complete treatment. If discharge is other than to irrigation, a clarifier is used to extract excess solids and return to the septic tank. The final stage of treatment is disinfection, which ensures that any pathogens are removed.

The following diagram illustrates a typical Lilliput system.

Figure 2.3: Diagram of Lilliput system



Typically, the sewage from the septic tank is pumped at a constant rate to the Lilliput Bioreactor. The effluent enters the bio-reactor below the fixed-growth media where it mixes with an air diffuser. The effluent then rises through the media where the microbial population attached to the media removes and aerobically degrades the organic material contained in the aerated effluent. A degree of nitrification takes place in the upper layers of the media. Once it has passed through the media, the treated effluent – which meets DWA's requirements for the discharge of treated effluent to water sources – is pumped through a disinfecting contactor and discharged to the garden for irrigation.

The Up-flow Submerged Reactor aerobic biological treatment unit is based on the Submerged Fixed Film principle. The plant utilises random-packed biofilter media which has a high surface to volume ratio to permit a high biomass-density. The units would be established above ground, but may be camouflaged as for instance a rock water feature. The reactor would be constructed of linear low-density poly-ethylene (LLDPE).

The plants do not require continuous supervision and no maintenance. All pumps are sealed units rated for continuous use. The chlorine disinfection unit should be topped up with chlorine intermittently to ensure optimum efficiency. All mechanical / electrical components are readily available off the shelf from local shops. All plant and equipment is supplied in non-corrosive or corrosive protected material. As the entire plant can be

constructed above ground, the necessity for extensive earth works and civil requirements is curtailed. However, the above-ground units may be unsightly.

Two options exist when installing a Lilliput system: either a Small Plant or a Large Plant can be installed.

Lilliput Small Plant: The small plants could be used in the proposed development for treatment of domestic sewage from the septic tank of a single house unit. The treated effluent would then be discharged to the garden for irrigation. Disinfection would be achieved by in-line chlorination or ozonation of the treated effluent (WSM Leshika, 2009).

Lilliput Large Plant: The large plants are designed to treat domestic sewage from a cluster of housing units across the development spectrum to include townships and cities. The treated effluent is discharged to garden for irrigation, or to rivers, streams, dams or storm water systems.

The range can incorporate all their components into a single unit such as containerised applications or in modular form to suit topographical and/or aesthetic requirements. Modular components can, for instance, be arranged in such a way as to promote the use of gravity, particularly where electricity is not available.

A bio-enhancing catalyst material may be introduced to increase the rates and degree of biodegradation of solids in the septic tank, thereby reducing sludge production and extending the intervals between de-sludging. It also reduces the negative impact of kitchen wastes such as cooking oil. Chemical Oxygen Demand (COD) removal in the septic tank is enhanced and general plant performance is enhanced, particularly in periods of abnormal load peaking.

For the purpose of this development, two large plants would most likely be required, depending on the final design. The placement would be at the two lowest sites within the property and this will have the effect of taking up space from the planned stands. Should the Lilliput system be installed, clusters of stands would most likely share bio-reactors, instead of small plants being installed on each and every stand.

*2.4.5. Sewerage Alternative E: Calcamite system **(preferred option)***

The Calcamite system is similar to the Lilliput system described above. The main difference lies in the fact that Lilliput tanks / reactors are generally installed above ground, whilst the Calcamite system is placed below ground, with less visual impact than an above-ground installation. A tank can be installed at each stand, or a Biomite treatment system can be provided for several stands combined.

The Biomite system is a package treatment plant that produces treated effluent that can be discharged to a natural watercourse or through surface irrigation, as it complies with the strict environmental water quality requirements stipulated by DWA.

Different Calcamite tank sizes are available and the size to be installed will depend on the final design flow volumes. The sizes available are 1 500 litres, 3 000 litres and 5 400 litres. The following diagrams illustrate the different units which can be used at single housing unit level.

Figure 2.4: Calcamite System at Single Housing Unit (Level 3)

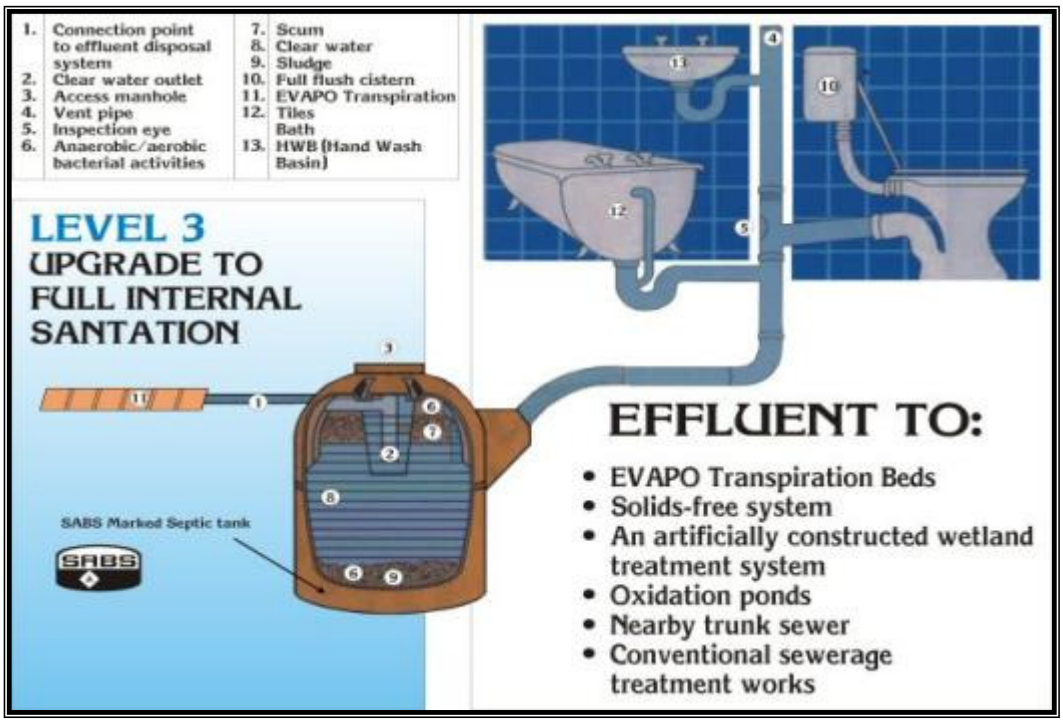
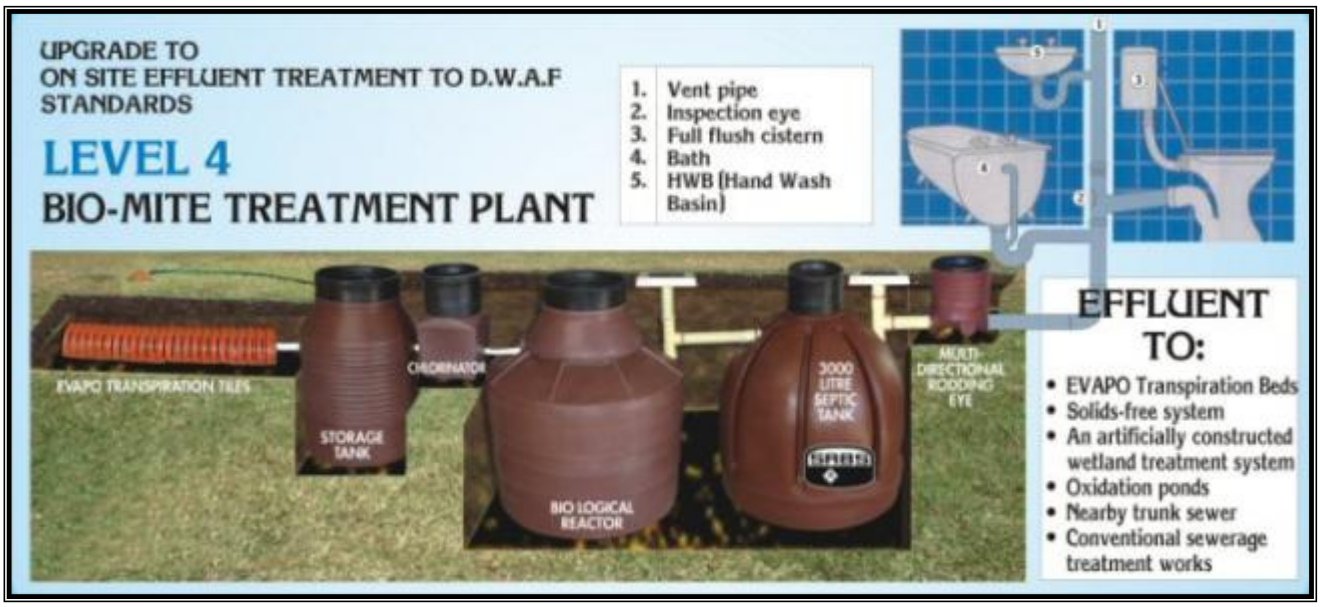


Figure 2.5: Calcamite System at Single Housing Unit (Level 4)



The Bio-Mite treatment plant, which can be used for clusters of homes, incorporates a biological process to clean waste water that flows from the septic tank. In this process a biomass of bacteria break down biodegradable waste and convert it into carbon dioxide and water. Any non-biodegradable matter collects at the bottom of the tank and is periodically removed in the same way as the septic tank is pumped out. The biomass is a colony of self-regenerating bacteria that will survive as long as they have a suitable food source (the waste) and a comfortable environment (sufficient oxygen and no harsh chemicals).

The septic tank provides the food source and the Bio-Mite the comfortable environment. Inside the Bio-Mite is a matrix of plastic media upon which the slimy bacteria cling. As the waste water circulates through the media

food is delivered to the bacteria. A powerful air blower aerates the waste water, introducing oxygen into the system and ensuring that the waste stream is continuously circulated through the media.

If effluent is to be used for irrigation, it will be necessary to chlorinate the waste stream in order to kill off any pathogenic organisms that may be present at that point. This is done in the specially constructed chlorination capsule provided for this purpose.

Figure 2.6: Calcamite Domestic Waste Water Treatment.

The Calcamite treatment system is considered the **preferred alternative** for this proposed project, because of the following:

- The quality of the treated effluent meets the standards set by DWA;
- The system requires little maintenance;
- The full installation is also underground and will therefore not be visible as would be the case with the Lilliput treatment system;
- It is a closed system holding very little risk of contamination of the natural groundwater source. The system will be designed as a sealed unit to prevent the contamination of the groundwater on the site. All couplings will be properly sealed and the septic tanks will be installed in accordance with the supplier's instructions ensuring no damage to the tanks, therefore ensuring no leakages from the tanks. Calcamite have SABS, British and European certification of their septic tanks, indicating that the system is designed to very high standards.

It is proposed that a Bio-Mite treatment plant be installed to serve the single residential stands, and a separate plant to serve the cluster housing and business stands. The plant to serve the single residential erven is proposed to be installed on a stand set aside for this purpose and on which a servitude will be registered. The system will not be visible; the stand will simply appear as a vacant, landscaped stand. The plant serving the cluster housing is to be installed on a designated portion of the proposed Residential 3 stand, which will also be landscaped.

Treated effluent may be distributed to the stands via a pipe network with a tap at each stand so that the individual gardens, not only the communal landscaped areas, can be irrigated with this recycled water to reduce the dependence of the proposed development on potable water provided by Lepelle Northern Water.

2.5. No-go Alternative

The 'no-go' alternative refers to the scenario in which the proposed activity does not take place and the site remains as it is.

If the no-go alternative is taken, the impacts that can be anticipated to be associated with the proposed development would not come to pass and the conditions and trends on the property can be expected to remain as per the status quo. Impacts that can be expected to be experienced in case of the no-go alternative being selected, include the following:

Table 2.1: Potential impacts associated with the no-go option

	POTENTIAL IMPACT	STATUS	EXTENT	MAGNITUDE	LIKELIHOOD	SIGNIFICANCE
BIO-PHYSICAL MPACTS	No increased trapping of smoke by temperature inversion layer (winter)	Neutral	Local	Low	Highly probable	Low
	No increased risk of erosion and sedimentation of drainage line – construction phase	Neutral	Local	Medium	Highly probable	Medium
	Long-term rates & trends of soil erosion and sedimentation of drainage line remain unchanged	Neutral	Local	Low	Highly probable	Low
	No alteration of topography or drainage regime	Neutral	Local	Low	Highly probable	Low
	Risk of soil instability / soil slip remains unchanged	Neutral	Local	Low-medium	Highly probable	Low
	No increase in risk of groundwater or surface water pollution by sewage	Neutral	Sub-regional	Unknown	Highly probable	Medium
	No loss of agricultural / forestry land	Neutral	Local	Low	Highly probable	Low
	No structured, long-term programme for eradication of alien invasive vegetation	Neutral	Local	Medium	Highly probable	Medium
	No added fire risk	Neutral	Local	Unknown	Highly probable	Low
	No reduction in the undeveloped area available as habitat for fauna and flora	Neutral	Local	Medium	Highly probable	Medium
	No rehabilitation of the flood line area / wetland	Neutral	Local	Medium	Highly probable	Medium
	No contribution to conservation of	Neutral	Local	Medium	Definite	Medium

	sensitive grassland					
	No additional introduction of alien plants into gardens	Neutral	Local	Medium	Highly probable	Medium
	No habitat destruction and/or fragmentation	Neutral	Local	Medium-high	Definite	Medium-high
	No killing or disturbance of fauna by construction-related activities	Neutral	Local	Low-Medium	Highly probable	Low - Medium
	No long-term faunal road fatalities within the development	Neutral	Local	Low-Medium	Highly probable	Medium
	No improvement of habitat for *Breviceps sylvestris* in gardens	Neutral	Local	Low-Medium	Highly probable	Low-Medium
SOCIO-ECONOMIC IMPACTS	No job creation or supporting of local businesses through local procurement of labour, materials, equipment & services (construction phase)	Neutral	Local	Medium	Definite	Medium
	No influx of job-seekers into Haenertsburg	Neutral	Local	Low	Highly probable	Low
	No increase in trespassing or criminal activity	Neutral	Local	Unknown	Unknown	Low-Medium
	No rowdiness of construction workers	Neutral	Local	Low	Definite	Low
	No job creation (operational phase)	Neutral	Sub-regional	Low-medium	Definite	Low
	No increase in local population due to increased number of dwellings	Neutral	Sub-regional	Medium-high	Unknown	Medium
	No impacts (positive or negative) on existing local businesses	Neutral	Local	Low-medium	Definite	Medium
	No impact on the “village” ambience	Neutral	Local	Unknown	Highly probable	Medium-high
	No impacts (positive or negative) on local tourism	Neutral	Local	Unknown	Highly probable	Medium
	No visual impact of construction activities and site clearing	Neutral	Local	Low – high	Definite	Medium
	No visual impact of the development (operational phase)	Neutral	Local	Medium-high	Definite	Medium-high
	No light pollution	Neutral	Local	Low – high	Definite	Low – high
	No construction-phase noise	Neutral	Local	Low – medium	Definite	Low
	No long-term increase in ambient noise levels associated with human habitation and traffic	Neutral	Local	Low	Definite	Low
CUMULATIVE IMPACTS	No reduction in the area of habitat available locally to fauna and flora	Neutral	Sub-regional	Low-medium	Definite	Medium
	No contribution to conservation of grasslands (conservation offsets)	Neutral	Sub-regional	Low-medium	Definite	Medium
	No impacts on sense of place and ambience	Neutral	Local	Medium-high	Definite	Medium-high
	No impacts on tourism	Neutral	Sub-regional	Medium	Definite	Low-medium
	No added risk of groundwater pollution	Neutral	Sub-regional	Low	Definite	Low-medium
	No increase in pressure on water provision	Neutral	Sub-regional	Low	Definite	Low
	No increase in pressure on electricity supply	Neutral	Sub-regional	Low	Definite	Low
	No visual impact or light pollution	Neutral	Sub-	Low-medium	Definite	Medium

			regional			
	No increase in traffic	Neutral	Sub-regional	Low-medium	Definite	Medium

3. APPLICABLE LEGISLATION

3.1. Environmental Legislation

- *National Environmental Management Act (1998)*

In terms of the EIA Regulations (2006), published in terms of section 24(5) read with section 44 of the National Environmental Management Act (NEMA, Act No. 107 of 1998), environmental authorization is required for this proposed project. **Although new EIA regulations came into effect in 2010, the 2006 EIA regulations still apply to this project, as the application for environmental authorisation was submitted to LDEDET in 2007 in terms of the 2006 EIA regulations.**

A full EIA is required to be conducted in terms of Regulation R. 387 of the EIA regulations, as the following listed activities are applicable to this proposed project:

Table 3.1: Applicable activities listed in EIA Regulations (2006)

R. 386 ACTIVITY NR	**ACTIVITY DESCRIPTION**
16 (b)	The transformation of undeveloped, vacant or derelict land for residential, mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare.
18	The subdivision of portions of land 9 hectares or larger into portions of 5 hectares or less.
R. 387 ACTIVITY NR	**ACTIVITY DESCRIPTION**
1(p)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the treatment of effluent, wastewater or sewage with an annual throughput capacity of 15 000 m^3 or more.
1(r)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the microbial deactivation, chemical sterilisation or non-thermal treatment of waste or effluent.

Even though waste-related activities were removed from the NEMA EIA Regulations as from 1 July 2009 to be taken up in the National Environmental Management: Waste Act (2008), NEMWA only applies to applications launched after its commencement date 1 July 2009. The sewerage treatment system which is proposed as part of this township establishment will therefore be assessed in terms of the EIA Regulations (2006) and not in terms of NEMWA, as the EIA application was submitted to LDEDET in 2007 already.

- *National Water Act (1998)*

The following activities, which are classified as water uses in terms of the National Water Act (NWA, Act No. 36 of 1998), will require authorisation by DWA in the form of a Water Use Licence (WUL):

Table 3.2: Applicable water uses in terms of the National Water Act (1998)

SECTION	WATER USE DESCRIPTION
21(c)	Impeding or diverting the flow of water in a watercourse.
21(e)	Engaging in a controlled activity identified as such in Section 37(1) or declared under 38(1).
21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource.
21(i)	Altering the bed, banks, course or characteristics of a watercourse.
37(1)(a)	Irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterwork.

A Water Use Licence Application (WULA) will be submitted to DWA in due course, likely by the project civil engineers.

3.2. Other Legislation

Table 3.3: Other applicable legislation

LEGISLATION	RELEVANT SECTIONS	PERTAINS TO
The Constitution Act (No 108 of 1996)	Chapter 2, Section 24	Bill of Rights: Environmental rights
Conservation of Agricultural Resources Act (1983)	Section 5	Prohibition of the spreading of weeds
Fencing Act (No 31 of 1963)	Section 17	Clearing of bush for fencing
Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (No 36 of 1947)	Sections 3 – 10	Control of the use of pesticides, herbicides and fertilizers, and precautions to protect workers in this regard
Limpopo Environmental Management Act	Schedule 2, 3, 11 and 12	Lists of protected animals and plants
National Environmental Management: Air Quality Act (No 39 of 2004)	Section 32	Control of dust
	Section 34	Control of noise
	Section 35	Control of offensive odours
National Environmental Management: Biodiversity Act (No 10 of 2004)	Section 57	Restricted activities involving listed threatened or protected species
	Sections 65–69	Regulation of activities involving alien species
	Sections 71, 73 and 75	Regulation of activities involving invasive species
National Heritage Resources Act (No 25 of 1999)	Section 34	Protection of structures older than 60 years
	Section 35	Protection of archaeological and palaeontological sites and material as well as meteorites
	Section 36	Conservation of burial grounds and graves
National Forests Act (No 84 of 1998), as amended by the Forestry Laws Amendment Act (No 35 of 2005)	Section 7	Prohibition on destruction of trees in natural forests
	Sections 12–16	Declaration of trees, groups of trees, woodlands or tree species as protected
	Section 17	Declaration of controlled forest areas
National Water Act (No 36 of 1998)	Section 19	Prevention and remedying effects of pollution, particularly where pollution of a water resource occurs or might occur as a result of activities on land
	Section 20	Control of pollution of water resources following an

		emergency incident
	Chapter 4 (Sections 21-55)	Governs water use
Occupational Health and Safety Act (No 85 of 1993)	Section 8	General duties of employers to their employees
	Section 9	General duties of employers and self-employed persons to persons other than their employees

The following municipal by-laws are also applicable.

Table 3.4: Applicable municipal by-laws (Greater Tzaneen Municipality)

GTM BY-LAW	PERTAINS TO
GTM Refuse By-Law (2004)	Handling and disposal of refuse.
GTM Drainage By-Law (2004)	Matters pertaining to drainage, including drains & manholes, sewerage, storm water, wastewater fittings & fixtures, and other related matters.
GTM Waste Management Plan (2006/07)	Strategies and programmes for waste minimization; collection, transportation, disposal and treatment of waste; pollution control.
GTM Corporate Disaster and Emergency Plan (date of compilation unknown)	To outline policy and procedures for the both the proactive disaster prevention and the reactive disaster response and mitigation phases of Disaster Management. It is intended to facilitate multi sectoral coordination in both pro-active and reactive programmes.

4. SERVICES

The following service infrastructure is proposed to be established in order to serve the township:

- Calcamite onsite sewage treatment in the form of a Bio-Mite treatment plant to serve the single residential stands and another plant to serve the cluster housing and businesses;
- Water, sewerage and electricity reticulation;
- Pipeline system to carry treated effluent (to DWA's standards) from the proposed treatment plant to stands for irrigation purposes.

4.1. Water

Potable water is proposed to be obtained from an existing water pipeline operated by Lepelle Northern Water Board. Confirmation is awaited of the availability of sufficient water to be taken off this pipeline. It is proposed that a portion of the irrigation water that will be required for gardens and communal landscaped areas be obtained from the proposed onsite sewage treatment system. A pipeline system is planned to be installed to carry treated effluent (complying with DWA's applicable standards) from the treatment plants to stands for irrigation purposes to reduce dependency on water supplied by Lepelle.

4.2. Sewerage

It is proposed that a Calcamite Bio-Mite treatment plant be installed to serve the single residential stands, and a separate plant to serve the cluster housing and business stands. The plant to serve the single residential erven is proposed to be installed on a stand set aside for this purpose and on which a servitude will be registered. The system will not be visible; the stand will simply appear as a vacant, landscaped stand. The

plant serving the cluster housing is to be installed on a designated portion of the proposed Residential 3 stand, which will also be landscaped. Please refer to Section 2.4.5 for a description of the functioning of the Calcamite system.

