

**PRELIMINARY ECOLOGICAL HABITAT  
ASSESSMENT & MANAGEMENT  
RECOMMENDATIONS FOR THE  
PROPOSED UPGRADING OF THE N11;  
MOKOPANE; LIMPOPO PROVINCE**



**Compiled for SSI Environmental Consultants PTY (Ltd) by:**

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## 1. INTRODUCTION

### Background

SANRAL has appointed SSI Engineers and Environmental Consultants to undertake the Environmental Basic Assessment and Environmental Management Plan for the Rehabilitation of Section13 of N11 in Mokopane, Limpopo Province. The project involves the upgrading of the N11 from the Dorps Bridge (km 0.0) to the Groot Sandsloot Bridge (24km). The project involves the upgrading of four existing bridges; as well as six borrow pits (new as well as existing borrow pits) are proposed as well as a quarry for the construction material for the road upgrading.

SSI Engineers and Environmental Consultants as an Independent Environmental Practitioner appointed Mr C. L. Cook to provide a basic ecological description of the current habitat integrity of the proposed upgrading of the N11 and to provide appropriate management recommendations for the proposed road upgrading and bridge crossings as well as six borrow pits and proposed quarry.

**The assignment is interpreted as follows:** Determine the current ecological status of the road reserve of the N11 as well as six borrow pits and quarry site and the ecological impact of the proposed N11 upgrading; as well as an environmental management plan for the disturbances on the site and immediately adjacent area. In order to compile the report the following had to be done:

**Initial preparations:**

- Obtain all relevant maps including aerial photographs (Google images) of the proposed upgrading of the N11 and information on the natural environment adjacent to the existing road reserve (approximately 100m) as well as quarry and borrow pit sites.
- An initial site investigation (11<sup>th</sup> August 2011) to assess the current environmental status of the current N11 road alignment with special emphasis on the proposed new borrow pit sites, quarry as well as four bridge crossings.
- Identify problematic areas which require immediate attention as well as management, e.g. soil and bank erosion, degraded areas, reclamation areas, alien vegetation.
- Make management recommendations for the current impacts especially pertaining to the four bridge crossings.

**1.1 Objectives of the Preliminary Ecological Survey/ Habitat Assessment**

- To provide a basic description of the vegetation and fauna occurring along the proposed 24km N11 road upgrading.
- To provide a description of any threatened plant or animal (mammals, birds, reptiles and amphibians) occurring or likely to occur adjacent to the N11 road reserve as well as proposed quarry and borrow pit sites.
- To describe the available habitats on site including areas of important conservation value or areas most likely to form important habitat for remaining threatened plant and animal species.
- To determine potential impacts of the proposed upgrading/widening of the N11 road and borrow pits and quarry on the remaining vegetation and fauna.
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed upgraded N11 road.

**1.2 Scope of Study**

- An initial ecological survey documenting the dominant vegetation on the site and recording sightings and/or evidence of present fauna.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened animal species (Red Data Species), within the proposed road reserve, borrow pits and quarry site.
- Literature investigations with which to augment field data were necessary.
- Identification of potential ecological impacts that could occur as a result of the upgrading of the N11 road and assess the significance of these, where possible.
- Investigate feasible and practical management recommendations that should be implemented to reduce or minimize the impacts, should the project be approved.
- Documentation of the findings of the study in a report.

### **1.3 Constraints and Limitations of Short Duration Ecological and Faunal Surveys**

- Limitation to a base-line ecological survey for only 1day (8 hours) during the late winter months early spring months prior to sufficient rainfall (August 2011).
- The majority of habitats adjacent to the N11 Road as well as existing borrow pits have already been completely transformed and heavily impacted on by associated rural activities (small-scale agricultural activities, wood harvesting, hunting etc).
- The majority vegetation of the existing N11 road reserve has been completely transformed and is dominated by weedy pioneer plants (rurals) as well as alien invasive species. No comprehensive vegetation surveys have been undertaken for the project.
- The majority of animal species are extremely seasonal only emerging after sufficient heavy early summer rainfall (October-November). No comprehensive faunal surveys have been conducted along the site.
- The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records) and previous surveys conducted in similar habitats between 2000-2011).

## **2. METHODOLOGY**

A survey of the site and surrounding areas was carried out by driving along the proposed 24km upgraded section of the N11 by car and closer inspection of the four bridge crossings, six borrow pits and quarry site carried out on foot. As the majority of the proposed upgraded section of the N11 is situated within an existing road servitude as well as adjacent to rural homesteads and agricultural areas the majority of natural vegetation consisting of **Makhado Sweet Bushveld (SVcb 20)** (Mucina *et al.* 2006) has already been transformed during the construction of the N11 as well as transformed into small-scale agricultural lands, livestock enclosures or heavily impacted on by the adjacent human activities including wood harvesting, collection of traditional medicinal plants, vegetation clearance; bank erosion as well as invasion of weedy plant and tree species. The site was visited predominantly during daylight hours (09h30-15h30) on the 11<sup>th</sup> August 2011.

It must be stressed that due to time and financial constraints no comprehensive vegetation or faunal surveys were undertaken during the brief ecological survey. Data was heavily supplemented by literature investigations; personal records, historic data and previous surveys conducted in the area. Different habitats were explored to identify any sensitive or specialised species which could possibly occur on the site. Habitats explored included the four seasonal and perennial river/ bridge crossings, six borrow pit sites as well as quarry site, secondary

grasslands (old agricultural lands) and remnant pockets of indigenous Makhado Sweet Bushveld vegetation.

The vegetation literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al*, 2009). **Mammal** names are as used by Skinner and Chimimba (2005), **Bird** names by Hockey, Dean & Ryan (2006); **Reptile** names by Branch (1998) and **Amphibian** names by Carruthers & Du Preez (2009).

### 3.1 STUDY AREA

The proposed upgraded 24 km section of the N11 road as well as the borrow pits and quarry site are situated within the rural; agricultural areas of Mokopane in the Limpopo Province (see **Figure 2** locality map). The site falls within the **Makhado Sweet Bushveld (SVcb 20)** vegetation unit (Mucina & Rutherford 2006); previously classified as Mixed Bushveld (VT 18) (Acocks 1953) and Mixed Bushveld (LR 18) and Sweet Bushveld (LR 17) (Low and Rebelo 1996). This vegetation unit is transitional between the higher-lying Polokwane Plateau and the lower-lying vegetation units of the Limpopo River. This vegetation unit is distributed on the plains in Limpopo Province straddling the Tropic of Capricorn. It occurs to the south of the Soutpansberg, east of the Waterberg and on the apron surrounding the Blouberg and Lerataupje Mountains; and north of the Polokwane Plateau and west of the escarpment, with extensions to Mokopane to the south and to the north near Vivo. Altitude varies around 850- 1 200m (Mucina & Rhutherford 2006).

#### **Vegetation and Landscape Features**

Slightly to moderately undulating plains sloping generally down to the north, with some hills in the southwest. Short and shrubby bushveld with a poorly developed grass layer. Existing impacts occurring along the N11 and around the proposed borrow pits and surrounding area include:

- Vegetation clearance
- Extensive overgrazing and erosion
- Frequent burning
- Wood harvesting and tree clear-felling
- Thicket formation and severe bush encroachment occurs in certain areas of the site by *Acacia melifera* and *Dichrostachys cinera*
- Numerous human pathways bisecting the site
- Illegal poaching and hunting (dogs, catapults and snares)
- Riparian zone degradation due to removal of majority of tree species for wood harvesting.
- Reed invasion.