4.3. Electricity

Electricity is proposed to be provided by Eskom, but distributed by the GTM. A new substation was recently established by the GTM to improve the capacity for electricity provision in the municipal area, but written confirmation is still awaited from the GTM that sufficient electricity will be available to supply this proposed development.

5. ENVIRONMENTAL IMPACT ASSESSMENT – BIO-PHYSICAL INVESTIGATIONS

Bio-physical investigations during the EIA consisted of the following **specialist studies**:

- Ecological investigation conducted by Dr Buks Henning of Africa Geo-Environmental Services (AGES);
- Vegetation assessment conducted by Prof George Bredenkamp of EcoAgent;
- Faunal investigation conducted by Mr Dewald Kamffer of Ecocheck CC;
- Amphibian assessment conducted by Prof Les Minter of the University of Limpopo;
- Reptile assessment conducted by Mr JJ Moller and Mr F Viljoen of Bateleur Environmental Services;
- Geo-technical investigation conducted by Matthys Dippenaar on behalf of Mark Down Geoconsulting;
- Geo-hydrological investigation conducted by Matthys Dippenaar of Moonlight Enviro; and
- Slope stability investigation conducted by Prof Louis van Rooy of the University of Pretoria.

Potential impacts in terms of climate, topography, soils and geology, vegetation and fauna were scored on the following basis:

- **Status:**
  - *Positive* – the proposed project is to have a positive impact in terms of the particular parameter;
  - *Negative* – the proposed project is to have a negative impact in terms of the particular parameter;
  - *Neutral* – the proposed project is to have neither a positive nor a negative impact in terms of the particular parameter.

- **Extent:**
  - *Local* – the impact is to be felt on the site and in its immediate surroundings, up to a radius of 50km from the site);
  - *Sub-regional* – the impact is to be felt at a distance of up to 100km from the site;
  - *Regional* – the impact is to be felt in the Limpopo Province;
  - *National* – the impact is to be felt across provincial boundaries.

- **Duration:**
  Refers to the period of time over which impacts can be expected to be experienced.

  - *Short term* – 0 to 5 years;

- *Medium term* – more than 5 years, up to 15 years;
- *Long term* – more than 15 years;
- *Permanent* – the impact is irreversible.

- **Magnitude:**
  Refers to the intensity of the potential impact, if it is experienced.

  - *Negligible* – the impact will barely be felt, if at all. No mitigation required;
  - *Low* – the parameter will only be affected to a small extent by the proposed project. No mitigation required, but monitoring is recommended;
  - *Medium* – the parameter will be affected by the proposed project, but functions in terms of the parameter can still continue. Mitigation and monitoring required;
  - *High* – functioning in terms of the parameter will be significantly affected by the impact. Extensive mitigation and long-term monitoring required.

- **Likelihood:**
  - *Improbable* – it is unlikely that the impact will be experienced;
  - *Possible* – the impact may be experienced. Monitoring required; mitigation may also be required based on the type of impact and its significance;
  - *Highly probable* – the impact will most likely be experienced. Monitoring and mitigation required based on the type of impact and its significance in order to reduce the probability of the impact occurring and/or to reduce the magnitude of the impact;
  - *Definite* – the impact will be experienced. Monitoring and mitigation required based on the type of impact and its significance in order to reduce the probability of the impact occurring and/or to reduce the magnitude of the impact.

- **Significance:**
  Significance is based on a consolidation of the anticipated extent, duration, magnitude and likelihood of the potential impact.

  - *Negligible* – The impact will barely be felt, if at all. No mitigation required;
  - *Low* – The parameter will only be affected to a small extent by the proposed project. No mitigation required, but monitoring is recommended;
  - *Medium* – The parameter will be affected by the proposed project, but functions in terms of the parameter can still continue. Mitigation and monitoring required;
  - *High* – Functioning in terms of the parameter will be significantly affected by the impact. Extensive mitigation and long-term monitoring required.

5.1. Climate

5.1.1. Status quo

The proposed development site is situated in a summer rainfall area, with Mean Annual Precipitation (MAP) up to 1 500mm. Peak precipitation is experienced in January, though some precipitation may also occur in winter. Mist is common, and Mean Annual Temperature (MAT) is approximately 16.6°C. Frost is infrequent (Mucina & Rutherford, 2006).

5.1.2. Potential impacts

An increased risk of erosion (and associated potential siltation of the drainage line) can be anticipated during the construction phase in case of rain. The attached Environmental Management Plan (EMP) recommends that the installation of internal roads and services should be undertaken wholly during the relatively dry winter season in order to reduce the risk of this potential impact. The site should also be terraced to reduce erosion.

A concern was raised during the public meeting (17 July 2007) that smoke from home fireplaces in the proposed development may cause discomfort to asthma sufferers, as a temperature inversion layer prevents smoke from lifting until late in the morning during winter. The resident who raised this concern already experiences this problem and fears that the added homes are likely to make use of fireplaces due to the cold winters in Haenertsburg and that this additional smoke would exacerbate the problem of smoke over the village on winter mornings. This is, however, not considered a significant impact, as the additional use of fireplaces is anticipated of low magnitude and limited mostly to winter time. Furthermore, being situated in a forestry area (pine and *Eucalyptus* plantations abound around the Haenertsburg area), fires are an annual occurrence when foresters burn firebreaks. Another stakeholder indicated at the public meeting that the burning of one firebreak can quite conceivably release more smoke than the combined fireplaces in all of Haenertsburg over one winter season. Natural / non-intentional fires are also not uncommon and are always a risk in a forestry area. The impact of the additional anticipated fireplaces is therefore not considered significant in this context.

Table 5.1: Potential impacts in terms of climate

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Increased soil erosion during rainy season	Negative	Local	Short-term	Medium	Highly probable	Medium
Sedimentation of drainage line due to soil erosion	Negative	Local	Short-term	Medium	Highly probable	Medium
Increased risk of soil slip (instability) during rainy season	Negative	Local	Short-term	Low-Medium	Possible	Low
OPERATIONAL PHASE						
Increased soil erosion during rainy season	Negative	Local	Long-term	Low	Possible	Low
Sedimentation of drainage line due to soil erosion	Negative	Local	Long term	Low	Possible	Low
Additional smoke from fireplaces may be trapped over the village by an inversion layer in winter	Negative	Local	Long-term	Very low	Possible	Low

5.2. Topography, Soils, Geology and Hydrology

An engineering geological investigation was conducted by Mark Down Geoconsulting CC in 2007, and a specialist slope stability analysis was undertaken by Prof Louis van Rooy of the University of Pretoria in 2012 in response to a concern raised by Mrs Melinda Rodgers of LDEDET, who had indicated that slope stability problems had been experienced at other sites in the area. A geo-hydrological investigation was also undertaken by Moonlight Enviro in 2010 to investigate the potential impact of the proposed onsite wastewater treatment system on groundwater quality.

The findings of these investigations have been combined in the following sub-sections, and the full reports are available under Appendix O, P and Q, respectively.

5.2.1. Topography

The site slopes steeply to the south with local variations to southwest and southeast due to a small drainage gulley occurring in the central part and a prominent ridge on the western part. The elevation changes from 1 390 m at the lowest point in the southeast to 1 456 m above mean sea level along the northern boundary (Van Rooy, 2012). The general slope angle is between 20° and 30° (Mark Down Geoconsulting, 2007).

5.2.2. Geology

According to the 1:250 000 sheet 2328 Pietersburg the southern part of the site is underlain by Groot-Letaba Gneiss and the northern part by Duivelskloof Leucogranite. Further to the south large rafts of greenstone belt material occurs in the leucogranite including scattered outcrops of chlorite schist of the Pietersburg Group and a large occurrence of talcoze rocks and serpentenite (Johnson, 2006). The leucogranite is generally massive and the gneisses show typical gneissic banding. Small intrusions or occurrences of diabase and/or mafic rocks are present on site (Van Rooy, 2012).

The Tzaneen lineament strikes northeast-to-southwest, forming a pathway for the Great Letaba River. A fault structure is found south of the site, but there are no recorded faults, shear zones or other lineaments on the site itself (Mark Down Geoconsulting CC, 2007).

No specific mineral deposits are found on the site, and the site is *not* underlain by dolomitic bedrock. (Mark Down Geoconsulting CC, 2007). The climatic N-value (Weinert, 1980) of the region is less than 5, which implies that chemical weathering is dominant (Mark Down Geoconsulting CC, 2007 and Van Rooy, 2012).

The terraced central part of the property, which comprises overnight chalets and associated facilities (not forming part of the proposed development area), consists of cut faces and levelled platforms with very little support of vertical cut faces. There are also not any signs of significant erosion or slumping of the vertical cut faces in the open and covered areas. In some of the platforms, close to the cuts, evidence of highly weathered rock was seen (Van Rooy, 2012).

5.2.3. Soils

Soils are generally clayey, which can be expected to lead to high surface runoff. However, sandy soil covering the sandstone area are considered to be susceptible to erosion. The site is underlain by weathered biotite granite overlain by a relatively thin surficial transported horizon (<0.20m). The overlying horizon was described as slightly moist to moist light brown loose intact clayey sandy SILT. The horizon contains abundant roots with scattered organic activities. In most profiles, this horizon was found to be underlain by a second colluvial horizon with an average thickness of approximately 0.25m, characterized as slightly moist dark brown loose to medium dense intact silty fine and medium sand with abundant roots and less organic activity (Mark Down Geoconsulting CC, 2007).

A pebble marker – typically the boundary between the transported soil horizons and the residual material – was observed over most of the site. It was described as slightly moist dark brown loose to medium dense intact gravelly sandy silt with abundant subrounded to rounded quartz pebbles. Some profiles also consist of abundant subrounded to rounded reworked granite pebbles with a slickensided matrix. Average thickness was 0.10m (Mark Down Geoconsulting CC, 2007).

All profiles are underlain by very highly to highly weathered biotite-rich granite. Three distinct horizons were recognized onsite (Mark Down Geoconsulting CC, 2007):

Horizon 1: Moist dark reddis brown firm intact sandy clayey SILT.
Horizon 2: Moist glittery reddish pink with speckled white and olive lenses firm intact sandy silty CLAY.
Horizon 3: Moist pinkish red with white and yellow lenses loose intact (sometimes consisting of highly weathered remnants of veins) sandy clayey SILT with reworked lenses consisting of pyroxene and plagioclase.

Horizons 2 and 3 had a high content of weathered mica. The three horizons have a combined average thickness of more than 2.0m (Mark Down Geoconsulting CC, 2007).

The natural exposed profiles did not encounter bedrock, but the colour changes with depth indicate less weathered material. Profiles TP03 and TP04 are not representative of the natural conditions as earthworks probably disturbed the upper portion of the profiles due to removal or reworking. The typical profile comprises of transported surficial soils containing quarts gravel and cobbles of granite bedrock that is separated from the residual granite soil by typical pebble marker horizon. The residual granite changes from an orange silt to light brown and orange mottled yellow, red and black sand below approximately 1,0 m on the higher elevated areas. All the different soil horizons in the profiles exhibit voided structure, mainly due to biotic activity (Van Rooy, 2012).

A small ridge, running in an east-to-west direction, was recorded in the eastern part of the site. Two test pits were excavated near the ridge – both neared refusal during excavation with a TLB. The characteristic profile was described as slightly moist to dark brown stiff slightly pinholed gravely silty CLAY with abundant subangular to subrounded highly weathered biotite granite cobbles and boulders (Mark Down Geoconsulting CC, 2007).

5.2.4. Surface hydrology

Surface water drainage is towards a distinct perennial drainage features approximately 1.2km east of the site. A non-perennial drainage line is situated approximately in the middle of the site, draining southward. The development will not encroach upon the 1:100 year flood line.

5.2.5. Geo-hydrology

No groundwater seepage was found during the engineering geological investigation as conducted in 2007. However, perched or fluctuating groundwater levels are commonly associated with granites in South Africa and the possibility of wet profile conditions exists. The regional groundwater in this area will occur primarily in water-bearing intergranular and fractured aquifers. The groundwater may be shallower near the drainage channels. Groundwater flow is expected to follow surface topography towards the east. A perennial drainage feature is present approximately 1.2km to the east of the site.

Two boreholes were identified on the site or the proximate properties during a hydrocensus. Of these, one borehole (BH02) is used for irrigation and the other (BH01) not equipped. Furthermore, during the hydrocensus two proximate boreholes are noted in DWA's National Groundwater Database (NGDB): Durthdorp (site ID: 11) and Haenertsburg Town & Townlands (site ID: 211).

The Groundwater Resources of RSA Sheets supply the following information for the site:

- More than 50mm groundwater component to baseflow
- More than 100mm mean annual recharge
- Groundwater level typically 10 – 20m below surface (> 15m deviation from mean)
- Groundwater probably (Ca,Mg)(HCO3)2 hydrochemical type

No recent data (including water levels, pumping tests or ground water chemistry) are available for either of the two boreholes onsite. Two water samples were therefore submitted for determination of the water chemistry and water microbiology; the detailed results are contained in the attached geo-hydrological report. Most parameters tested (including physical and aggregate properties, alkalinity, metals, inorganic non-metallic constituents and microbiology) placed the water from both boreholes in Class 0 (Ideal). However, both samples had a total heterotrophic count and total coliforms falling in Class II (Max Allowable). The nitrate level in the water from BH02 also classed as Class II (Max Allowable). This renders the water not potable and unsuitable for domestic or agricultural use.

Borehole BH01 showed a water level of 12.5m below the natural ground level. However, groundwater levels can vary significantly based on the position in the catchment, localised relief and climatic variations.

Three percolation tests were done; the results and locality of the tests are contained in the attached geo-hydrological report. Maximum rate at natural moisture content and minimum rate after pre-soaking were determined. From the tests, high percolation rates were determined.
The pre-soaked percolation rates as shown in the geo-hydrological report can be compared to recommended application rates (notably relating to french drains) as shown in Table 5 of the geo-hydrological report. Based on the percolation rates, application rates between 70ℓ/m2/day and 110 ℓ/m^2/day are recommended.

Based on the results of the investigation, the following should be noted in terms of groundwater:

- Borehole BH01 showed a water level of 12.5m below the natural ground level. However, groundwater levels can vary significantly based on the position in the catchment, localised relief and climatic variations.
- Shallow permanent, perched or fluctuating water levels (the latter following episodes of long and intense rainfall) are a reality in granitic terrains. Wet profile conditions may prevail, notably during the rainy seasons. These may aid in mobilising contaminants to the subsurface.
- No pumping test data are available for the NGDB or hydrocensus boreholes. No hydraulic parameters could therefore be determined and the groundwater flow rate and direction cannot be addressed with complete surety.
- The groundwater shows elevated levels of nitrate, total heterotrophic plates and coliform bacteria. These three combined render the water not potable and unsuitable for any domestic or agricultural practices (SABS 2001 and DWAF 1996).
- The town of Haenertsburg and the proximate properties rely mostly on on-site sanitation systems such as septic tanks. In this event, the groundwater quality can be motivated by long-term contamination of the groundwater by such systems.

In terms of the vadose zone the following aspects should be considered:

- The high percolation rates associated with the site soils may mobilise contaminants emanating from shallow subsurface and surface sources such as french drains. This increases the possibility of

groundwater contamination, especially near drainage features, where a shallow groundwater level is present and following intense precipitation events.
- The lower anticipated permeability of the bedrock at depth may decrease the percolation rate. Bedrock typically occurs at depths shallower than 2.0m below surface.

Recommendations:

- Groundwater is at this stage *not* proposed to be utilised, but if it is at a later stage proposed to be used, validation of the groundwater quality may be useful at a later stage since the quality can change seasonally. This will depend on the proposed use of the groundwater. Alternatively, filtering and purifying of the groundwater is recommended prior to any use thereof.
- Should groundwater later be proposed to be utilised, a water use license application will be required. Depending on the water requirements, additional pumping testing may be required by DWA to ensure that enough water is available. A pumping test or slug-test will aid in defining the hydrological parameters of the aquifer.
- French drains, underground storage tanks, waste disposal, cemeteries and so forth are all aspects that will influence the groundwater quality. None of these are proposed to form part of this development, but the proposed wastewater treatment plant may impact on groundwater quality and must therefore be situated above the 1:100 year flood line.
- Additionally, quality testing will be useful baseline data for future monitoring protocols if required.

5.2.6. Slope stability model

Two sections were selected arbitrarily in the eastern part where some of the steeper slopes are present without any major existing disturbance apart from one or two cut terraces. The geological model was further designed to incorporate three soil horizons as follows:

1. An upper 2 m thick horizon of transported soil, pebble marker and the near surface residual granite layer;
2. Three metre thick residual granite horizon; and
3. The highly weathered granite material.

These soil horizons were assumed to rest on medium weathered to slightly weathered granite bedrock. The medium weathered bedrock was incorporated into the model from a depth of 10m below slope surface. This may not be entirely true due to the uneven bedrock profiles usually occurring in granitic bedrock and the possible occurrence of shallower bedrock in some parts.

The slope boundaries were inferred from the drawing provided in the geotechnical report (Mark Down Geoconsulting, 2007) on which 2m elevation contours are indicated. The slope model dimensions were scaled as accurately as possible from this plan. Values for input parameters into the slope analysis were used from the laboratory test results for the upper two horizons and published data were used for the weathered granite materials. The material property values used for the various horizons are presented in the table below.

Table 5.2: Material properties used in the slope analysis (Van Rooy, 2012)

	Cohesion c	Friction angle ϕ	Dry unit weight γ
Transported & residual soils (0 - 2 m): Case a Case b	 0 kPa 20 kPa	 30° 24°	 11 kN/m³ 14 kN/m³
Residual granite (2 - 5 m)	5 kPa	35°	17,5 kN/m³
Weathered granite 5 – 10 m)	150 kPa	45°	24 kN/m³
Medium weathered bedrock > 10m)	200 KPa	50°	27 kN/m³

Two sets of data were used for the strength parameters of the first horizon based on the results from the shear box tests executed on residual granite from profiles P03 and P04. The same parameter values were used in both slope cross sections. The western section is referred to as Section A – B and the eastern section as Section X – Y.

The Mohr-Coulomb shear strength equation and the Bishop Method of Slices were used in the stability analysis. The stability analyses were executed assuming a dry slope and one where a perched groundwater level is present in the upper soil horizons with possible seepage at the steeper parts of the slopes in both sections A-B and X-Y. It was further assumed that there will not be a composite failure surface and that the failure surface will propagate from upslope to the slope toe through all soil horizons with the material below the perched water table regarded as saturated in the analyses including the water table. The factor of safety was also calculated using the infinite slope model where the slope is assumed to extend infinitely in all directions and sliding occurs on a plane parallel to the face of the slope (Taylor, 1948). In this case the failure plane was assumed to be 5 m below surface and the steepest slope angle of 21o was used. This model is not entirely correct due to the geometry of the slope and the variation in material properties.

5.2.7. Slope stability analysis

The calculated Factor of Safety (FS) results from the stability analysis on the two slope sections with the various parameters and groundwater conditions are summarized in the following table. There are four different scenarios for each slope section where the strength parameters for the upper 2 m thick layer is changed for Case A and Case B as in Table 5.22 and the slopes are further analysed for the dry and perched groundwater conditions.

Table 5.3: Factors of Safety

	Dry slope	Perched groundwater
SLOPE A - B		
Parameters Case a	1.7	0.9
Parameters Case b	2.9	2.0
SLOPE X - Y		
Parameters Case a	1.2	0
Parameters Case b	2.2	1.3

The various minimum FS slip circles for the various conditions are indicated in the attached slope stability report. It is generally accepted that Factors of Safety for existing slopes with high risk to life (e.g. occupied buildings) should be higher than 1.3 (GEO, 1984). The FS for the dry slope conditions are generally higher than 1.6 with a FS of 1.2 in Section X-Y in the dry condition and in the Case A conditions where no cohesion is

present in the upper soil layer. In Figure 6 of the attached report, this minimum FS slip circle can be seen to occur near surface and very localized.

The dry condition slopes can therefore be regarded as being sufficiently stable. In the wet slope situation the FS values indicate stable conditions when Case B material parameters are used but unstable where the upper 2 m of soil has no cohesion. Very shallow slip circles are seen in both slope sections where the water table intersects the surface, indicating surface seepage conditions. In the Case B situation both slopes are stable even under saturated conditions. The infinite slope calculations also indicate FS values of higher than 1.5.

Discussion:

Slope instability is possible and will depend on the material properties, slope angle and groundwater conditions. If the worst case scenario is taken into account along the two sections of slope analysed, the most important factor will be the groundwater conditions. In all instances the slopes have acceptable Factors of Safety in the dry state. In the case where the soil is assumed to have no cohesion (the worst-case scenario), failure is predicted. All the laboratory results indicate clay contents of more than 10%, which will typically add some cohesion to the soil. It can therefore be assumed that the case of no cohesion will be the worst possible situation on site. In the near surface groundwater situation, shallow (< 2 m) and very limited (< 5 m) slip circles are predicted. It is also obvious that **the control of groundwater on the site will play an overriding role in the stability of the slopes**.

It should be noted that, due to the limited nature of the investigation, it is impossible to guarantee that isolated zones of poorer soil materials or harder rock have not been missed, although every effort was made during the fieldwork phase to identify the different soil horizons, areas subject to a perched water table, areas of poor drainage and areas underlain by hard rock, and to estimate their distribution. A competent person should provide input into the final site layout and should inspect future excavations at the time of construction or the open service trenches, to determine the actual variance from the above assessment of the site.

Recommendations:

The following is recommended at this stage:

- The present proposed site layout on the western half of the site is acceptable due to the roads being placed on the existing cut terraces;
- The layout on the eastern half of the site should ideally be adjusted to locate roads on cut terraces;
- The terracing of the site will enhance the slope stability due to the removal of overburden weight and allow for stronger material to be exposed;
- The layout as suggested above will also afford the effective management of surface runoff and the road cuts will provide points for drainage of the upper soil horizons. This will go a long way to prevent the total saturation of the upper soil horizons with possible slope failures occurring;
- The cut faces should be as near as possible to the vertical to prevent erosion of these faces and the cuts can be protected with retaining walls that should be free draining;
- Runoff water from the adjacent, higher elevated northern property should ideally be collected and channelled away from the slopes via the storm water reticulation system;
- Property owners should be made aware of the dangers of soil saturation and general storm water management on this site will be of the utmost importance to prevent small and localized slope failures.
- Adequate space should be provided between future buildings and cut faces to prevent localised failure of vertical cuts due to loading on the upslope part.
- Final slope design and layout should be done in conjunction with a competent geotechnical/civil engineer.

The proposed layout is currently being revised based on Prof Van Rooy's recommendations regarding the placement of roads on existing cut terraces.

5.2.8. Potential impacts

- **Alteration of topography and hydrological regime**
  The topography is to be altered in that the site is proposed to be terraced for construction and to minimise soil erosion. This is likely to affect the pattern of water runoff from the site, though runoff will still feed into the drainage line which dips underneath the R71.

- **Acceleration of soil erosion and concomitant siltation of drainage line**
  Though terracing will minimise soil erosion (particularly during construction, when a site is most vulnerable to erosion), erosion will still be a risk due to the steep slope, and erosion will have to be prevented and/or mitigated as far as possible, and closely monitored during the construction phase. The site is expected to be most vulnerable during earthworks and terracing, when the site will be cleared of vegetation. Earthworks, terracing and establishment of civil services and roads will have to be done during the relatively dry winter season to limit the risk of soil erosion.

  Furthermore, though lower than the levels of soil erosion expected to be experienced during construction, slightly accelerated soil erosion may be experienced during the operational phase due to the increased proportion of hard surfaces and concomitant increase in peak stormwater runoff.

- **Slope failure / soil slip**
  The possibility exists of slope failure / soil slip, particularly on the slopes in the eastern part of the site and under conditions of soil saturation in the rainy summer season. However, the risk is anticipated to be low as long as the recommended mitigation measures are adhered to.

- **Loss of forestry land**
  Loss of land that was previously used for forestry and could potentially be used for this purpose in future, is a long-term to permanent impact. The development of the site would lead to the site no longer being available for forestry.

- **Possible groundwater contamination by wastewater treatment system**
  The proposed onsite sewerage treatment system carries with it the risk of potential groundwater pollution. There will be no outflow of untreated waste water (the effluent will have been treated up to DWA's standards), and a monitoring system will be in place to pick up any leakages, but the risk of leakage and subsequent contamination of groundwater during the lifetime of the proposed sewerage system cannot be precluded. The high percolation rates associated with the site soils may mobilise contaminants emanating from shallow subsurface and surface sources such as the sewerage treatment system. This increases the possibility of groundwater contamination, especially near drainage features, where a shallow groundwater level is present and following intense precipitation events. However, the lower anticipated permeability of the bedrock at depth may decrease the percolation rate. Bedrock typically occurs at depths shallower than 2.0m below surface.

Table 5.4: Potential impacts in terms of topography, soils, geology and hydrology

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Increased soil erosion	Negative	Local	Short term	Medium	Possible	Medium
Sedimentation of drainage line due to soil erosion	Negative	Local	Short term	Medium	Possible	Medium
Increased risk of soil slip (instability) during rainy season	Negative	Local	Short-term	Low-Medium	Possible	Low
OPERATIONAL PHASE						
Alteration of topography and hydrological regime	Negative	Local	Long term	Low	Highly probable	Low
Increased soil erosion	Negative	Local	Long term	Low	Possible	Low
Sedimentation of drainage line due to soil erosion	Negative	Local	Long term	Low	Possible	Low
Increased risk of soil slip (instability) during rainy season	Negative	Local	Short-term	Low	Possible	Low
Groundwater contamination by wastewater treatment system	Negative	Sub-regional	Long term	Unknown	Possible	Medium
Surface water contamination by wastewater treatment system	Negative	Sub-regional	Long term	Unknown	Possible	Low - Medium
Loss of forestry land	Negative	Local	Permanent	Low	Definite	Low

5.3. Vegetation

Vegetation assessments on the proposed development site consisted of the following:

- An **ecological assessment**, consisting of vegetation and faunal assessments, was conducted by Dr Buks Henning of Africa Geo-Environmental Services (AGES) during June 2007. His findings in terms of vegetation are reported in this section.
- A specialist **vegetation assessment** was conducted by Prof George Bredenkamp of Eco-Agent CC in March 2008.

5.3.1. Ecological Assessment – Dr Buks Henning (AGES)

5.3.1.1. Methodology

The Braun-Blanquet survey technique was employed by Dr Henning in the vegetation. This method is used to describe plant communities as ecological units and allows for the mapping of vegetation and the comparison of the data with similar studies in the area. Dr Henning found the vegetation to be in a moderate condition and found that most species could be identified, though some forbs and geophytes might have been dormant. The survey was considered successful, especially considering that most of the site was in a degraded to semi-degraded state.

A list of all plant species present was compiled, including trees, shrubs, grasses, forbs, geophytes and succulents. In addition to listing all identifiable plant species, notes were added of any other features that might have an ecological influence. Furthermore, a species list of the red data species (classified according to the IUCN red data list categories) previously recorded in the vicinity of the proposed development site was

obtained from the South African National Biodiversity Institute (SANBI), South Africa. A list of protected tree species was obtained from the Limpopo Environmental Management Act (2003).

A classification of vegetation data was done to identify, describe and map vegetation types. The description of the plant communities includes the tree, shrub and herbaceous layers.

The conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Limpopo Province, as well as the Savanna Biomes of South Africa.

The following conservation priority categories were used for each vegetation unit:

High: Ecologically sensitive and valuable land with high species richness that should be conserved and no development allowed.

Medium: Land that should be conserved but on which low impact development could be considered under exceptional circumstances.

Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.

Low: Land that has little conservation value and that could be considered for development with little or no impact on the vegetation / ecosystem.

5.3.1.2. Results

Only three clear distinctions could be made regarding vegetation units, *viz*. the existing cottages with their surrounding gardens, the exotic tree stands and the degraded drainage channels. The site is currently vacant apart from the section occupied by the cottages, which are used for overnight accommodation. Most of the vegetation can be considered to be in a degraded state as judged by the presence of various indicator species such as exotic weeds and alien species. This does not represent climax grassland, but is more representative of totally modified exotic plantations.

Below are representative photographs of the condition of the vegetation onsite at the time of the ecological survey.

Figure 5.1: Exotic tree stands

Figure 5.2: Drainage channel with floodplain

Figure 5.3: Gardens

Figure 5.4 below maps the vegetation units on the proposed development site, whilst the next figure maps the ecological sensitivity of the site. The table overleaf indicates the general characteristics for each of the identified vegetation units. A detailed species list for each vegetation unit is included in the ecological report (Appendix I of this draft EIR).

Figure 5.4: Vegetation map of the proposed development site (AGES, 2007)

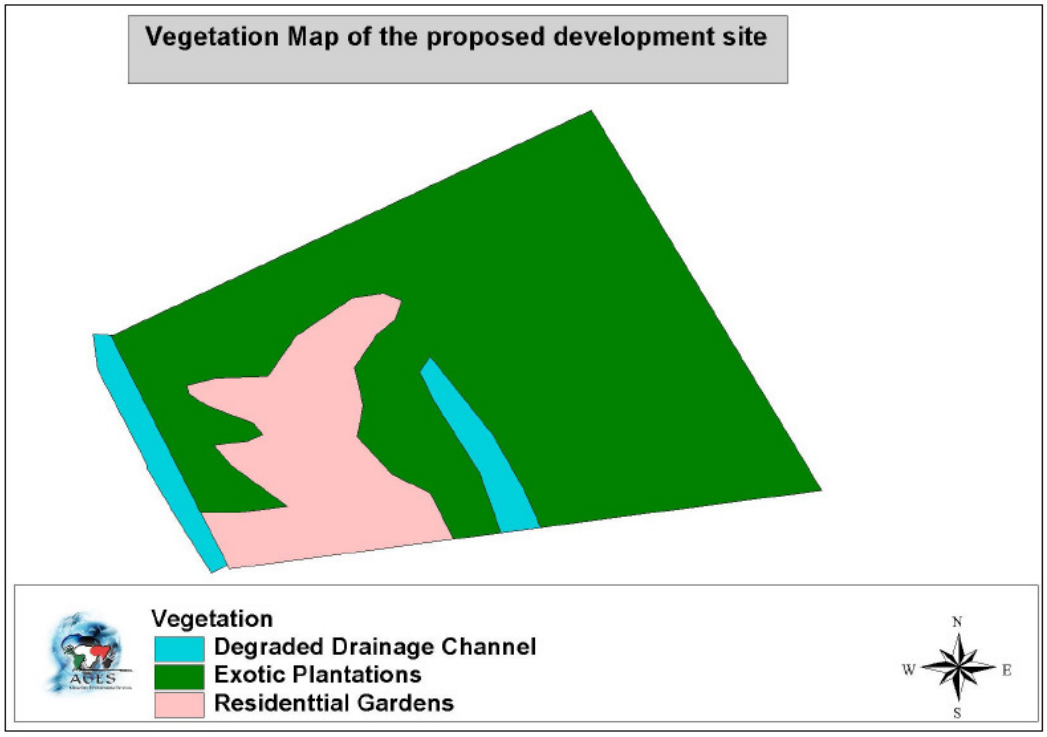


Figure 5.5: Ecological sensitivity map (AGES, 2007)

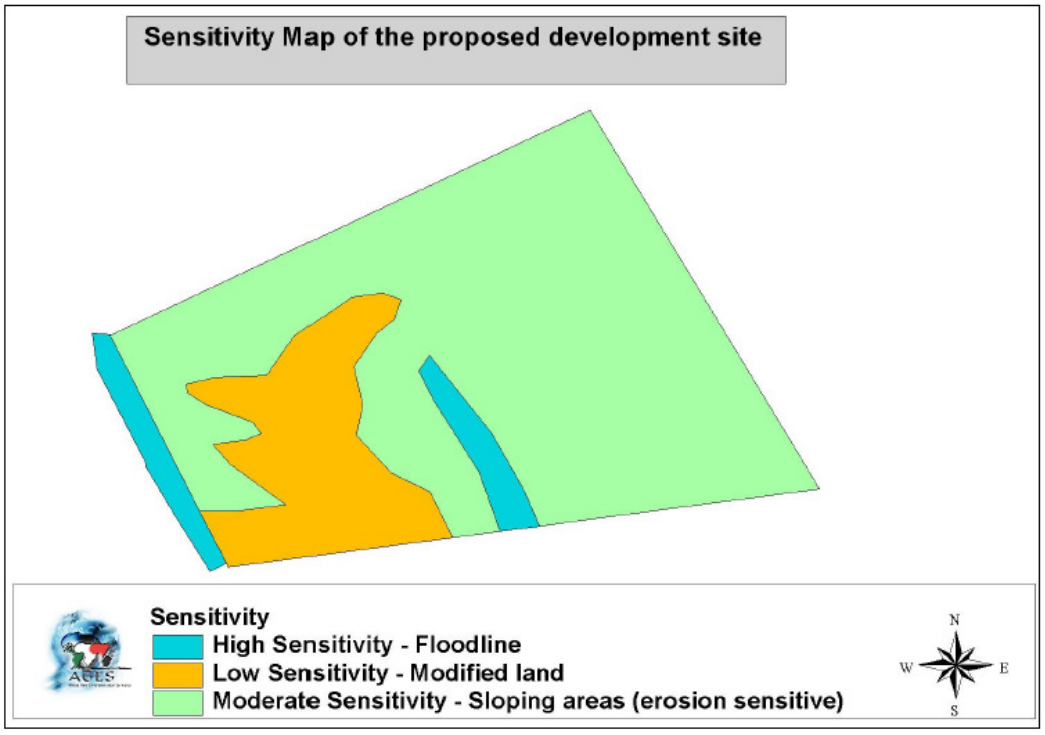


Table 5.5: General characteristics of identified vegetation units (AGES, 2007)

Characteristics	Drainage Channel & Floodplains	Exotic Plantations	Residential gardens
State	Degraded (encroached in certain areas)	Degraded (totally modified)	Open degraded grassland & residential gardens
Red data plant species	None	None	None
Dominant plant species	Bramble, *Pyracantha angustifolia, Solanum mauritianum, Acacia mearnsii*	*Acacia mearnsii, Acacia dealbata, Acacia melanoxylon, Solanum mauritianum, Azaleas, Eragrostis curvula,* exotic weeds	Garden ornamentals, lawns (*Cynodon dactylon, Pennisetum clandestinum*
Indicator species	Various sedges and grasses indicate seasonally wet areas. All species stated above indicate the degraded state of the vegetation in the drainage areas	All species noted above indicate typical exotic plantations. Exotic weeds also typical of these areas	Lawn, crab apples, azaleas, roses and may other exotics
Protected tree species	None	None	None
General (Landscape geomorphology, soil)	Alluvial soils. Moderately steep to steep edges – erosion sensitive. Floodline determination and geotechnical specialist studies needed.	Shallow red-yellow apedal soils on moderately steep to steep soils. Slope analysis and geotechnical surveys needed by specialist.	Shallow red-yellow apedal soils on moderately steep to steep soils. Slope analysis and geotechnical surveys needed by specialist.
Conservation priority	High – Floodline zone	Low – Degraded	Low - Degraded

* The cover and height of the different floristic components were not included since the areas were completely modified and unnatural

5.3.2. Specialist Vegetation Assessment – Prof George Bredenkamp (Eco-Agent)

5.3.2.1. Site description

The south-western portion of the site has been developed as a small resort with a residential house and several chalets, for recreational purposes. There is a developed garden with lawn grass, planted alien, ornamental trees and shrubs, a swimming pool and several paved roads or tracks for access to the chalets. The north-eastern portion is currently covered by a pine plantation. The northern and north-eastern parts are remains of an old plantation, currently dominated by weeds and alien encroacher species. A drainage line originates in the central part of the site and drains in a southward direction. A further drainage line, also draining southwards, is situated outside but immediately west of the site.

5.3.2.2. Methodology

Initial preparations consisted of obtaining all relevant maps as well as information on the natural environment of the concerned area. This includes information on red data plant species that may occur in the area.

Vegetation and habitat survey in each vegetation type / plant community on site

- List the plant species (trees, shrubs, grasses and herbaceous species) present for plant community and ecosystem delimitation.
- Identify potential red data plant species, alien plant species, and medicinal plants.

Plant community delimitation and description

- Process data (vegetation and habitat classification) to determine vegetation types (= plant communities) on an ecological basis.
- Describe the habitat and vegetation.
- Determine the sensitivity of each plant community on basis of plant diversity, veld condition and presence of rare or protected species.
- Prepare a vegetation map of the area if more than one plant community is present.
- Prepare a sensitivity map of the plant communities present.

General

- Identify and describe particular 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.

The vegetation was mapped into homogenous units based on a recent aerial photograph of the area. At several site localities a description of the dominant and characteristic species identified within the homogenous units was made. These descriptions were based on total floristic composition found in each unit, 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, was 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 other features that could have an ecological influence.

The identified systems are described in terms of their plant species composition, and evaluated in terms of the potential habitat for red data plant species.

Red data species as listed in Hilton-Taylor (1996) with updated threatened status according to IUCN 2000 by SANBI, were obtained. 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 Van Wyk, Van Oudtshoorn & Gericke (1997),

Conservation priority

The following five conservation priority categories were used for each vegetation unit:

High: Ecologically sensitive and valuable land with high species richness that should be conserved and no developed allowed.

Medium-high: Land where smaller sections are disturbed but which is in general ecologically sensitive to development/disturbances. This includes primary grassland that has been disturbed to a certain degree, but should recover when disturbances are removed, or when properly managed. Development will not be supported.

Medium: Land on which low impact development with limited impact on the vegetation / ecosystem could be considered. It is recommended that certain portions of the natural vegetation be maintained as open space.

Medium-low: Land that has little conservation value on which development could be supported. This includes secondary grassland with little chance to recover to typical primary condition.

Low: Land with no conservation value on which development could be supported.

Sensitivity

High: High and Medium-High conservation priority categories mentioned above are considered to have a High sensitivity and development should not be supported.

Low: Medium, Medium-Low and Low conservation priority categories mentioned above are considered to have a Low sensitivity and development may be supported. Portions of vegetation with a Medium conservation priority should be conserved.

5.3.2.3. Results

Broad vegetation types

The site is situated in the North Eastern Mountain Sourveld Veld Type as described by Acocks (1988). Low & Rebelo (1996) described the vegetation of the area as North Eastern Mountain Grassland. In the new vegetation map of South Africa (Mucina *&* Rutherford 2006) the area falls within the Woodbush Granite Grassland. The original grassland of the area was destroyed by the establishment of the plantations and the development of the recreational resort.

A few relicts of indigenous woody species at the plantation margin and also at the drainage lines suggest that there were elements of forest vegetation, representing relicts of the forest described in this Veld Type by Acocks (1988). These forests are named Northern Mistbelt Forest by Mucina *&* Rutherford (2006).

5.3.3. Vegetation description

The original vegetation of almost the entire site was destroyed or transformed. Infrastructure and gardens and also plantations replaced the original vegetation.

Four units were recognised:

- House and Chalet Area
- Plantation Area
- Old Plantation Area
- Drainage Line Area

The above-mentioned units are discussed in more detail in the following sections.

House and Chalet Area

Community 1: House and Chalet Area			
Status	Transformed		
Soil	Sandy loam,	**Rockiness**	0-5%
Conservation value	Low	**Sensitivity:**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	Garden ornamentals		

Several chalets, a house and outbuildings occur on the property. Many garden ornamentals were planted in this area. These include Azaleas, *Acacia dealbata, Acacia mearnsii, Acacia melanoxylon, Hibiscus sinensis, Cedrus deodara, Platanus* sp, *Cotoneaster* sp*, Prunus* sp *Pinus* sp, and several other exotic ornamental trees, shubs and garden flowering plants. Some indigenous tree species were also planted in the garden, e.g. *Olea europaea* subsp *africana* and *Podocarpus latifolius*. A few indigenous trees are still present locally, e.g. *Searsia pyroides* (= *Rhus pyroides*), *Leucosidea sericea, Buddleja salvifolia, Hypericum revolutum, Myrsine africana, Rhamnus prinoides* and *Celtis africana.* These species indicate that the vegetation of the House and Chalet Area originally had forest elements, now totally transformed.

More than half of the species recorded in the House and Chalet Area are aliens or weeds. No red data species or protected species were recorded. The built-up area and garden areas have no conservation value and a Low sensitivity. Please refer to the attached vegetation assessment for a list of plant species recorded in this unit.

Figure 5.6(a) and (b): Part of the house and chalet area

Plantation Area

Community 2: Plantation Area			
Status	Transformed		
Soil	Sandy loam	**Rockiness**	0-5%
Conservation value	Low	**Sensitivity:**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Pinus* sp. (Pine trees)		

A Pine plantation is present in the south-eastern portion of the site. The dominant plant species is therefore *Pinus* sp. Other species are lacking in the plantation, though some species occur on the plantation edge. The most conspicuous species include *Searsia pyroides* (= *Rhus pyroides*), *Rhamnus prinoides, Buddleja salvifolia, Hypericum revolutum, Rubus cuneifolius*, *Acacia dealbata, Acacia mearnsii, Solanum mauritianum* and *Cotoneaster* sp. Please refer to the attached vegetation assessment for a list of plant species recorded in this unit.

The slopes in this area are quite steep, this could be a limiting factor for the planned development. Erosion is a definite threat and erosion control measures and storm water management will be of great importance. From a vegetation perspective the Plantation area has Low conservation value and a Low sensitivity.

Figure 5.7: The plantation area

Old Plantation Area

Community 3: Old Plantation Area			
Status	Transformed		
Soil	Sandy loam	**Rockiness**	0-5%
Conservation value	Low	**Sensitivity:**	Low-Medium
Agricultural potential:	Low	**Need for rehabilitation**	Medium-High
Dominant spp.	*Pinus* sp. (Pine trees), *Solanum mauritianum* (Bugweed), *Acacia mearnsii* (Black Wattle), *Acacia dealbata* (Silver Wattle)		

A portion of the site was covered with pine and/or *Eucalyptus* plantation but these trees have been harvested some years ago. This area is currently seen as transformed. This area which covers the largest portion of the site is now dominated by alien invasive species and weeds, while indigenous species are scarce and restricted to the edges of the old plantation site.

The dominant plant species are weeds such as *Solanum mauritianum, Acacia mearnsii* and/or *Acacia dealbata, Lantana camara, Rubus cuneifolius, and Pinus* sp. Few individuals of indigenous species are found close to the old plantation edge. These include *Searsia pyroides* (= *Rhus pyroides*), *Rhamnus prinoides, Buddleja salvifolia, Hypericum revolutum* and *Celtis africana.* The most prominent forb species within this area are weeds. However, quite a number of forb species occur on the edges, especially along the roads, where they exist as relicts of the original vegetation. This area is very limited.

Please refer to the attached vegetation assessment for a list of plant species recorded in this unit.

Of the 18 woody species recorded in this area, nine were alien species, some of which are serious invaders. Furthermore, of the 31 forb species recorded, 15 were weeds. The weed species are dominant. The slopes in the southern part of this area are quite steep, this could be a limiting factor for the planned development. Erosion is a definite threat and erosion control measures and storm water management will be of great importance. From a vegetation perspective the Plantation area has Low conservation value and a Low sensitivity.

Figure 5.8: The old plantation area

Drainage line area

Community 4: Drainage Line Area			
Status	Drainage line		
Soil	Clay loam	**Rockiness**	0%
Conservation value	High	**Sensitivity:**	High
Agricultural potential:	Low	**Need for rehabilitation**	High (aliens)
Dominant spp.	*Solanum mauritianum* (Bugweed), *Rubus cuneifolius* (Blackberry)		

Vegetation Structure		
Layer	**Height (m)**	**Cover (%)**
Trees	4-5	5
Shrubs	1-3	10
Grass	1.2	50
Forbs	1.0	10

A *spruit* (small stream / drainage line) running southwards originates in the central part of the site. A further stream is located just outside the western boundary of the site, which is not included in this report. At the time of the survey (March 2008) very little running water was found in the *spruit*. The *spruit* area is much degraded; it was situated inside the old plantation and borders on the house area. Alien woody species and especially garden ornamentals occur on and down the banks. A few individuals of indigenous woody species are present. Small patches reeds (*Phragmites australis* and bulrush (*Typha capensis*) are present, while some hygrophilous grass species also occur in the stream bed.

Although quite disturbed and although not rich in plant species, the *spruit* area is considered **ecologically sensitive**. It serves as a natural watercourse that needs protection from any development. No development within the 1:100 year floodline will be supported., and therefore the *spruit* area has been incorporated intp the development plan as natural open space area which will not be developed. The area should be maintained as a natural open space and no lawn grass should be planted. Furthermore, all alien plant species along the *spruit* must be removed and controlled. These are declared weeds under the Conservation of Agricultural Resources Act (Act 43 of 1983). It is important to note that not all the alien invaders species should be removed at once as this would lead to severe soil erosion. An alien plant control management plan needs to be compiled before any action takes. It is suggested that for every alien tree that is removed, a new, indigenous tree be planted. By removing 20% of the invader species and replacing them with indigenous trees annually, this operation should take 5 years to complete.

The following is therefore suggested:

- No development can be supported within the 1:100 year flood line on both sides of the river.
- All alien species on the river banks should be removed and controlled and replaced by indigenous species
- Care should be taken that no erosion takes place along the river banks, during construction phases and there-after.
- The river and river bank area should be included in an open space plan, where the indigenous vegetation is protected and no planting of alien species allowed.

Figure 5.9: The drainage line area

5.3.4. Discussion

Following the investigation and ecological interpretation of the vegetation of the study area, some conclusions can be made.

Any development will have an effect on the environment in that most of the natural areas will be destroyed. However, the natural vegetation of the proposed development site is already destroyed on most of the site. The slopes on the southern / south-eastern part of the site are steep and erosion may be a problem to address. Erosion control measures and storm water control will be an essential condition for authorization of the development. From a vegetation ecology perspective, the site does not have specific conservation value, and development can be supported.

The drainage line area within the 1:100 year flood line is however ecologically sensitive and this area should be protected.
It should be emphasized that Woodbush Granite Grassland is a rare and endangered vegetation type containing several red data plant species. The original grassland of this particular site was however destroyed by the establishment of the plantations and the development of the recreational resort. Grassland in general is a very sensitive vegetation type which does not recover once destroyed. A totally different anthropogenic grassland may develop on such a destroyed site, but it will never regain its original species diversity. It is therefore important that the original intact grasslands in the Haenertsburg area be conserved, and possible developments in these grassland should be discouraged.

5.3.5. Potential impacts

Table 5.6: Potential impacts in terms of vegetation

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Removal of alien vegetation	Positive	Local	Long term	Medium	Definite	Medium
Fire risk associated with “hot” construction activities and workers smoking etc	Negative	Local	Short term	Unknown	Possible	Low

OPERATIONAL PHASE						
Reduction in the undeveloped area available as habitat	Negative	Local	Long term-permanent	Medium-low	Definite	Medium
Habitat destruction & fragmentation	Negative	Local	Long term-permanent	Medium	Definite	Medium
Rehabilitation of the flood line area	Positive	Local	Long term	Medium	Definite	Medium
Contribution to conservation of sensitive grassland outside the development	Positive	Local	Long term	Medium	Highly probable	Medium
Potential introduction of alien plants into gardens	Negative	Local	Long term	Medium	Possible	Medium

5.4. Fauna

Faunal assessments on the proposed development site consisted of the following:

- An **ecological assessment**, consisting of vegetation and faunal assessments, was conducted by Dr Buks Henning of Africa Geo-Environmental Services (AGES) during June 2007. His findings in terms of fauna are reported in this section.
- A specialist **faunal assessment** was conducted by Mr Dewald Kamffer of Ecocheck during January 2008.
- A specialist **herpetological assessment** with specific focus on frog species was conducted by Prof Les Minter of the University of Limpopo during October 2007.
- A specialist **reptile assessment** by Mr JJ Moller and Mr F Viljoen of Bateleur Environmental Services during October 2011.

The methodologies and findings of each of the above-mentioned studies are discussed in the following sections. Please note that in the case of the ecological assessment conducted by AGES, only the portion of the report relating to *fauna* is included in this section, as his findings in terms of vegetation are included in the vegetation section of this EIR.

5.4.1. Ecological Assessment – Dr Buks Henning (AGES)

5.4.1.1. Methodology

A healthy environment is inhabited by animals that vary from micro-organisms to birds and mammals, etc. A comprehensive survey of all animals is a time consuming task that would take a long time and several specialists to conduct. The alternative approach, which was followed for this assessment, is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study or on site, specialist surveys can then be conducted.

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats by identifying plant communities;
- A scoping survey was then conducted by comparing the habitat types identified with the preferred habitats of species occurring in the area;

- A list was compiled of all species of fauna and their status as observed on the site or that could potentially occur on the site. Notes were furthermore made of any specific sensitive or specialized habitats that occur on the site.

A species list of the red data species of the different faunal classes was obtained from the following references:

- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004);
- The Atlas of the Southern African Birds – digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town);
- Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland (Minter *et al*., 2004);
- South African Red Data Book – Reptiles and Amphibians, National Scientific Programmes Report no. 151;
- South African Red Data Book – Butterflies, South African National Scientific Programmes Report no. 158.

The habitat (plant communities) occurring on the property was compared to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled.

5.4.1.2. Results – Avifauna

Dr Henning conducted a survey on the study site during June 2007 to identify specific bird habitats and to compare these habitats with habitat preferences of birds occurring in the quarter degree grid according to Harrison *et al* (1997).

The Magoebaskloof area is a picturesque mountainous region speckled with pristine Afromontane forest pathes. Spectacular forests play host to a number of southern Africa's forest bird species, making the area a very worthwhile birding destination. Two of the most worthwhile forests in the area are the enormous Woodbush and small Swartbos forests – Woodbush is probably the best place in South Africa to see the Black-fronted Bush-shrike. However, the site is considered to be in a degraded state and many of the birds will not occur in such degraded areas due to their habitat requirements being different from that occurring on the site.

Habitats in the area include large expanses of Afromontane forest with a canopy height of 15 to 30 metres. The forests hold numerous small streams that cascade down the hills in ferns and moss-rich gullies. Special bird species that may occur in the Magoebaskloof area include the Cape Parrot, Black-fronted Bush-shrike, Yellow-streaked Greenbul, Orange Ground-Thrush, Buff-spotted Flufftail, African Olive-Pigeon, Tambourine Dove, Lemon Dove, Black Cuckoo, African Emerald Cuckoo, Narina Trogon, Olive Woodpecker, Grey Cuckooshrike and Green Twinspot.

Following is a list of red data species could potentially occur in the area. The detailed list of birds is included as Appendix B of the ecological report (which in turn is attached as Appendix I of this draft EIR).

Table 5.7: List of red data birds that could occur in the study area.

Rob	English Name	Afrikaans Name	Conservation status	Probability of occurrence on site
89	Marabou Stork	Maraboe	Near threatened	Medium
118	Secretarybird	Sekretarisvoël	Near threatened	Very low
122	Cape Vulture	Kransaasvoël	Vulnerable	Low
123	Whitebacked Vulture	Witrugaasvoël	Vulnerable	Low
129	Bat Hawk	Vlermuisvalk	Near threatened	High
132	Tawny Eagle	Roofarend	Vulnerable	Medium
138	Ayres' Eagle	Kleinjagarend	Near threatened	Medium
140	Martial Eagle	Breëkoparend	Vulnerable	Low
172	Lanner Falcon	Edelvalk	Near threatened	Medium
231	Stanley's Bustard	Veldpou	Vulnerable	Very Low
233	Whitebellied Korhaan	Witpenskorhaan	Vulnerable	Very Low
238	Blackbellied Korhaan	Langbeenkorhaan	Near threatened	Very Low
362	Cape Parrot	Woudpapegaai	Endangered	Medium
393	African Grass owl	Grasuil	Vulnerable	Very Low
463	Southern Ground Hornbill	Bromvoël	Vulnerable	Very Low
501	Shortclawed Lark	Kortkloulewerik	Near threatened	Very Low
521	Blue swallow	Blouswael	Critically endangered	Very Low

A total of 17 bird species are listed in the red data book of South African birds. The probability that most of the red data bird species occur on the specific site is, however, very low as a result of the following:

- Marginal habitat requirements observed on the proposed development site
- Degraded state of the vegetation in general
- Human disturbances in the general area of the proposed development area
- The relatively small area to be impacted on by the proposed development

The following is proposed considering the conservation management of bird species, their habitat and their feeding grounds:

- Vegetation should be rehabilitated in the open areas
- Gardens should incorporate indigenous vegetation to as large an extent as possible.

5.4.1.3. Results – Mammals

The following list of rare species can occur in the area according to Friedman & Daly (2004). Where animals or signs of them were seen, occurrence is indicated as confirmed. The complete list of potential mammal species occurring on site is included in Appendix B of the ecological report, which in turn is included as Appendix I of this draft EIR.

Table 5.8: List of red data mammals that could occur in the study area

Scientific name	Vernacular name	Probability of occurrence	Status (Friedman & Daly, 2004)
Cercopithecus mitis	Samango monkey	Medium	Vulnerable
Myotis tricolor	Welwitschi's hairy bat	Medium	Near threatened
Raphicerus sharpei	Sharp's grysbok	Low	Near threatened

Although the species listed above might occur in the area according to their distribution range as indicated in the Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004), species were only included if observed or if the habitat was considered suitable according to the species' habitat preference.

Species classified as "Least Concern" in the Red Data Book have a wide distribution range and monitoring over the long term is needed to prevent habitat fragmentation. Mammal species classified as being "Data Deficient" were no included in the list due to inadequate information being available to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

The probability that any of the species mentioned in the table above occur on the proposed development site is considered to be medium to low due to the close proximity to rural areas and anthropogenic influences in the area, as well as the degraded state of the vegetation. Species like samango monkeys prefer natural forest areas.

The following recommendations were made:

- More natural areas should be preserved as potential habitat and corridors for smaller mammal species. In this regard the drainage channels are anticipated to be more than sufficient on the site.
- No animals may be captured, killed or hunted.
- Poisons for the control of rats and mice should only be used after approval by the Environmental Control Officer or an ecologist.
- The above recommendations were made by Dr Henning. Detailed management and mitigation measures will be contained in the EMP, which will be made available for public review along with the draft Environmental Impact Report (EIR) before being submitted to L DEDET for decision making.

5.4.1.4. Results – Herpetofauna

The following list of rare species can occur in the area according to Friedman & Daly (2004). Where animals or signs of them were seen, occurrence is indicated as confirmed. The complete list of potential mammal species occurring on site is included in Appendix B of the ecological report, which in turn is included as Appendix I of this draft EIR.

The only species listed in the IUCN red data categories is the South African python, Methuen's Dwarf Gecko and the Northern Forest Rain Frog, while the black file snake and cape file snake are listed as protected species under the Limpopo Environmental Act. The close proximity to the residential areas and degraded state of the vegetation makes the probability of these species occurring on site low. A low diversity of amphibians could occur on the site as a result of little or no breeding habitat occurring (steep sloping drainage areas).

The following recommendations are made:

- No reptiles must be captured or killed.
- The habitat is of such a nature that the probability of any of the red data species or protected species occurring on site is low. However, it is proposed that a monitoring programme be implemented to document their status and occurrence in the general area.

5.4.1.5. Potential Impacts

According to the existing databases and the field survey, the following number of faunal species included in the IUCN Red Data lists could be found on the proposed development site:

Faunal group	Number of potential Red Data / protected species (Least Concern not included)
Mammals	3
Birds	17
Reptiles	4
Amphibians	1

The development will not have a significant impact on the potential faunal species habitat, as a result of the degraded state of the vegetation (exotic plantations) on site. Faunal species classified on the Red Data list mostly have a low probability of occurring on the proposed development site, due to the close proximity of the human activities of Haenertsburg and the degraded state of the vegetation. However, monitoring of these species still needs to be implemented in the general area to have a clearer indication of their distribution and status, and to prevent major habitat fragmentation.

The cumulative negative impact of the proposed development on the fauna and flora will be low because of the following:

- The areas proposed to be developed have already been disturbed;
- Corridors are proposed to be created for faunal species in the form of conservation of the drainage areas.

5.4.2. Specialist Faunal Assessment – Mr Dewald Kamffer (Ecocheck)

5.4.2.1. Methodology

- Mammals: Tracks and other ecological indicators coupled with visual sightings were used to provide an inventory of medium-sized and large mammals on site.
- Birds: Sounds and visual sightings were used to compile a list of the birds found in the study area.
- Invertebrates: Hand-netting was used to sample butterflies in order to confirm the absence/presence of red data butterflies in the study area.
- Data analysis: All GPS acquired data was converted from text to shapefiles to allow GIS analyses. Sensitivity maps were compiled once data analyses have been completed.

5.4.2.2. Assumptions and Limitations

- Faunal assessment studies of this nature are always limited in scope, time and budget. Discussions and proposed mitigation are made on assumptions, estimations and subjective reasoning. It should therefore be viewed and acted upon with these limitations in mind.
- Conclusions in this document are reached by assessing current knowledge of each species from the literature and personal experience. It is however unlikely that this would always be supported 100% by reality.

5.4.2.3. Results – Commonly occurring species encountered

Table 5.10: 9 butterfly species, 9 bird species and 2 mammal species are confirmed for the study area.

PHYLUM~ARTHROPODA; CLASS~INSECTA			
ORDER	**FAMILY**	**BIOLOGICAL NAME**	**ENGLISH NAME**
Lepidoptera	Nymphalidae	*Danaus chryssipus*	African Monarch
		Acraea acara	Acara Acraea
		Precis oenone	Blue Pansy
		Precis octavia	Gaudy Commodore
		Acraea horta	Garden Acraea
	Papilionidae	*Papilio nireus*	Green-banded Swallowtail
	Pieridae	*Eurema brigitta*	Broad-bordered Grass Yellow
	Lycaenidae	*Cacyreus marshalli*	Common Geranium Bronze
		Zizula hylax	Gaika Blue
PHYLUM~VERTEBRATA; CLASS~AVES			
ORDER	**FAMILY**	**BIOLOGICAL NAME**	**ENGLISH NAME**
Ciconiiformes	Threskiornithidae	*Bostrychia hagedash*	Hadeda Ibis
Falconiformes	Accipitridae	*Buteo rufofuscus*	Jackal Buzzard
Passeriformes	Hirundinidae	*Hirundo abyssinica*	Lesser Striped Swallow
		Hirundo rustica	Barn Swallow
	Pycnonotidae	*Pycnonotus tricolor*	Dark-capped Bulbul
	Cisticolidae	*Cisticola fulvicapillus*	Neddicky
	Nectariniidae	*Chalcomitra amethystina*	Amethyst Sunbird
	Motacillidae	*Macronyx capensis*	Cape Longclaw
	Ploceidae	*Euplectes afer*	Yellow-crowned Bishop
PHYLUM~VERTEBRATA; CLASS~MAMMALIA			
ORDER	**FAMILY**	**BIOLOGICAL NAME**	**ENGLISH NAME**
Primates	Cercopithecidae	*Cercopithecus aethiops*	Vervet Monkey
Artiodactyla	Bovidae	*Sylvicapra grimmia*	Common Duiker

5.4.2.4. Potential Red Data species

Seventy-five of the seventy-nine red data species that could occur in the study area are considered to have a **low** likelihood of occurring in the study area and 4 a **moderate** likelihood. Twenty-one of the species are listed as Data Deficient (DD), thirty-two as Near Threatened (NT), twenty as Vulnerable (VU), four as Endangered (EN) and two as Critically Endangered (CR).

Table 5.10: Red Data species that **may** occur in the study area

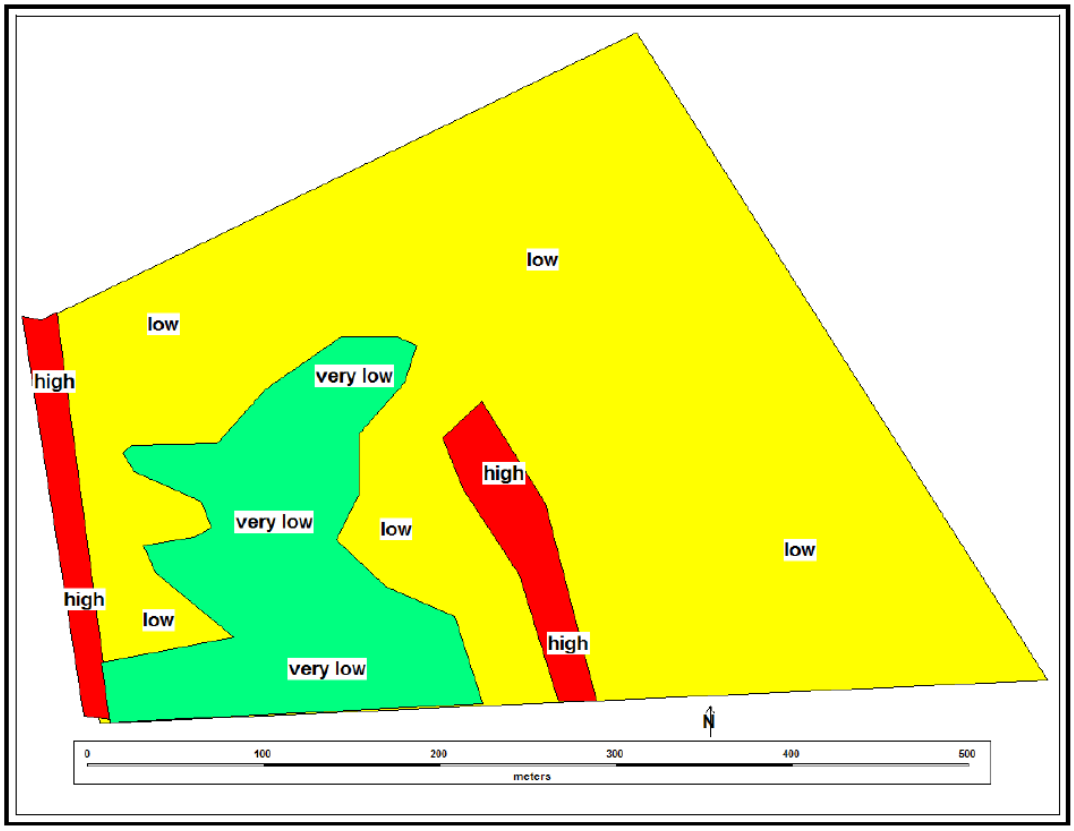
SPECIES DETAILS			RESULT
Biological Name	**English Name**	**RD**	**Probability**
INVERTEBRATES			
Alaena margaritacea	Wolkberg Zulu	CR	low
Aloeides stevensoni	Stevenson's Copper	VU	low
Dingana dingana clara	Wolkberg Widow	VU	low
Pseudonympha swanepoeli	Swanepoel's Brown	VU	low
BIRDS			
Pelecanus rufescens	Pink-backed Pelican	VU	low
Gorsachius leuconotus	White-backed Night-Heron	VU	low
Ciconia nigra	Black Stork	NT	low
Anastomus lamelligerus	African Openbill	NT	low
Ephippiorhynchus senegalensis	Saddle-billed Stork	EN	low
Leptoptilos crumeniferus	Marabou Stork	NT	low
Mycteria ibis	Yellow-billed Stork	NT	low
Geronticus calvus	Southern Bald Ibis	VU	low
Phoenicopterus ruber	Greater Flamingo	NT	low
Phoenicopterus minor	Lesser Flamingo	NT	low
Nettapus auritus	African Pygmy-Goose	NT	low
Sagittarius serpentarius	Secretarybird	NT	low
Gyps coprotheres	Cape Vulture	VU	low
Gyps africanus	White-backed Vulture	VU	low
Macheiramphus alcinus	Bat Hawk	NT	moderate
Aquila rapax	Tawny Eagle	VU	low
Hieraaetus ayresii	Ayres's Hawk-Eagle	NT	low
Polemaetus bellicosus	Martial Eagle	VU	moderate
Stephanoaetus coronatus	African Crowned Eagle	NT	low
Circus ranivorus	African Marsh-Harrier	VU	low
Circus macrourus	Pallid Harrier	NT	low
Falco peregrinus	Peregrine Falcon	NT	low
Falco biarmicus	Lanner Falcon	NT	low
Falco naumanni	Lesser Kestrel	VU	low
Anthropoides paradisea	Blue Crane	VU	low
Crex crex	Corn Crake	VU	low
Podica senegalensis	African Finfoot	VU	low
Neotis denhami	Denham's Bustard	VU	low
Eupodotis barrowii	Barrow's Korhaan	VU	low
Eupodotis melanogaster	Black-bellied Bustard	NT	low
Rostratula benghalensis	Greater Painted-snipe	NT	low
Poicephalus robustus	Cape Parrot	EN	low
Tyto capensis	African Grass-Owl	VU	low
Alcedo semitorquata	Half-collared Kingfisher	NT	low
Bucorvus leadbeateri	Southern Ground-Hornbill	VU	low
Certhilauda chuana	Short-clawed Lark	NT	low
Zoothera gurneyi	Orange Ground-Thrush	NT	low

Buphagus erythrorhynchus	Red-billed Oxpecker	NT	low
MAMMALS			
Cercopithecus mitis labiatus	Samango Monkey	EN	moderate
Cloeotis percivali	Short-eared Trident Bat	CR	low
Crocidura cyanea	Reddish-grey Musk Shrew	DD	low
Crocidura fuscomurina	Tiny Musk Shrew	DD	low
Crocidura hirta	Lesser Red Musk Shrew	DD	low
Crocidura mariquensis	Swamp Musk Shrew	DD	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	DD	low
Dasymys incomtus	Water Rat	NT	low
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	DD	low
Epomophorus gambianus crypturus	Gambian Epauletted Fruit Bat	DD	low
Grammomys dolichurus	Woodland Mouse	DD	low
Graphiurus platyops	Rock Dormouse	DD	low
Hipposideros caffer	Sundevall's Leaf-nosed Bat	DD	low
Hyaena brunnea	Brown Hyaena	NT	low
Lemniscomys rosalia	Single-striped Mouse	DD	moderate
Leptailurus serval	Serval	NT	low
Lutra maculicollis	Spotted-necked Otter	NT	low
Manis temminckii	Pangolin	VU	low
Mellivora capensis	Honey Badger	NT	low
Miniopterus schreibersii	Schreiber's Long-fingered Bat	NT	low
Mus neavei	Thomas' Pygmy Mouse	DD	low
Myosorex cafer	Dark-footed Forest Shrew	DD	low
Myosorex varius	Forest Shrew	DD	low
Myotis bocagei	Rufous Hairy Bat	DD	low
Myotis tricolor	Temminck's Hairy Bat	NT	low
Myotis welwitschii	Welwitsch's Hairy Bat	NT	low
Neamblysomus gunningi	Gunning's Golden Mole	EN	low
Paracynictis selousi	Selous' Mongoose	DD	low
Pipistrellus rusticus	Rusty Bat	NT	low
Poecilogale albinucha	African Weasel	DD	low
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	NT	low
Rhinolophus darlingi	Darling's Horseshoe Bat	NT	low
Rhinolophus hildebrantii	Hildebrant's Horseshoe Bat	NT	low
Rhynchogale melleri	Meller's Mongoose	DD	low
Suncus infinitesimus	Least Dwarf Shrew	DD	low
Suncus lixus	Greater Dwarf Shrew	DD	low
Tatera leucogaster	Bushveld Gerbil	DD	low

5.4.2.5. Sensitivity

The drainage channels are considered to have a high faunal sensitivity, the transformed areas (gardens and overnight accommodation) a very low sensitivity and the old and current pine plantations a low faunal sensitivity.

Figure 5.10: Faunal sensitivity map (Eco-Check, 2008)



5.4.2.6. Discussion

The study area falls within the regional vegetation community of Woodbush Granite Grassland, which is not protected and is considered to be Critically Endangered. Only 26% of the original habitat remains untransformed (8991 of 33986 Ha) and 0% of a targeted 27% of this vegetation type is under any protection. Most of the area has been transformed into exotic tree plantations. Patches of this highly threatened grassland habitat are still evident around the town of Haenertsburg; it acts as known habitat for many sensitive faunal species including the Critically Endangered Wolkberg Zulu (*Alaena margaritacea*). However, nowhere in the study area does any significant element of Woodbush Granite Grassland exist; the whole area has been transformed into exotic tree plantations and overnight accommodation (and associated infrastructure and gardens). The only significant elements of natural habitat remaining are limited to the two drainage lines.

None of the butterflies, birds or mammals confirmed as inhabitants of the study area are considered to be sensitive species – all of these species are widespread within the southern African subregion; they commonly found and not currently under threat (table 1).

Seventy-nine red data species (DD, NT, VU, EN or CR) are known from the region of the study area (table 5.8). Most of these species (95%) are deemed to have a low likelihood of occurring within the study area's boundaries; the rest only have a moderate probability of occurring (5%) – they could potentially utilize the study area as a migration route between areas of suitable habitat or as temporary refuges. The estimations of likelihood of occurrence of these species are a direct result of the transformed nature of the habitat in the study area.

In conclusion, the study area generally has a **very low faunal sensitivity** as a result of **the high degree of transformation**. The only areas that differ in terms of faunal sensitivity are the two **drainage lines** (one located onsite and one adjacent to the site) – these could still act as migration routes for smaller mammals, birds and invertebrates. It is not expected that the activities associated with the proposed project will significantly influence the fauna of the study area and surrounding areas.

5.4.3. Specialist Herpetological Assessment – Prof Les Minter (University of Limpopo)

5.4.3.1. Methodology

The assessment consisted of a survey of literature and data sources, supplemented with field investigations.

Literature / data sources:

- Amphibians were collected from the quarter-degree grid cell 2329DD Haenertsburg during Jacobsen's (1989) extensive field survey of the reptiles and amphibians of the Transvaal. His study included data from the literature and from museum collections in South Africa, Europe and the USA.
- A second, more recent source of data, was the Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter et. Al. 2004). The original data were obtained from the atlas data sheets for this quarter-degree grid cell (for 6 separate surveys).
- Information on the life history, habitat preferences and conservation status of *B. sylvestris* were obtained from the following scientific works: Jacobsen 1989; Minter 1998; Minter 2004; Minter et al. 2004; Poynton 1964; Wager 1965. Unpublished data from the author's current research on the reproductive biology and phenology of *B. sylvestris* in the Woodbush and Haenertsburg areas, were also included.

Field surveys

- Visual encounter survey (VES): This standard method (Heyer et al 1994) is useful for rapid evaluation of species richness in relatively open habitats. A limitation of this method is that its effectiveness is influenced by time of day and weather conditions.
- Systematic, medium intensity searches were carried out at night along access roads crossing the property and along its perimeter. A few transects across sections covered by dead pine and wattle branches and leaf litter, were also searched. The duration of each survey was approximately 90 minutes.

- Audio survey (AS): The species-specific nature of the frog call and the fact that *B. sylvestris* exhibits call site fidelity (i.e. individuals use the same call site on subsequent days/nights), made it possible to accurately locate males that were calling during the surveys. The position of each male was recorded on a map of the site (Fig.8). Other frog species calling on the property and in the surrounding area were identified by their calls and the chorus size and intensity was estimated.

- Straight-line drift fences and pitfall traps (PT): This standard method is commonly used to inventory and monitor amphibian and reptile populations and to determine species richness and detect the presence of rare species (Heyer et al 1994). The drift fences form barriers that direct the animals into traps (i.e. buckets) sunk into the ground at the ends of the fences.

  Three arrays (A1-3) were used in this study, each consisting of three drift fences radiating out from a central point (Fig. 5.6). Five-liter buckets were used as pitfall traps and the drift fences forming the three arms of the arrays were constructed of asbestos-cement fascia boards, and were 5m in length and 30cm

in height. These dimensions are adequate for the primary target species, *B. sylvestris*, as well as toads and various smaller frog species but not for larger, more agile species such as *Amietia angolensis.*

Figure 5.11: View of array A1 (drift fences and pitfall traps), facing SE.

Figure 5.12: View, facing east, of Cooyong Portion 2, showing access roads and the present ground cover.

Figure 5.13: View, facing north, of Cooyong Portion 2, situated on the far side of the tarred road, with Haenertsburg's water reservoirs and residences in the foreground. Cooyong 2's chalets and older buildings are seen at centre-left, while the firebreak running up the slope to the right of the cleared area forms the eastern boundary. The stand of pines on the right, just above the tarred road, occupies the south-eastern part of the property. The building with a black roof at bottom-right is *Picasso's* restaurant.

5.4.3.2. Assumptions and Limitations

- *Population size:* The audio survey, which proved to be the most productive method, was limited in that only sexually mature males were sampled: females and non-breeding (juvenile) males do not call. It was assumed that a 1:1 sex ratio pertains in *B. sylvestris* as is the case in most sexually reproducing animals.
- *Financial constraints:* There were no financial constraints to the study.
- *Time Constraints:* The period over which this survey took place did not represent a limitation with regard to *B. sylvestris*, as this species had commenced breeding in the area 2-3 weeks prior to the survey and continued for the duration of the survey. However, it is possible that the survey was concluded before certain other frog species had formed breeding assemblages.
- *Weather constraints:* The field survey was conducted at the beginning of the rainy season, mostly during overcast, drizzly or misty weather, i.e. ideal breeding conditions for *B. sylvestris* and other frog species. Therefore, weather conditions did not constitute a limitation in respect of this survey.
- *Confidentiality constraints:* There were no confidentiality constraints.
- *Implications for the study:* There were **no** significant limitations to this study.

5.4.3.3. Background on Breviceps sylvestris

B. sylvestris is a terrestrial breeder, laying its eggs in underground chambers away from water. The eggs contain large quantities of yolk which enables the tadpoles to complete their development without leaving the nest chamber. Breeding takes place after early spring rains, usually in September and October but may continue through November into early December (Minter 2004). During this time, adults are active on the surface in wet, misty weather throughout the day and night (Fig.9). The male uses an advertisement call to attract the female and during amplexus become glued to her back by a sticky secretion produced by both partners (Fig.6). A nest chamber is constructed in loose soil and leaf litter, a few cm. below the surface (pers. Obs.), often next to a rock or the roots of a sturdy plant (Sheila Thompson in Wager 1965). The female lays a single mass of 50-60 eggs, which are fertilised by the male and then covered by a layer of sterile jelly capsules

(Fig.7). The female remains with the tadpoles until development is completed, about 8 weeks later (ie. By late December to mid-January), when the juveniles emerge from the nest and disperse.

B. sylvestris inhabit Northern Mistbelt Forest and Woodbush Granite Grassland (Mucina & Rutherford 2006) where they feed on insects, amphipods, isopods and other invertebrates. Winter (ie. the dry season) is spent in a tunnel or chamber below the surface, presumably in a dormant state. Although individuals are occasionally heard calling after winter rains, breeding has not been recorded at this time of year.

Major threats to the survival of this species are habitat loss and fragmentation, due mainly to afforestation and other agricultural practices (Harrison et al 2000; IUCN 2006; Minter 2004). Although there are many instances of populations existing in artificial habitats such as wooded parks and gardens, it is not known whether these populations are viable in the long term. Males have also been observed calling from the edges of pine plantations adjacent to natural breeding habitat, but they do not appear to move more than a few meters into the plantations, and are not known to breed there successfully.

Figure 5.14: Male *Breviceps sylvestris* glued to the back of a female during amplexus

Figure 5.15: Exposed egg mass of *Breviceps sylvestris* from Woodbush.

5.4.3.4. Results and Comments: Literature survey and additional data sources

There are historical and recent records of 19 frog species from the quarter-degree grid cell 2329DD Haenertsburg (Jacobsen, 1989; Minter et. Al., 2004). *Xenopus laevis*, seems to have been overlooked during these surveys but does occur in the area (James Turner pers. Comm.), bringing the total to 20 species.

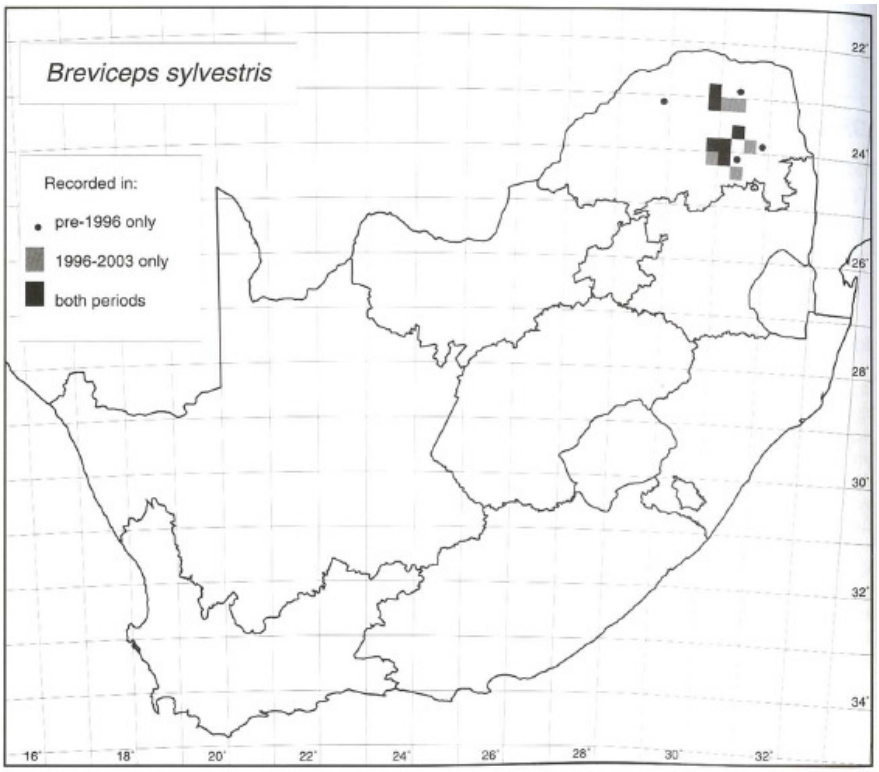
This relatively high diversity of frog species is partly due to the wide range of vegetation types and habitats present in 2329DD, ranging from relatively arid bushveld in the west, eg. Around Zion City Moria, Mangkoeng and west of Houtbosdorp, to relatively wet montane grassland and forest in the east. The original vegetation on Cooyong Portion 2 probably was Woodbush Granite Grassland and/or Northern Mistbelt Forest (sensu Mucina & Rutherford 2006). Taking into consideration the frog species known from these habitats, and the absence of running and standing water on Cooyong Portion 2, two terrestrial breeders (*Breviceps*) are likely to occupy the site permanently, while an additional eight aquatic breeders may use it when foraging (see Table 5.9; br = breeding).

Table 5.11: Species List for 2329DD Haenertsburg (nomenclature follows Frost et. Al., 2006).

	Data for 2329DD		Expected	Found
	Pre-1996	1996-2003	on site	on site
Bufonidae				
Poyntonophrynus (Bufo) fenoulheti	X			
Amietophrynus (Bufo) gutturalis	X	X	X	X
Amietophrynus (Bufo) rangeri	X		X	
Schismaderma carens	X			
Heleophrynidae				
Heleophryne natalensis	X	X		
Hyperoliidae				
Hyperolius marmoratus	X	X	X	
Kassina senegalensis	X	X	X	
Brevicipitidae				
Breviceps adspersus	X	X		
Breviceps mossambicus	X	X	X (br)	X
Breviceps sylvestris (Vulnerable)	X	X	X (br)	X
Pipidae				
Xenopus laevis		X		
Pyxicephalidae				
Cacosternum nanum	X			
Amietia (Afrana) angolensis	X	X	X	
Strongylopus fasciatus	X		X	
Strongylopus grayii	X			
Tomopterna cryptotis	X			
Tomopterna natalensis	X		X	
Phrynobatrachidae				
Phrynobatrachus natalensis	X			
Ptychadenidae				
Ptychadena anchietae	X			
Ptychadena porosissima	X		X	

Of the above, *Breviceps sylvestris* is the only frog species endemic to Limpopo Province) and is a threatened, red data species currently listed by the IUCN as **Vulnerable** (Harrison et al. 2000; IUCN 2006; Minter 2004).

Figure 5.16: Global distribution of *B. sylvestris* (from Minter et al. 2004)



Results and Comments: Field surveys

Visual encounter (VES), audio surveys (AS), and inspections of the pitfall traps (PT) were carried out as follows:

Date	Time	Survey method		
13th October	18:00 – 21:00	VES	AS	PT
14th October	17:00 – 20:00	VES	AS	PT
16th October	07:15 – 09:15		AS	PT
17th October	08:50 – 10:50		AS	PT
18th October	10:00 – 11:00		AS	PT
19th October	05:50 – 09:30		AS	PT
20th October	08:00 – 10:00		AS	PT
27th October	19:00 – 21:00	VES	AS	PT

- Visual encounter surveys
  The only amphibian species encountered during these surveys was the Guttural Toad, *Amietophrynus gutturalis.* This species was encountered after dark on the roads bordering and crossing Cooyong Portion 2 (also in the pitfall traps – see below). All were juveniles, probably dispersing from breeding sites located elsewhere. The highest number of individuals encountered on any one evening, was 9. Other frog species were not encountered during the VES, although *Kassina senegalensis, Amietia angolensis, Strongylopus fasciatus* and *Hyperolius marmoratus* were heard calling from water bodies on adjacent properties.

- Audio surveys (refer to Figs. 5.8 & 5.12 for locations mentioned below)

With regard to *Breviceps sylvestris* the following observations were made:

13th October, 18:00 – 21:00: The weather was clear following a hot, cloudless day, but rain had fallen on the previous day. A strong chorus of *B. sylvestris* had developed and 21 calling males were located: 3 near A1; 3 below A2; 3 in the drainage line between A3, the chalets and the road; 2 near the swimming pool; 10 scattered along the northern and eastern (powerline) boundaries.
14th October, 17:00 – 20:00: The weather was clear but a thunderstorm was developing. Four new *B. sylvestris* males were calling sporadically from the drainage line between the chalets and A3. Seven known specimens were calling from the same call sites as before.
16th October, 07:15 – 09:15: The weather was cold with heavy mist. A moderately strong *B. sylvestris* chorus had developed. Known males were calling from the same call sites and 8 new individuals were located.
17th October, 08:50 – 10:50. The weather was sunny but cool with a clear sky and a light breeze. No *B. sylvestris* males were heard.
18th October, 10:00 – 11:00: The weather was cool with low cloud and a light breeze. No *B. sylvestris* males were heard.
19th October, 05:50 – 09:30: The weather was cool and wet with heavy mist throughout the morning. A weak, slow, intermittent chorus of *B. sylvestris* was heard. Five new males were located amongst the leaf litter under the pines on the SE part of the property above Picasso, and also on the cleared slopes above the pines.
20th October, 08:00 – 10:00: A strong chorus of *B. sylvestris* was present. Known males were calling from the same call sites and about 7 new males were located in various parts of the property.
27th October, 19:00 – 21:00: The weather was overcast and fairly cold, but calm. The rain, drizzle, mist and wind of the previous two days had cleared. *B. sylvestris* was calling sporadically and 13 new males were located: 3 in the drainage line, 5 on the SE slopes above Picasso, and 5 elsewhere on the property.

The location of the above individuals is indicated in Fig. 5.12. In total, 58 males were located on Portion 2 of Cooyong and an additional 10 on adjoining land. Assuming that a 1:1 sex ratio pertains, at least 116 adult *B. sylvestris* could be expected to occur on the property (i.e. approximately 9.3 individuals per hectare). This is higher than expected considering the degree of habitat alteration and degradation that has taken place on the property, but substantially lower than the population density of this species in areas such as the Woodbush indigenous forests (pers. Obs.).

In addition to *B. sylvestris,* the following frog species were heard calling on Cooyong Portion 2 (*B. mossambicus*) or in its vicinity during this survey:

- *Amietophrynus gutturalis* – small to moderate choruses comprising 10-50 individuals were heard calling from breeding sites on farmland to the NW and from Haenertsburg to the south.
- *Breviceps mossambicus* – on the 27th October, 10-20 males were calling near Picasso on the SE corner of Cooyong Portion 2 and in the drainage line. This was the first record of this species this season. No calls were heard on the upper slopes.
- *Hyperolius marmoratus* – a small chorus of 5-10 individuals was heard in vegetation bordering the Kantoorspruit near Picasso.
- *Kassina senegalensis* – 3-5 males were heard calling from the same breeding sites as *A. gutturalis* (above).

- Straight-line drift fences and pitfall traps
  The following vertebrate species were collected from the three arrays (A1, A2, A3)

  - A 1: 6 x *Amietophrynus gutturalis* juveniles.
    1 x *Breviceps sylvestris* (adult male)
    2 x *Trachylepis varia* (skink)

  - A 2.: 4 x *Amietophrynus gutturalis* juveniles.
    1 x *Breviceps sylvestris* (adult female)
    1 x *Dendromus mesomelas* (Brant's climbing mouse)
    2 x shrews

  - A 3: 3 x *Amietophrynus gutturalis* juveniles.
    1 x *Breviceps sylvestris* (subadult)
    1 x shrew

  Invertebrates found in the traps included tenebrionid and carabid beetles, crickets (Gryllidae), king crickets (Gryllacrididae), centipedes, millipedes and lycosid and other spiders.

Figure 5.17: Plan of the proposed development showing the positions of the pitfall trap arrays and calling male *Breviceps sylvestris* located during this survey ***(please note that the layout has since changed)***.

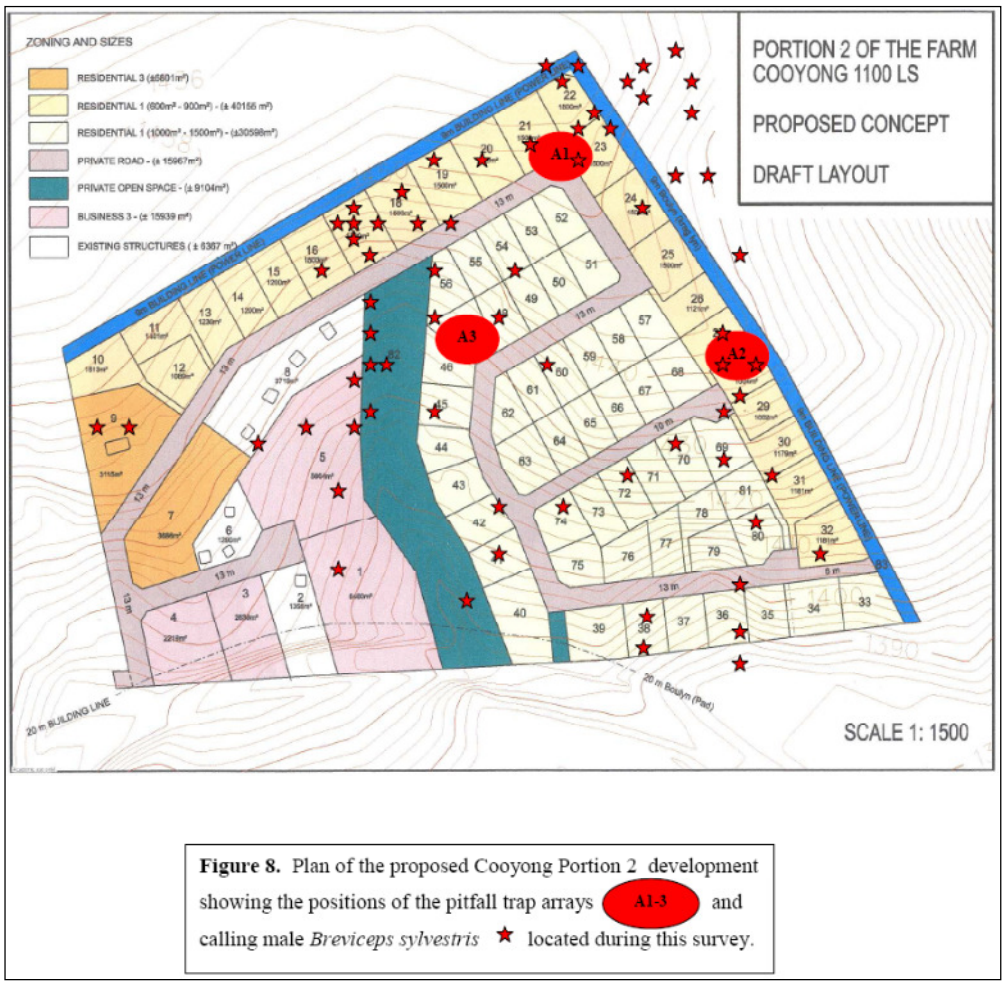


Figure 8. Plan of the proposed Cooyong Portion 2 development showing the positions of the pitfall trap arrays A1-3 and calling male *Breviceps sylvestris* ★ located during this survey.

Micro-habitat occupied by *B. sylvestris* onsite

On Cooyong Portion 2, *B.* sylvestris was encountered wherever there was sufficient plant debris or living vegetation to provide a shaded, humid environment. Fewer individuals were found in the gardens and lawns between the chalets and other buildings on the property (Fig.13). This may be accounted for by the disturbance and/or removal of individuals during garden maintenance (e.g. mowing of lawns), road kills, domestic cats, or the use of insecticides.

Accumulations of plant debris and mounds of loose soil produced by harvesting of the timber, grading of access roads, removal of stumps, etc., provide suitable nesting sites for *Breviceps*, and may partly account for the distribution pattern of the males encountered during the survey.

Figure 5.18: View to the NE from Residential stand 16. In early spring strong *Breviceps* choruses develop in this type of weather. On this occasion a number of *B. sylvestris* males were calling in the vicinity of the dead tree in the foreground.

Potential threats to the resident *B. sylvestris* population on Cooyong Portion 2:

The proposed transformation of this property into a housing estate has significant implications for the resident *B. sylvestris*. It will entail the removal/burning of the existing cover of pine needles, branches and tree stumps and extensive earthworks to construct roads and stormwater drains, stabilise slopes, level building sites and dig trenches for sewerage pipes and underground cables. During this process it is likely that many, if not all resident *B. sylvestris* individuals will be killed or displaced.

While it is feasible to rehabilitate land that has been used for agriculture, a housing development represents a permanent alteration or loss of natural habitat. It is important to note that the natural vegetation type in this area, Woodbush Granite Grassland, is critically endangered, and that the remaining 10% is not conserved (Mucina & Rutherford 2006).

The major threats to the survival of *B. sylvestris* have been identified as habitat loss and fragmentation and road kills. Due to its severely fragmented and restricted distribution (area of occupancy: 501-2000km^2), the rate at which its habitat is disappearing (>20% in the last 50 years), and the predicted decline in population sizes (>20% in the next 30 years), the species has been placed in the "Vulnerable" category of threat (Harrison et al. 2000; IUCN 2006; Minter 2004).

Furthermore, this is the only endemic frog species in Limpopo Province (Fig.5) and as such, is considered a conservation priority in this Province.

Figure 5.19: View to the west from array A3, across the drainage line to the chalets and other existing buildings and their surrounding gardens and mowed lawns.

Figure 5.20: View from the tarred road northwards, showing the drainage line designated as "Private Open Space" (Fig.5.15). No running or standing water was present

Recommendations / Mitigating measures

The farming of exotic trees on Cooyong Portion 2 has resulted in a considerable reduction in biodiversity as well as changes in edaphic* factors such as the moisture content and pH of the soil. Although *B. sylvestris* are sometimes found on the fringes of pine plantations and along the roads that pass through them, they do not penetrate very deep within pure stands of pine (Minter, pers. Obs.) and it is unlikely that pine plantations can sustain populations of *B. sylvestris* in the long term.

* Edaphic: Relating to soil.

The above does not, however, justify the conversion of Cooyong Portion 2 into a housing development: rather a compromise should be reached which would satisfy both the developer and the need to protect this threatened frog species and its habitat. To this end it is recommended that the developer be required to:

- Compensate for the loss of *B. sylvestris* habitat by means of a conservation offset, i.e. the rehabilitation and maintenance of an equivalent area of *B. sylvestris* habitat adjacent to or within the development. For example, the "private open space" could be extended to include the area assigned to Residential stands 42-45 and 57-68 (Figs 5.12, 5.14 and 5.15). Alternatively, the developer could contribute to the rehabilitation and maintenance of the grassland and forest on the Haenertsburg commonage (Fig.5.16) and a maintenance fund and management committee could be established. Efforts are presently being made to proclaim this land as a Protected Area. These costs could be built into the purchase price of the business and residential stands and maintenance costs could be covered by an annual conservation levy paid by the owners of the stands.

- Plan and execute the development of Cooyong Portion 2 in a way that is conducive to maintaining a resident population of *B. sylvestris.* To this end, it is recommended that:

  - Exotic vegetation be removed with due regard to the sensitivity of amphibians to herbicides such as "Roundup". If no effective alternative to Roundup is available, then the variety of Roundup that lacks a wetting agent should be used. Spraying should only take place during the months when the frogs are not active on the surface and should be carefully monitored.
  - Only vegetation indigenous to the immediate area should be planted. The use of lawn grasses such as *Pennisetum clandistinium* (Kikuyu) and *Cynodon dactylon* (Kweek) should be avoided entirely. Limited areas of paving around buildings should be considered as an alternative to lawns.
  - Woodbush Granite Grassland should be re-introduced in the areas designated as "private open space", where appropriate. A grassland specialist should be consulted in this regard.
  - Compacting of soil must be avoided within the public open space.
  - Connectivity between the development, the open space system and adjacent land must be ensured to enable the movement of *B. sylvestris* through the development. For example, boundary walls (if any) should incorporate regularly spaced openings at their base to allow for the entry/exit of small animals.
  - The possibility of capturing as many individuals as possible during the breeding season and translocating them to adjacent land, could be considered (a permit would have to be obtained).

- An ecological management plan (EMP) for the open space system must be compiled by a suitably qualified specialist for implementation by the appropriate management authority (e.g. the body corporate) that is contractually bound to implement the EMP. The EMP should include:
  - a fire management programme to ensure the persistence of grassland
  - an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species.
  - measures to ensure the persistence of red list species such as *B. sylvestris.*
  - a monitoring programme for *B. sylvestris* that requires an annual census (October / November) in order to track changes in distribution and population size. This would inform the management policy of the estate and provide useful guidance for similar developments in the surrounding area.
  - measures that facilitate/augment natural ecological processes
  - measures that minimise artificial edge effects (e.g. water runoff from developed areas and application of chemicals).

- An annual report on the ecological management of the estate must be produced and made available to all interested parties, such as relevant Government Departments (Conservation, SANBI) and public organisations concerned with the protection of the environment.
- Clear, informative signage warning drivers of the presence of *B. sylvestris* on the property should be erected and maintained at the entrance to the development.
- Residents of the housing development should be provided with explicit information about *B. sylvestris*, such as its conservation status, biology and habitat preferences, and guidelines with regard to its protection on their property. They should also be encouraged to create and maintain breeding habitat for this species. The presence of *B. sylvestris* on Cooyong Portion 2 should be regarded as a valuable and unique asset. This would help to foster an appreciation of the natural environment.
- Residents should not be permitted to keep cats on their properties, as these animals prey on frogs and other small animals and will bring about a significant reduction in the *B. sylvestris* population.
- The profiles of kerbstones on the sides of roads in the development should not have vertical or near-vertical sides as this would act as a barrier, leading frogs into the storm water drains and culverts where they could be trapped and perish.

Figure 5.21: View, to the north, of Woodbush Granite Grassland and a small forest patch on Haenertsburg Commonage. Note the extensive loss of habitat, in the background, to alien tree species, predominantly pine.

5.4.4. Specialist Reptile Assessment – Bateleur Environmental Services

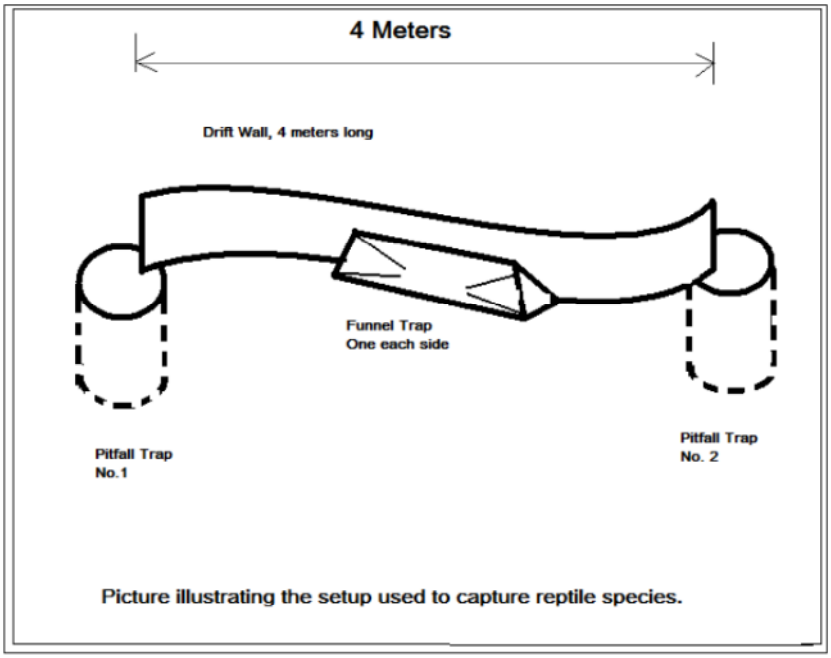
5.4.4.1. Methodology

A literature survey was followed by a site survey. Data was collected and incorporated with the literature study in order to create a holistic picture of the specific environment. With the initial assessment GPS points were taken at main points of interest such as the property borders, rocky outcrops and trap sites. Photos were taken to form visual evidence for later referral.

An active search for reptiles was conducted, and during the active search specific habitat types were surveyed. The specific needs of different reptile species were also taken into account. Reptiles that were found supported relevant literature as did informal interviews with some of the farm workers. Three separate trap systems were then set out in each of the identified habitat types. Each trap system consisted of two pitfall traps, a 4m drift-wall and two funnel traps. Four funnel traps were also placed at random sites on the property where natural or manmade drift-walls were available.

The study was conducted after the first rains of the season, as this would increase possible observations when active searches were conducted and also improve chances of capturing reptile species in funnel and pitfall traps. Reptiles become more active during this part of the year due to higher daytime temperatures and the abundance of typical food items.

Figure 5.22: Illustration of the setup of traps used to capture reptile species.



5.4.3.5. Habitat assessment

The veld type can be classified as Wood-brush / Granite Grassland which is in a heavily modified state. Almost no trace of the historical veld type exists on site. The current vegetation on site ranges from degraded to semi-natural. The bulk of the site consists of alien forest vegetation. Prey items occur in relatively low numbers while water is readily available. A few rocky outcrops are present on site. Soil types were not ideal for burrowing species. The site is generally cut off from other more viable sites in the area with high risk in crossing from one area to another due to roads and associated infrastructure. Habitat suitability for reptile species was poor. The following table provides a detailed list of habitat aspects and suitability ratings.

Table 5.12: Assessment of habitat suitability in terms of relevant habitat aspects

No.	Aspect	Suitability
1	Vegetation	Totally transformed due to alien plants and buildings
2	Veld type	Woodbrush – Granite Grassland – in a highly modified state
3	Available cover	Majority of site consists of alien thicket
4	Signs of food / prey	Pray items such as mice, insects and frogs were encountered, but numbers would be low due to the ecological state of the site
5	Availability of water	Water is available
6	Degree of transformation	95% transformed
7	Habitat description	severely degraded and not in its natural state any more
8	Suitability of habitat for reptile species	Low
9	Rocks / outcrops / boulders	Present
10	Soil depth and type	Glenrosa and Shortland soil types, not particularly suitable for burrowing species preferring loose soil, but provided good soil for cover
11	Surrounding immediate area	The site is isolated as it is cut off from other viable sites by roads and alien vegetation
12	Possible risk	High risk due to roads, pipes and fences
13	Slope	Severe slope
14	Size of property	12.7 hectares in extent

Skinks and seps are found in fairly friable soils, under rocks and logs, or around the base of shrubs or grasses in the humus rich leaf litter and can live in moist conditions. They are found in a variety of vegetation types including montane grassland and forest. Not much is known about their diet, but it is believed that they feed on a variety of invertebrates. They are mainly found in islands of montane evergreen high forest and adjacent montane grasslands that are isolated by plantations, roads and other developments; which pose a serious threat to these species.

5.4.3.6. Species survey

The literature survey was found to be on par with the site survey in terms of the habitat and species that were found. Species lists were drawn up for reptiles and can be found in the attached reptile assessment report.
By studying the habitat of the site, it was possible to determine with fair accuracy the species which would occur on site.

Because of the degraded and neglected state of the ecosystem, biodiversity was found to be relatively low and as such very few species would and actually did occur on site.

5.4.3.7. Protected species

The following reptile species are protected in terms of the National Environmental Management: Biodiversity Act (NEMBA) and/or the Limpopo Environmental Management Act (LEMA):

Table 5.13: Protected reptile species

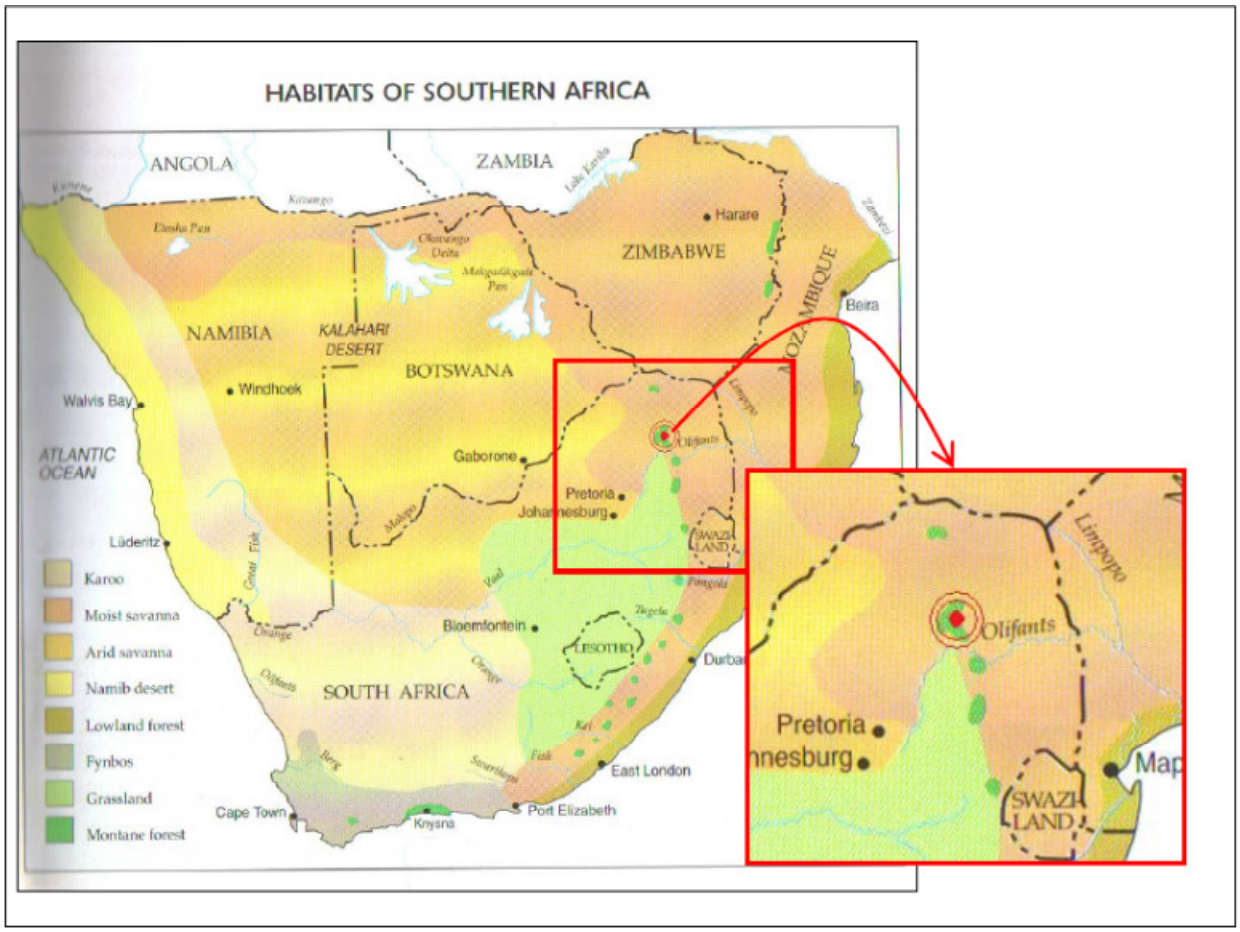
Scientific name	Common name	Conservation status	Probability of occurrence
Python natalensis	African Rock Python	Protected	Medium
Mehelya nyassae	Black File Snake	Protected	Medium
Mehelya capensis	Cape File Snake	Protected	Medium

A total of 93 reptile species may occur onsite, of which 67 are indigenous; 26 of these species are endemic to the area. Of the species that may occur onsite, 6 are Red Data listed and 9 are IUCN listed. 3 species are protected by NEMBA and/or LEMA, and two are listed in Appendix II of CITES (Convention on the International Trade in Endangered Species).

5.4.3.8. Species distribution

The main focus of the assessment was the Eastwood's Long-tailed Seps and the Woodbush Legless Skink, in order to determine the suitability of the site as habitat for these species and to gauge the likelihood of specimens occurring on the proposed development site. The following figure gives an indication of the presumed distribution of these species (please note, though, that Eastwood's Long-tailed Seps is listed as extinct by the IUCN).

Figure 5.23: Distribution of the Eastwood's Long-tailed Seps and Woodbush Legless Skink



***Tetradactylus eastwoodae* - Eastwood's Long tailed Seps**

The Eastwood's Long tailed Seps or Eastwood's Whip Lizard (*Tetradactylus eastwoodae*) was a species of lizard in the Cordylidae family. It was endemic to South Africa and its natural habitat was subtropical or tropical

high-altitude grassland. It is presumed to have become extinct due to habitat loss; the IUCN also lists this species as extinct. The species was originally discovered in the Woodbush forest close to Haenertsburg in the Limpopo province. Since its discovery in 1913 it has not been observed again.

The area is now under extensive pine plantations and it is likely that this modification of habitat has resulted in the demise of the species. Very little is known about the actual habitat of this species. Some scientists believe that it could still be present in some small pockets of vegetation, but others believe it is indeed extinct or could be restricted to the Woodbush forest alone. It appears though that, if the species is still holding on, its habitat is severely fragmented and that it is only present in the most pristine pockets of micro habitats left.

***Acontophiops lineatus* - Woodbush Legless skink**

The Woodbush Legless skink is listed by the IUCN as Vulnerable on account of its very restricted distribution and apparent rarity and is listed in the South African Red data book as Restricted. This as an unusual burrowing skink that seems to be an intermediate stage between the greater legless skink and the blind legless skink. It is endemic to the Limpopo Province. Much of their habitat has been destroyed by pine plantations at Woodbush, but there is a healthy population on the Wolkberg.

Figure 5.24: Woodbush Legless Skink

5.4.3.9. Impacts and recommendations

Construction activities are expected to lead to destruction of reptile habitat. Furthermore, waste generation during the construction phase may have a direct or indirect detrimental impact on reptiles and their habitat.

During the operational phase, the following impacts may be anticipated:

- The use of internal roads is expected to lead to an increase in road kill of reptiles trying to cross the roads.
- A potentially positive impact is that food items disposed by residents as waste can be anticipated to attract rodents and cockroaches, which in turn serve as food for some reptiles and may boost their numbers.
- The use of poisons to control pest populations may lead to unintentional secondary poisoning of reptiles.
- Human and reptile conflict – possible catching and/or killing of reptiles.

The above-mentioned potential impacts of the proposed development are expected to have a localised impact, limited to the immediate surrounding environment. The duration of the impact will be long-term: 25 years and more. The severity of the impacts can be rated as low. The probability of the impact can be reduced from medium to low should conservation measures be adhered to for the proposed establishment.

The significance of the impact on reptile species, in particular *A. lineatus* and *T. Eastwoodae*, can be rated as low.

This specific site is already disturbed by previous forestry activities and the presence of numerous alien invasive species, therefore biodiversity within the site is relatively low. Due to the ecology of the site being highly transformed from its natural state, it is **highly unlikely** that any of the two species in question (*A. lineatus* and *T. Eastwoodae*) would occur on the site. The amount of buildings and road infrastructure already present on site also reduces the chances of occurrence. The soil types present (Glenrosa and Hutton) are not the preferred soil types for these species as the structure of the soil makes burrowing difficult. The site is also cut off from any vegetation that could support these to reptile species by pine plantations at the one end and a main road and the town of Haenertsburg on the other.

The current habitat is also not suitable for most other reptile species which would naturally occur in the area as it is in an ecologically degraded state and has little biodiversity. There is therefore no reason for the establishment not to continue, from the viewpoint of the reptile assessment which has been conducted and documented, as long as the recommendations are adhered to and sustained.

5.4.4. Potential impacts

Table 5.14: Potential impacts in terms of fauna

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Habitat destruction and/or fragmentation	Negative	Local	Long term-permanent	Medium-High	Definite	Medium-High
Faunal fatalities resulting from construction-related activities	Negative	Local	Short term	Low	Highly probable	Low-Medium
Disruption of the activities of fauna on and around the site	Negative	Local	Short term	Low-Medium, depending on development stage	Highly probable	Low-Medium, depending on development stage
Trapping / hunting / killing fauna by labourers	Negative	Local	Short term	Low	Possible	Low
OPERATIONAL PHASE						
Road fatalities within the development	Negative	Local	Long term	Low-Medium	Highly probable	Medium
Faunal fatalities due to garden chemicals	Negative	Local	Long term	Low-Medium, depending on degree of mitigation	Possible	Low-Medium, depending on degree of mitigation
Killing of fauna, e.g. spiders or frogs, by residents	Negative	Local	Long term	Low	Possible	Low
Habitat fragmentation	Negative	Local	Long term-permanent	Medium-High	Definite	Medium-High
Reduction in the undeveloped area available as habitat	Negative	Local	Long term-permanent	Medium	Definite	Medium
Improvement of habitat for *Breviceps sylvestris*	Positive	Local	Long term	Low-Medium, depending on degree of implementation	Possible	Low-Medium, depending on degree of implementation
Rehabilitation of habitat in the flood line area	Positive	Local	Long term	Medium	Highly probable	Medium
Contribution to conservation of habitat in sensitive grassland outside development	Positive	Local	Long term	Medium	Highly probable	Medium

6. ENVIRONMENTAL IMPACT ASSESSMENT – SOCIO-ECONOMIC INVESTIGATIONS

6.1. Heritage Assessment

A Phase 1 Heritage Impact Assessment (HIA) was conducted by Mr Stephan Gaigher in accordance with section 38 of the National Heritage Resources Act (Act 25 of 1999) during June 2007 in order to determine the presence or not of heritage resources such as archaeological and historical sites and features, graves and places of religious and cultural significance, and to submit appropriate recommendations with regard to the cultural resources management measures that may be required at affected sites / features, as the proposed activity might potentially be harmful to heritage resources that might occur in the demarcated area.

A Phase 2 HIA was undertaken by Mr Gaigher in 2010 to investigate the potential impact of the proposed development on the historic building which is situated on the property (although not on the part of the property which is proposed to be developed).

6.1.1. Methodology

This section provides a very brief summary of the methodology followed by the specialist. More detail on the methodology followed by the archaeologist is provided in the attached HIA report.

The **Phase 1** HIA made use of inventory studies involving the in-field survey and recording of archaeological resources within a proposed development area, as well as site surveying, which is the process by which archaeological sites are located and identified on the ground and which includes both a systematic surface inspection and subsurface testing. Survey sampling was also done; this involves the complete or partial inspection of a proposed project area for the purpose of locating archaeological or other heritage sites.

A **Phase 2** assessment was subsequently undertaken to evaluate potential impacts of the proposed development on the historic building on the property, and to provide recommendations as to the most appropriate manner in which the resource may be managed in light of the identified impacts. In this phase, the identified structure was evaluated through archival and document studies, and several types of significance were taken into account, including scientific, public, ethnic, historic and economic significance.

Site integrity, or the degree to which a heritage site has been impaired or disturbed as a result of past land alteration, is an important consideration in evaluating site significance. In this regard, it is important to recognize that although an archaeological site has been disturbed, it may still contain important scientific information.

6.1.2. Resource Inventory

CRD 001
GPS: 23° 56’ 20.8” S
29° 56’ 13.1” E

At the time of the Phase 1 assessment, this site consisted of one dilapidated occupational structure. The building had several rooms and was built in the early-colonial, western style. It is constructed from clay bricks and where left intact the roof is constructed from corrugated iron sheets. A concrete floor serves the structure. Several of the walls were also formed out of combinations of bricks, concrete and corrugated iron sheets.

At the time of the Phase 2 assessment, the structure was being converted to a private dwelling by the owner of that portion of the property (not the developer / applicant for this proposed project).

6.1.3. Resource evaluation

CRD 001

The building is obviously from the post-contact phase and shows strong colonial and western influences in its design and construction. The building style, using corrugated metal sheets as walling material, dates from the era between 1900 and 1960 whereafter this type of construction was less often found in formal designs. Interviews with local inhabitants indicated that the structure functioned as a general store until the early 1960s (no specific date was given). After this it served subsequently as accommodation and storage and finally fell into disrepair sometime during the 1980s.

No dates could be found on the building itself to corroborate the statements of the local inhabitants, although the building style and materials used are in line with the oral history of the structure. The identified structure was evaluated through archival and document studies. The original registration deed, edited from 1908, shows no structures on the site. No structures are evident up to the 1908 editing of the 1887 deed. It is therefore still possible that the structure is older than 60 years (built between 1909 and 1950.

At the public meeting held on 18 July 2007 as part of the EIA for another proposed development (on Portion 2 of the farm Eindelik 1082-LS and the Remainder of the farm Cooyong 1100-LS), Mr Graham McComb, a local resident, landowner (farm Bali-Will-Will) and ward councillor at the time, indicated that the building is indeed more than 60 years old and used to be run as a store known as Adam's Store. According to Mr McComb, the owner, an Indian gentleman by the name of Mr Adam, was later evicted from the area under the Group Areas Act (under the previous government) and the building was subsequently occupied by squatters.

It is certain that the structure dates from at least the 1950s (although it is probably much older) and was constructed after 1908.

Table 6.1: Site significance evaluation

Site significance characteristics slide scale (post-contact criteria)	
Scientific significance	2
Historic significance	3
Public significance	3
Other significance	2
Ethnic significance	1
Economic significance	2
Total score	13

This score places the site within the category of **high significance**; however, the development will **not** be affecting the site.

6.1.4. Impact identification and assessment

CRD 001

The structures at CER 001 will **not** be directly impacted by the proposed development, but it has been restored and converted to a residence by the landowner (not the applicant). The structure has limited historic importance.

Table 6.2: Impact effect

Impact Effect	Score
Magnitude	4
Severity	4
Duration	1
Range	4
Frequency	1
Diversity	3
Cumulative effect	4
Rate of change	4
Total score	25

A score of 25 or higher indicates total destruction of the site and its attributes.

6.1.5. Resource management recommendations

The following recommendations are given for the mitigation of the site identified at CRD 001:

- Provided the layout of the residential development is not altered, the identified site will not be affected by the proposed development;
- No further mitigative work is needed for the preservation of this site.

6.1.6. Potential impacts

As the site is not to be affected by the proposed development of the residential complex, no negative impacts are anticipated, provided the layout of the residential development is not altered.

Table 6.3: Potential heritage impacts

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
No negative impacts are expected, as found through the Phase 2 Heritage Impact Assessment.						
OPERATIONAL PHASE						
No negative impacts are expected, as found through the Phase 2 Heritage Impact Assessment.						

6.2. Social Aspects

The proposed development site forms part of the Greater Tzaneen Municipality within the Mopani District of the Limpopo Province.

6.2.1. Haenertsburg and surrounds

The Haenertsburg area, where the proposed development site is situated, has seen very slow development since the establishment of the town. The village is relatively compact, with approximately 120 homes and a number of small, mostly tourism-centred businesses clustered along a handful of streets on a slope to the south of the R71 (Polokwane-Tzaneen road). A number of homesteads and guesthouses / lodges are dotted along the hills around the town, and a road camp, housing road workers, has in the more recent past been established directly to the east of the village.

Commercial activity in Haenertsburg is limited to a grocery store, convenience store, filling station, a number restaurants, overnight accommodation and shops aimed primarily at tourists. No industrial activities take place in the village itself and a retirement village forms part of Haenertsburg. A large number of the employed residents commute to either Polokwane or Tzaneen for work.

Tourism is a vital industry in and around Haenertsburg (refer to section 6.3), and many of the local jobs are in this sector. Tourism ranges from adventure and nature-based tourism to holistic tours, art and crafts. The village is both a tourism destination in its own right and a stop-off *en route* to other tourist attractions such as the Kruger National Park, Modjadji Cycad Reserve, etc.

The following are the main factors that have arrested Haenertsburg's development:

- A lack of industries or large businesses results in a dearth of job opportunities in the direct vicinity of Haenertsburg;
- Lack of service infrastructure. Haenertsburg has no formalised sewerage disposal or treatment infrastructure and dwellings or businesses have therefore had to install French drains. Water and electricity supply infrastructure is available, but supply for expansion of the village has been limited. Currently, no additional electricity is available for new development; the Greater Tzaneen Municipality is, however, planning on upgrading the Haenertsburg mini-substation to increase electricity supply;
- Much of the land around the town is in private ownership. The area not forming part of the Haenertsburg Commonage consists mostly of private pine plantations;
- Topographical constraints: the area around Haenertsburg is undulating and in places relatively steep, with streams bisecting the landscape in places. The terrain has therefore not been conducive to organic expansion of the town beyond a certain point;
- Ecological constraints: the Haenertsburg Commonage consists of the critically endangered vegetation type Woodbush Granite Grassland. The ecological sensitivity of this area has discouraged development into the Commonage.

6.2.2. Greater Tzaneen Municipality

Information was gleaned from the GTM Integrated Development Plan (IDP) for 2011 to 2012.

6.2.2.1. Location

The GTM forms part of the Mopani District in the Limpopo Province. The municipal area, which covers roughly 3 240 km^2, extends from Haenertsburg in the west to Rubbervale in the east (a distance of 85 km), and from just south of Modjadjiskloof in the north to Trichardtsdal in the south (47 km).

The GTM comprises the proclaimed towns of Tzaneen, Nkowankowa, Lenyenye, Letsitele and Haenertsburg, together with 125 rural villages. The municipal area is divided into 34 wards.

6.2.2.2. Population

At the time of the 2001 national census, a population of 375 588 was recorded within the GTM. The population is largely youthful (74% of the population was aged 35 and younger) and female (54.4%). Almost 80% of the population resides in rural villages.

The population is mostly black (± 98.6% according to the 2007 Community Survey), with the minority consisting of white (1%), Indian / Asian (0.3%) and Coloured (0,1%). The most widely spoken first language is SePedi (53%), followed by XiTsonga (42%), Afrikaans (2%) and English (0.7%). The other 7 official languages and other languages are represented by a small minority.

6.2.2.3. Income, employment and education

Unemployment within GTM, although worryingly high, is lower than the national or provincial averages, and was at 20% at the time of the 2007 Community Survey. In 2001 (according to Census data) 85% of households earned less than R19 200 per year.

In 2007, only 46.6% of the adult population had an education level higher than Grade 7, and only 7.6% had any tertiary qualification. Approximately 36.7% had no schooling at all.

6.2.2.4. Land ownership and claims

Approximately 66% of land within the municipal area is privately owned, whilst approximately 33% is owned by the state. Of the latter, most is administered by traditional authorities. A negligible extent of land constitutes municipal commonage.

Almost 45 land claims have been lodged on land within the GTM's boundaries, many of which are still being investigated by the Land Claims Commission. There are no known land claims on the proposed development site.

6.2.2.5. Economic activities and opportunities

The agricultural sector is the main employer within the GTM, providing 40% of the available jobs within the GTM's area of jurisdiction. Community, social and other personal services supply 34% of jobs, followed by trade, catering and accommodation (7%), manufacturing (5%) and finance and business services (5%). Other economic sectors provide a minority of job opportunities.

The sector supplying the greatest proportion of the GTM's Gross Domestic Product (GDP) is Community Services (32%), followed by Finance (24%) and Trade (10%).

The GTM is the main contributor to the Mopani District's agricultural GDP (Gross Domestic Product), supplying 43% of the district's agricultural GDP.

6.2.3. Infrastructure and services

Water: The GTM has applied to the Department of Water Affairs (DWA) for an increased allocation to abstract raw water for purification and supply to residents. However, due to the pressure on the Ebenezer and Tzaneen Dams, DWA has not yet been able to grant such an increase, and hence water supply is a concern over the long term. Certain infrastructural projects are in the pipeline, such as raising the Tzaneen Dam wall and establishing a new dam near Nwamitwa; however, it is not known if or when these projects will be implemented. The GTM's drinking water quality is very good, and the GTM was awarded Blue Drop status by DWA in 2009 for the high quality of drinking water. Many of the rural areas are supplied by boreholes that are managed by the Mopani District Municipality (MDM).

Sanitation: Much of the municipal area, specifically in the extensive rural areas, relies on Ventilated Improved Pit (VIP) toilets; it is the MDM's responsibility to install these. Haenertsburg relies on individual septic tanks and French drains, whilst Tzaneen, Nkowankowa and Lenyenye have waterborne sewerage. Farms generally make use of septic tanks and French drains. Several villages have been, or are in the process of being, reticulated with waterborne sewerage.

Electricity: Electricity over most of the municipal area is provided by the GTM, but Nkowankowa, Lenyenye and the southernmost areas of the municipal area are supplied directly by Eskom. The GTM also supplies electricity to certain areas which do not fall within its area of jurisdiction, including Eiland and Gravelotte. Major investments have been made into electricity supply infrastructure in Tzaneen over the past approximately 2 years, which has improved the reliability and future capacity of electricity supply. The electrification backlog is estimated at 17.2%. Free basic electricity is provided to 7 306 households.

Housing: There is a backlog of more than 13 000 RDP houses and 403 middle income beneficiareis, but challenges are experienced in terms of the availability of land for the provision of these houses.

Health care: There are 29 clinics, 4 health centres and 165 visiting points within the municipal area, but only 16 of the visiting points have functioning structures, with the rest of the visiting points being community centres, day-care centres, farms or even just designated trees.

Waste management: Kerbside refuse removal is provided in Tzaneen, Lenyenye, Nkowankowa, Haenertsburg and Letsitele and disposal is done at the landfill site at Tzaneen; however, this constitutes only 11% of the households within the municipal area. Very little at-source recycling is done, but basic composting of garden waste is done adjacent to the landfill site.

Access: The Greater Tzaneen area has a well-developed network of primary and secondary arterial routes, and indeed the formal urban component (*viz*. Tzaneen, Nkowankowa and Lenyenye) have developed along a major arterial route. However, the majority of villages in the municipal area have limited accessibility as a result of inadequate access roads and internal street networks. Haenertsburg has excellent accessibility from the R71, which is currently being upgraded by SANRAL.

6.2.4. Potential impacts

The following short-term socio-economic impacts may be expected during the construction phase of the proposed project:

- Creation of employment opportunities, mostly in the form of unskilled labour hired on a short-term basis during construction;
- Support of local job opportunities through support of local businesses in the procurement of materials, equipment and services to be used in the construction phase, as well as the support of local shops by construction workers who are likely to purchase food locally while onsite;
- The possibility exists that construction workers may trespass onto neighbouring properties and that workers may be rowdy and noisy. An increase in criminal activity, linked to construction workers, may also be experienced;
- Job-seekers might be expected to come to the area in search of work related to the project. However, this is not anticipated to be a significant impact, as there is little, if any, accommodation for such job-seekers and the town is situated quite a distance from the nearest villages from where job-seekers are likely to come;
- Construction-related noise resulting mostly from construction machinery (particularly during earthworks and establishment of services), offloading of construction materials, and construction vehicles / plant on the road.

Impacts during the operational phase may relate to the following:

- Creation of long-term job opportunities, mostly relating to domestic workers and gardeners in the residential component of the proposed development, and staff at the business component. Certain of these positions are likely to be filled from the current resident population of Haenertsburg, but many of the job opportunities (such as domestic workers and gardeners) are likely to be filled by outsiders who do not currently reside in Haenertsburg nor are likely to purchase homes / stands in the proposed development, as the people who are likely to fill these positions do not generally have the financial means to live in more upmarket areas such as this. Accommodation would therefore need to be provided for these workers, or transport would need to be provided from e.g. Tzaneen or Seshego;
- The local resident population is anticipated to swell due to the increase in residential property available for purchase in the area. Though some of the dwellings may be anticipated to be purchased or built as holiday or weekend homes, many are likely to serve as permanent residences. An increased local population may be viewed as either positive or negative: local business owners might view it as positive due to the larger local market for their goods or services, but based on the results of public participation thus far it is evident that residents see it in a negative light due to the potential social and environmental impacts associated with a growing population;
- Local businesses may find increasing numbers of customers drawn from the ranks of new residents;
- New businesses forming part of the proposed new development may, however, serve as competition for existing businesses and restaurants in the area;
- Haenertsburg's "village" ambience may be impacted on by the growing population and expanding developed area;
- Noise impacts are expected to relate mostly to the noise of increased traffic to and from the new development, and normal domestic sounds emanating from the development, such as voices talking, dogs barking or music being played. These are, however, not anticipated to impact significantly on Haenertsburg, particularly if proper management measures are in place.

Table 6.8: Potential social impacts

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Employment creation and/or sustaining of jobs in construction-related fields	Positive	Local	Short term	Low-Medium	Definite	Medium
Supporting local businesses through local procurement of materials, equipment & services	Positive	Local to Sub-regional	Short term	Low	Highly probable	Low
Influx of job-seekers into Haenertsburg	Negative	Local	Short term	Low	Possible	Low
Trespassing and/or potential increase in criminal activity	Negative	Local	Short term	Unknown	Possible	Low-medium
Potential rowdiness	Negative	Local	Short term	Low	Possible	Low
OPERATIONAL PHASE						
Employment creation	Positive	Sub-regional	Long term	Low-medium	Highly probable	Low
Increase in local population due to increased number of dwellings	Positive or negative (depending on perspective)	Sub-regional	Long term	Medium-high	Definite	Medium
Support of local businesses by increased populace	Positive	Local	Long term	Low-medium	Highly probable	Low-medium
New businesses and restaurants may compete with existing establishments	Negative	Local	Long term	Unknown	Highly probable	Medium
Impact on the "village" ambience	Negative	Local	Long term	Medium - high	Highly probable	Medium –high

6.3. Tourism

6.3.1. Status quo

Tourism is a prominent aspect of the local economy in the Haenertsburg area. Haenertsburg is considered Limpopo Province's answer to attractions such as Pilgrim's Rest and Dullstroom, although, unlike Pilgrim's Rest, Haenertsburg is a fully functional village and not a contrived "museum town". The village is located near the Wolkberg Mountains and is situated in a very scenic part of the Limpopo escarpment area which offers attractions such as Magoebaskloof, the Modjadji Cycad Forest, a large number of game lodges, etc.

The village is both a tourism destination in its own right and a stop-off *en route* to other tourist attractions such as the Kruger National Park, Modjadji Cycad Reserve, etc. Local tourism ranges from adventure and nature-based tourism (e.g. Thaba Metsi Adventures, Magoebaskloof Adventures and Magoebaskloof Canopy Tour) to holistic tours, art and crafts. Tourist attractions in the area include trout fishing, horse-back riding, hiking, mountain biking, forest trails, canopy tours, 4x4 trails, birding, art galleries, craft centres, tea gardens, cheese making tours and many more. Annual events that draw tourists from very different sectors include the Spring Fair, Glenfiddich HTA Trout Fair, Ebenezer Mile (swimming), Berry Festival, Kiwi Festival and the Silvermist Holistic and Health Fair. Accommodation types include Bed & Breakfast chalets, log cabins, self-catering cottages, country hotels and lodges.

Tourist activities in the area include the following (information obtained from the website of the Magoebaskloof Tourism Association):

Table 6.9: Some of the tourist attractions and activities in the Haenertsburg and Magoebaskloof area

Adventure and ecotourism	
Abseiling / climbing / kloofing / tubing	Magoebaskloof Adventures
	Thaba Metsi Adventures
Biking (motorbike) and quad-biking	Magoebaskloof Adventures
	Thaba Metsi Adventures
Birding	Debegeni Waterfall
	Kudu's Valley, between Houtboschdorp and Mooketsi
	Kurisa Moya Nature Lodge
	Local bird guides
	Louis Changuion Hiking Trail and Haenertsburg Grasslands
	Woodbush Drive
Canopy tours	Magoebaskloof Canopy Tours
Fishing	Bellerieve Dam
	Bergplaas River
	Bramasole Dam
	Cheerio Gardens Trout Fishing Resort
	Dap Naude Dam
	Diepgelegen
	Dodingtons Weir
	Ebenezer Dam
	Goedvertrouen River
	Kromdraai River
	Lakeside and Stanford Lake
	Haenertsburg Trout Association
	Rondefontein Dam
	Stream below Dap Naude Dam
Hiking	Lesodi hiking trail
	Louis Changuion Hiking Trail in the Haenertsburg Grasslands
	Wolkberg overnight hiking trail in the Wolkberg Wilderness Area outside Haenertsburg
	Magoebaskloof overnight hiking trail (consisting of various combinations of short routes), under the management of Komatiland Forests
	Short routes at Wegraakbosch Organic Dairy, Black Forest Mountain Lodge, Growth Centre, etc.
Horse-back riding	Silvermist Resort
	Thaba Metsi Adventures
Mountainbiking	Thaba Metsi Adventures
	Trails in forestry areas
Picnicking	Debegeni Waterfall
	Picnic sites in forestry areas
4x4	Thaba Metsi Adventures
Fairs / Festivals	
Berry Festival	Annual festival held in February
Ebenezer Mile	Annual open-water swimming competition held in March
Glenfiddich HTA Trout Festival	Annual festival held in November
Kiwi Festival	Annual festival held in April
Silvermist Holistic and Health Fair	Annual festival held in June

Spring Fair	Annual festival held in September / October
General	
Applegrange Farm	
Cheerio Gardens	
Kuhestan Persian products, cooking classes and overnight accommodation	
Restaurants, pubs and tea gardens	
Several nurseries	
Wegraakbosch Organic Dairy	
Historical	
Cemetery, with many historical graves	
Collection of historical memorabilia in the hall at the municipal offices	
Monuments commemorating the Makgoba War and Anglo-Boer War (now known as the South African War)	
Open-air museum in Mare Street	
Remains of the last Long Tom gun	

Table 6.10: Some of the overnight accommodation available in and around Haenertsburg

Backpackers	
Satvik Backpackers	
Bed & Breakfasts / Guesthouses	
Bali Will-Will	Kaya Khutšo
Black Forest Mountain Lodge	MaGriet's B&B
Bramasole Guesthouse	Magoebaskloof Getaway
Glenshiel Country Retreat	Serala Heights Luxury B&B
Camping / Caravanning	
Bali Will-Will	Rheebokvlei Mountain Wilderness
Black Forest Mountain Lodge	Satvik Backpackers
Magoebaskloof Getaway	Silvermist Resort
Magoebaskloof Rest Camp	
Hotels	
Orion Magoebaskloof Hotel	Glenshiel Hotel
Self-catering	
Agoris Cabin	Lamei Lodge
Bali Will-Will	Little Thorntree
Bifrost Country Restreat	Little Haven
Black Forest Mountain Lodge	Magoebaskloof Birders Cottage
Boscobel Country Cottages	Magoebaskloof Getaway
Bramasole Guesthouse	Magoebaskloof Rest Camp
Cair Paravel Cottages	Pavetta Country House
Canadian Log Cabins	Sequoia Gardens Self-Catering Cottage
Cheerio Gardens Self-Catering Cottages	Saether's Cottage
Cheerio Trout Fishing Resort	Satvik Backpackers
Die Kothuis	Shuari Lodge
Kuhestan Farm Cottages	Stanford Lake Lodge
Mountain Flyfishing	The Pennefather Self-Catering Cottage
Oaklands Cabin	Woodmere Lodge
Owl Cottage	Zwakala River Retreat
Kurisa Moya Nature Lodge	

6.3.2. Potential impacts

The proposed development may impact either positively or negatively on the local tourism industry. Positive impacts may be linked to the fact that the local population is likely to increase, bringing with it an increased demand for local activities such as hiking, fishing, birding, fairs, etc. Negative impacts may result from the potential impacts of the proposed development on the local sense of place, which is one of the attractions of Haenertsburg for tourists.

Table 6.11: Potential tourism-related impacts

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Discouraging tourism due to negative visual and noise impacts, and impacts on sense of place	Negative	Local	Short term	Unknown	Possible	Low-Medium
OPERATIONAL PHASE						
Tourism boost due to increased population making use of tourism facilities and activities	Positive	Local	Long term – Permanent	Unknown	Possible	Medium
Discouraging tourism due to negative visual impacts, and impacts on sense of place	Negative	Local	Long term – Permanent	Unknown	Possible	Medium

6.4. Visual Aspects and Light Pollution

6.4.1. Status quo

The site is situated on a slope facing the village of Haenertsburg. The relatively busy R71 (the main Polokwane-Haenertsburg-Tzaneen road) separates the site from the village. The south-western part of the site is occupied by overnight chalets with accompanying lawns and gardens on terraces. The remainder of the site is mainly occupied by regrowth of the previous pine plantations, together with indigenous vegetation with an infestation of weeds and alien encroacher species (more information in this regard is contained in the section containing the results of the vegetation assessment).

The property is bordered on three sides (west, north and east) by forestry (pine plantations). The southern boundary is formed by the R71 road, beyond which is a vacant property with degraded vegetation. To the south-east a coffee shop (Picasso's) is situated, surrounded by pine plantation.

The higher-lying parts of the site have sweeping views of Haenertsburg and the surrounding hills and grasslands. Similarly, parts of the site are highly visible from Haenertsburg town and surrounds.

6.4.2. Potential impacts

The proposed development, if authorised, would be visible from Haenertsburg as well as to vehicles travelling between Polokwane and Haenertsburg or the areas beyond (e.g. Tzaneen) on the section of the R71 which passes Haenertsburg, and hence visual impacts during both the construction phase and the operational phase would affect travellers on this section of the R71 as well as residents of, and visitors to, the village of Haenertsburg.

Lighting from the proposed development can furthermore be expected to be visible from the R71 and from the village, if standard lighting fixtures are used which "waste" light upward and outward. Shielding of light fixtures

(including street lighting and outdoor lighting associated with dwellings and shops) should be installed in order to minimise this impact; please refer to the EMP, which contains measures in this regard.

6.4.2.1. Construction phase

Construction-phase visual impacts are short-term in nature and relate to construction activities such as clearing of vegetation, earthworks, the presence of construction vehicles, machinery and construction materials, and the presence of partly finished buildings during the construction phase. Visual impacts may also be experienced at night as a result of lighting onsite for security purposes.

The greatest impact will most likely be associated with the initial establishment of service infrastructure by the developer. This phase will comprise terracing, earthworks, road construction, pipe laying and installation of the sewage package plant. Subsequent construction of homes is anticipated to be smaller-scale and spread over a period of approximately 2 years, as buyers of stands in the development can be expected to construct homes in a staggered fashion. Visual impacts during this latter home construction phase will be smaller in scale than the impacts that will be experienced during the service establishment phase, but will be experienced over more protracted period.

6.4.2.2. Operational phase

Operational-phase impacts are long-term to permanent and relate to the alteration of the visual landscape as a result of the development itself, i.e. the replacement of open space and vegetation by built structures and paved surfaces. The modification of the sloping hillside into terraces will add to the visual impact of the development.

In order for the proposed development to blend in with the village Haenertsburg to as large an extent as possible, it is proposed that persons purchasing stands in the proposed development not be bound to a specific building style or colour scheme in the design of their dwellings. This is the direct opposite of the policy followed by many new developments country-wide, whereby dwellings are required to follow a specific style and colour, thereby leading to the swathes of homogeneous, monotonous buildings that have come to characterise certain areas, such as the so-called “new east” of Tshwane.

The purpose of not prescribing a specific style in this proposed development is to avoid homogeneity and to promote a diversity of styles according to the owners’ tastes in order to mimic the existing diverse situation in Haenertsburg, which is characterised by an eclectic mix of styles, colours and designs which form an interesting whole. In mimicking the diversity of the village, the visual impact of the proposed development is anticipated to be ameliorated to an extent. However, certain aesthetic guidelines will be in place, and all dwellings will be required by the homeowners’ association to conform to these general guidelines to prevent the construction of buildings which would be a crass visual intrusion on the landscape. Guidelines will be enforced by the aesthetic committee under the homeowners’ association, and will, for instance, regulate paint colours and require building plans to be approved by the aesthetic committee before construction.

The development is proposed to be walled for security purposes. The wall is likely to serve as a visual barrier, reducing the feeling of integration of the proposed development into the village.

By night, lighting from dwellings as well as street lights will be visible if normal, upward-scattering lighting fixtures are installed. If not properly managed, this would constitute light pollution. However, the

recommendations of the International Dark-Sky Association and *ASTROLab du Mont Megantic* are proposed to be incorporated into the lighting design of the proposed development in order to substantially reduce potential light pollution impacts. These measures aim to eliminate the upward scattering of light, instead concentrating light downwards onto the object / area requiring lighting, thereby largely eliminating the glow often found over inhabited areas at night.

Table 6.12: Potential visual impacts

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Construction activities and site clearing	Negative	Local	Short term	Low – high (depending on the stage of construction)	Definite	Low – high (depending on the stage of construction)
OPERATIONAL PHASE						
Visual impact of the development (day time)	Negative	Local	Long term	Medium-high	Definite	Medium-high
Light pollution	Negative	Local	Long term	Low – high (depending on level of mitigation)	Probable	Low – high (depending on level of mitigation)

6.5. Noise

6.5.1. Status quo

Current ambient noise in the vicinity of the proposed development site is mostly associated with motor vehicle traffic on the busy R71 road (the main road between Polokwane and Tzaneen) which passes by the site. Noise associated with roadworks on the R71 beside the site is also currently experienced, but this is short term in nature.

6.5.2. Potential impacts

Construction-phase impacts are anticipated to be mainly associated with construction activities themselves, including earthworks, off-loading of material from trucks, etc., as well as with increased traffic during construction (construction vehicles and the transport of construction workers).

Construction-phase impacts will be short-term in duration, occurring only whilst construction is underway. The level of noise generation is anticipated to vary over the course of the construction period, as different noise levels can be expected to be associated with earthworks, installation of services and construction of buildings. Generally, the highest noise levels are anticipated to be experienced during earthworks and installation of services due to the heavy, noisy machinery involved in these processes, whilst relatively lower noise levels are expected during building construction, when a larger proportion of the work will be done manually.

Given the short-term nature of anticipated construction phase noise impacts, these impacts are anticipated to be of low significance.

Though the proposed township itself (during the **operational phase**) is not a noise generating activity, a certain amount of noise can be anticipated to be generated by the additional motor vehicle trips which will be generated by residents, workers (domestic workers and gardeners) and visitors to the residential component of the project, as well as customers and workers at the proposed commercial premises. If adequate measures

are not enforced, impacts may also be experienced in terms of music from dwellings or the barking of dogs kept as pets – however, it is considered unlikely that such noise impacts would be felt in Haenertsburg village, due to the distance separating the site from the village and the noise experienced from the R71 road. Noise impacts are anticipated to be of low significance if mitigation measures are followed (e.g. curfew after which music will not be allowed to be audible outside the boundaries of each stand).

Table 6.11: Potential impacts in terms of noise

CONSTRUCTION PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Noise associated with increased traffic (heavy vehicles) during construction	Negative	Local	Short term	Low	Probable	Low
Noise associated with construction activities	Negative	Local	Short term	Medium	Probable	Low
OPERATIONAL PHASE						
Noise associated with increased traffic	Negative	Local	Long term	Low	Probable	Low
Loud music, barking of pet dogs and other sounds of human habitation	Negative	Local	Long term	Very low	Probable	Very low

6.6. Cumulative impacts

As is the case for any activity, impacts are not limited to those directly or even indirectly associated with the proposed activity – potential cumulative impacts need to be considered as well, so that activities can be seen not as stand-alone entities but as part of the larger picture of which they inevitably form part.

Should this proposed development be implemented, it may serve as a precedent to stimulate further similar development in the area. The additional residents that are likely to be drawn to Haenertsburg by the greater availability of residential stands or homes, may further act as incentive for development of new facilities such as shops, or expansion of existing such facilities to cater for the larger population.

The impacts that are anticipated to be associated with this proposed development will combine with the current impacts of existing land uses, as well as with the impacts of possible future development which might be precipitated by this proposed development, to form cumulative impacts.

Table 6.12: Potential cumulative impacts

OPERATIONAL PHASE						
Potential impact	**Status**	**Extent**	**Duration**	**Magnitude**	**Likelihood**	**Significance**
Reduction in the area of habitat available locally to fauna and flora	Negative	Sub-regional	Long-term – permanent	Medium	Definite	Medium
Contribution to conservation of grasslands (conservation offsets)	Positive	Sub-regional	Long-term	Low-medium	Definite	Medium
Impacts on sense of place and ambience	Negative	Local	Long-term – permanent	Medium-high	Highly probable	Medium-high
Impacts on tourism	Positive or negative	Local to sub-regional	Long-term	Medium	Possible	Low-medium
Risk of groundwater pollution	Negative	Sub-regional	Long-term	Low	Definite	Low-medium

Increased pressure on water provision	Negative	Sub-regional	Long-term	Low	Definite	Low
Increased pressure on electricity supply	Negative	Sub-regional	Long-term	Low	Definite	Low
Visual impact and light pollution	Negative	Sub-regional	Long-term	Low-medium	Definite	Medium
Increase in traffic	Negative	Sub-regional	Long-term	Low-medium	Definite	Medium

Please note that, while the direct effect of the particular impacts listed in the table above may only be felt locally or on the site itself, the extent in terms of the potential cumulative impact has been taken as sub-regional, as the impacts of the proposed development may be considered cumulatively with similar impacts in the area, sub-regionally.

7. NEED AND DESIRABILITY

Information regarding the need and desirability of the project was provided by Ms Janet Blackburn of Blackburn Properties, who is based in Haenertsburg.

7.1. Housing demand

Haenertsburg attracts many people – both tourists and those with a view to settle permanently. Although amenities and job opportunities are limited, people are attracted to the slower-paced lifestyle that characterises Haenertsburg, and many people commute between Haenertsburg and their place of work in either Tzaneen or Polokwane to have the 'best of both worlds'.

The property market is still in a recovery phase following the recent economic downturn. Haenertsburg falls in the recreational sector and the tempo of recovery still lags behind that of the domestic sector, because holiday, investment or retirement homes are more of a luxury than the domestic sector (people still need a home to live in). However, while sales were down, the economic downturn saw phenomenal growth in the rental sector. Local estate agents Blackburn Properties saw a rise from an average of 7 – 10 properties rented out on an annual basis before the downturn, to 27 – 32 from 2009 to the end of 2010. Demand is such that they have 47 potential renters on a waiting list, who cannot be placed due to a lack of stock. Some local overnight accommodation facilities, such as Diggersrest Lodge, Livingston Place and Silver Mist Equestrian Estate have even been converted to permanent rental units in an effort to provide in the burgeoning demand for rental stock, but this still does not solve the shortage of family-size homes (3 – 4 bedrooms) in particular.

The shortage of stock extends beyond rental to property purchase options as well. The main purchase profile of a client in Haenertsburg is to buy recreational property with a view to retire to later. Quite often, between the period of initially using a home for recreation and eventually retiring to it, home owners start renting out their properties. However, the enquiries that are on the waiting list outstrip the availability, especially in the Village itself. There is a lack of availability, diversity and choice – there are willing buyers on waiting lists looking for houses in the village, but there is not enough to choose from. The same scenario applies to vacant stands, with only a handful of stands available.

The housing units and vacant stands that are to form part of the proposed development are anticipated to go a long way to satisfying the demand for dwellings in Haenertsburg.

7.2. Demand for business space

The business stands forming part of the proposed development will provide opportunity for expansion of the limited business sector in the village. All the existing business stands in the village are occupied and fully built-up, with no further room for expansion. There is also highly limited scope for adding new business stands, as the main street (which is lucrative from a business perspective) is already fully occupied by businesses, and there is no option of extending the village into the surrounding grasslands.

Certain business owners in Haenertsburg have already expressed interest in occupying some of the business stands in the proposed development and see it as an opportunity for growth. Businesses envisaged to form part of the development are those related in some way to the tourism industry, such as restaurants, which will be in keeping with the type of businesses currently found in Haenertsburg.

Certain businesses in Haenertsburg Village can furthermore anticipate seeing growth in their customer base due to the growth in the local population that will be associated with the new development if it proceeds.

7.3. Expansion of Haenertsburg Village

Expansion of Haenertsburg is constrained mainly by the sensitive grasslands bordering the village to the east and south; the village therefore cannot expand in those directions. The site currently proposed to be developed, which is located directly north of the village, on the opposite side of the, was found during a variety of investigations to be potentially suitable for development (subject to strict conditions and environmental management measures) as the original grasslands have already been almost irreparably disturbed by many years of forestry. The pine plantations that stood on the site for many years have acidified the soil to such an extent that it is unsuitable for regeneration of the grassland (according to Prof George Bredenkamp of Eco-Agent, who undertook a specialist vegetation assessment on the site).

Of the vacant land around Haenertsburg and within the urban edge, this is one of the few sites on which expansion of the village can be considered.

7.4. Impact on value of existing properties

According to Blackburn Properties, the proposed development is not anticipated to impact negatively on the value of properties within the Village itself. Past developments in the area have not impacted negatively on property values in the village, and Haenertsburg stands are selling at higher prices per square metre than even the upmarket nearby Clearwaters Cove estate.

The authenticity and ambience of the village cannot be recreated, and the limited availability of property within the village perimeters makes it exclusive. Properties in the village are therefore expected to retain their value.

8. PUBLIC PARTICIPATION PROCESS

8.1. Background Information Document and Comment and Registration Form

A Background Information Document (BID) was compiled in English (also containing a SePedi summary) in order to provide a background and description of the proposed project and the EIA process being followed.

The BID was distributed to stakeholders and adjacent landowners along with the locality map and comment and registration form at the outset of the first public comment period. The comment and registration form provided I&APs and stakeholders with a convenient method of submitting their contact details to the consultants in order to register on the project database, as well as to raise any issues, comments or concerns that they had in terms of the proposed project.

8.2. Advertisement of Commencement of EIA Process

The commencement of the EIA process was advertised for a period of 30 days (05 July to 05 August 2007) in the following ways (please refer to Appendix D for copies of newspaper advertisements, photographs of site notices and the list of stakeholders who were directly notified):

- Placement of notices in the local newspaper the Letaba Herald (English notice) and the Mopani News (SePedi notice);
- Display of 2 site notices (each containing both the English and the SePedi adverts) at the proposed development site;
- Direct notification of identified stakeholders via fax and/or e-mail.

8.3. Public Meeting – Scoping Phase

A Public Meeting was held on 17 July 2007 at the Haenertsburg Public Library. The purpose of the Public Meeting was to afford stakeholders and members of the public the opportunity to interface with the project team to obtain information about the proposed project and to have their comments, queries and/or concerns noted. During the meeting, the project team presented the proposed project and the EIA process being followed, as well as the findings of the ESS-phase ecological investigation (conducted by Dr Buks Henning) and the Phase 1 heritage impact assessment (HIA) (these studies had already been conducted by that time).

Please refer to Appendix G for a copy of the minutes of the Public Meeting.

8.4. Availability of Draft ESR for Review and Comment

The draft ESR was available for public review and comment for a period of 30 days, from 29 April to 29 May 2010. Copies of the report were available at the Haenertsburg Public Library as well as at the offices of Polygon Environmental Planning. Electronic copies on CD were also available from Polygon upon request and copies (whether in hard copy or on CD) were submitted directly to a number stakeholders for their comment (notably DWA, LIHRA, SAHRA, GTM and FROHG (Friends of the Haenertsburg Grasslands). All comments received with regards to the report within the comment period were incorporated into the final ESR for submission to LDEDET.

8.5. Review of draft EMP by key stakeholders

Because of the sensitivity of the site, as well as certain stakeholders' request in the earlier part of the EIA that they should have input into the EMP, an additional public participation step was undertaken, which took the form of circulating the draft EMP to certain stakeholders. The report was forwarded on 20 August 2012 to certain stakeholders who had taken an active part in the public participation process from the outset; they were afforded 14 days (until 3 September 2012) to comment on the EMP.

The only comments on the draft EMP were received from Mr Luke Perkins, an ecologist and Haenertsburg resident, who was positive about the EMP and the approaches contained therein, but emphasised that he is still opposed to the proposed development.

8.6. Availability of Draft EIR for Review and Comment

This draft EIR, including EMP, is currently available for public review and comment, from 27 September to 6 November 2012 (40 days, even though the 2006 EIA Regulations, in terms of which this EIA is being undertaken, requires only a 30-day comment period). The availability of the report has been advertised by means of site notices, a newspaper advertisement (published in the Letaba Herald on 27 September 2012) and direct notification of registered I&APs. The report is available at the Haenertsburg Public Library and at Polygon's offices in Tzaneen, and can be provided electronically to I&APs upon request. Copies have also been submitted to certain key stakeholders (LIHRA, SAHRA, LDEDET and GTM) for their comment.

8.7. Public Meeting – Impact Assessment Phase

A second public meeting has been arranged for 11 October 2012 at 17:30 at the Haenertsburg Public Library. The details of the meeting weree advertised as part of the notification of the EIR public review period. The minutes will be submitted to LDEDET as part of the final EIR after the public review period.

8.8. Issues Raised

Comments and issues raised during the Public Participation Process thus far have been incorporated into the Issues Trail (Appendix F), which provides a summary in English of all issues raised, the forum through which these issues were raised and the response provided. Copies of correspondence with I&APs are also included in Appendix F.

The main issues have related to the environmental sensitivity of the general area and the potential social impacts relating to the increased population and larger town.

9. CONCLUSIONS

No fatal flaw issues have been identified. However, through the specialist investigations and stakeholder engagement process it was found that potentially significant environmental issues and risks are present, and therefore any development that does take place on the proposed development site will need to be undertaken according to strict management and mitigation measures to limit the impact of the proposed development. Development should furthermore only be allowed to proceed upon receipt of confirmation from Lepelle Northern Water and the GTM that there is sufficient water and electricity supply capacity to accommodate the proposed development.

A summary of the potential impacts identified within the ESS are contained in Table 9.1 overleaf.

Table 9.1: Summary of potential impacts

	POTENTIAL IMPACT	STATUS	EXTENT	DURATION	MAGNITUDE	LIKELIHOOD	SIGNIFICANCE
CLIMATE	Additional smoke from fireplaces may be trapped over the village by an inversion layer in winter	Negative	Local	Long-term	Very low	Possible	Low
SOIL, GEOLOGY & HYDROLOGY	Increased risk of erosion – construction phase	Negative	Local	Short-term	Medium	Highly probable	Medium
	Sedimentation of drainage line due to soil erosion – construction phase	Negative	Local	Short term	Medium	Highly probable	Medium
	Increased risk of soil slip (instability) during rainy season – construction phase	Negative	Local	Short-term	Low-Medium	Possible	Low
	Increased soil erosion – operational phase	Negative	Local	Long term	Low	Possible	Low
	Sedimentation of drainage line due to soil erosion – operational phase	Negative	Local	Long term	Low	Possible	Low
	Alteration of topography & drainage / hydrological regime	Negative	Local	Long term - permanent	Low	Highly probable	Low
	Soil instability – operational phase	Negative	Local	Long term	Low	Possible	Low
	Risk of contamination of groundwater by sewage treatment system	Negative	Sub-regional	Long term	Unknown	Possible	Medium
	Risk of contamination of surface water by sewage treatment system	Negative	Sub-regional	Long term	Unknown	Possible	Low-Medium
ECOLOGY	Loss of agricultural / forestry land	Negative	Local	Long term - permanent	Low	Definite	Low
	Removal of alien vegetation	Positive	Local	Long term	Medium	Definite	Medium
	Potential introduction of alien plants into gardens	Negative	Local	Long term	Medium	Possible	Medium
	Fire risk associated with “hot” construction activities and workers smoking etc	Negative	Local	Short term	Unknown	Possible	Low
	Reduction in the undeveloped area available as habitat	Negative	Local	Long term-permanent	Medium	Definite	Medium
	Rehabilitation of habitat in the flood line area	Positive	Local	Long term	Medium	Definite	Medium
	Contribution to conservation of sensitive grassland outside the development	Positive	Local	Long term	Medium	Highly probable	Medium
	Habitat destruction and/or fragmentation	Negative	Local	Long term-permanent	Medium-high	Definite	Medium-high
	Faunal fatalities resulting from construction-related activities	Negative	Local	Short term	Low	Highly probable	Low-Medium
	Disruption of the activities of fauna on and around the site	Negative	Local	Short term	Low-Medium, depending on development schedule	Highly probable	Low-Medium, depending on development schedule
	Trapping / hunting / killing fauna	Negative	Local	Short term	Low	Possible	Low

	by labourers						
	Road fatalities within the development	Negative	Local	Long term	Low-Medium	Highly probable	Medium
	Faunal fatalities due to garden chemicals	Negative	Local	Long term	Low-Medium, depending on degree of mitigation	Possible	Low-Medium, depending on degree of mitigation
	Killing of fauna, e.g. spiders or frogs, by residents	Negative	Local	Long term	Low	Possible	Low
	Improvement of habitat for *Breviceps sylvestris*	Positive	Local	Long term	Low-Medium, depending on degree of implementation	Possible	Low-Medium, depending on degree of implementation
HERITAGE	No impacts anticipated	-	-	-	-	-	-
SOCIO-ECONOMIC	Employment creation and/or sustaining of jobs in construction-related fields through local procurement of labour, materials, equipment & services	Positive	Local	Short term	Medium	Definite	Medium
	Influx of job-seekers into Haenertsburg	Negative	Local	Short term	Low	Possible	Low
	Trespassing and/or potential increase in criminal activity	Negative	Local	Short term	Unknown	Possible	Low-medium
	Potential rowdiness	Negative	Local	Short term	Low	Possible	Low
	Employment creation – operational phase	Positive	Sub-regional	Long term	Low-medium	Highly probable	Low
	Increase in local population due to increased number of dwellings	Positive or negative (depending on perspective)	Sub-regional	Long term	Medium-high	Definite	Medium
	Support of local businesses by increased populace	Positive	Local	Long term	Low-medium	Highly probable	Low-medium
	New businesses and restaurants may compete with existing establishments	Negative	Local	Long term	Unknown	Highly probable	Medium
	Impact on the “village” ambience	Negative	Local	Long term	Medium -high	Highly probable	Medium – high
TOURISM	Discouragement of tourism during construction phase	Negative	Local	Short term	Unknown	Possible	Low-Medium
	Tourism boost due to increased population making use of tourism facilities and activities	Positive	Local	Long term	Unknown	Possible	Medium
	Discouraging tourism due to negative visual impacts, and impacts on sense of place	Negative	Local	Long term	Unknown	Possible	Medium
VISUAL	Visual impact of construction activities and site clearing	Negative	Local	Short term	Low – high (depending on the stage of construction)	Definite	Medium
	Day-time visual impact of the development – operational phase	Negative	Local	Long term	Medium-high	Definite	Medium-high

	Light pollution	Negative	Local	Long term	Low – high (depending on level of mitigation)	Probable	Low – high (depending on level of mitigation)
NOISE	Noise associated with increased traffic (heavy vehicles) during construction	Negative	Local	Short term	Low	Probable	Low
	Noise associated with construction activities	Negative	Local	Short term	Medium	Probable	Low
	Noise associated with increased traffic – operational phase	Negative	Local	Long term	Low	Probable	Low
	Loud music, barking of dogs and other sounds associated with human habitation	Negative	Local	Long term	Very low	Probable	Very low
CUMULATIVE	Reduction in the area of habitat available locally to fauna and flora	Negative	Sub-regional	Long-term – permanent	Low-medium	Definite	Medium
	Contribution to conservation of grasslands (conservation offsets)	Positive	Sub-regional	Long-term	Low-medium	Definite	Medium
	Impacts on sense of place and ambience	Negative	Local	Long-term – permanent	Medium-high	Highly probable	Medium-high
	Impacts on tourism	Positive or negative	Local to sub-regional	Long-term	Medium	Possible	Low-medium
	Risk of groundwater pollution	Negative	Sub-regional	Long-term	Low	Definite	Low-medium
	Increased pressure on water provision	Negative	Sub-regional	Long-term	Low	Definite	Low
	Increased pressure on electricity supply	Negative	Sub-regional	Long-term	Low	Definite	Low
	Visual impact and light pollution	Negative	Sub-regional	Long-term	Low-medium	Definite	Medium
	Increase in traffic	Negative	Sub-regional	Long-term	Low-medium	Definite	Medium

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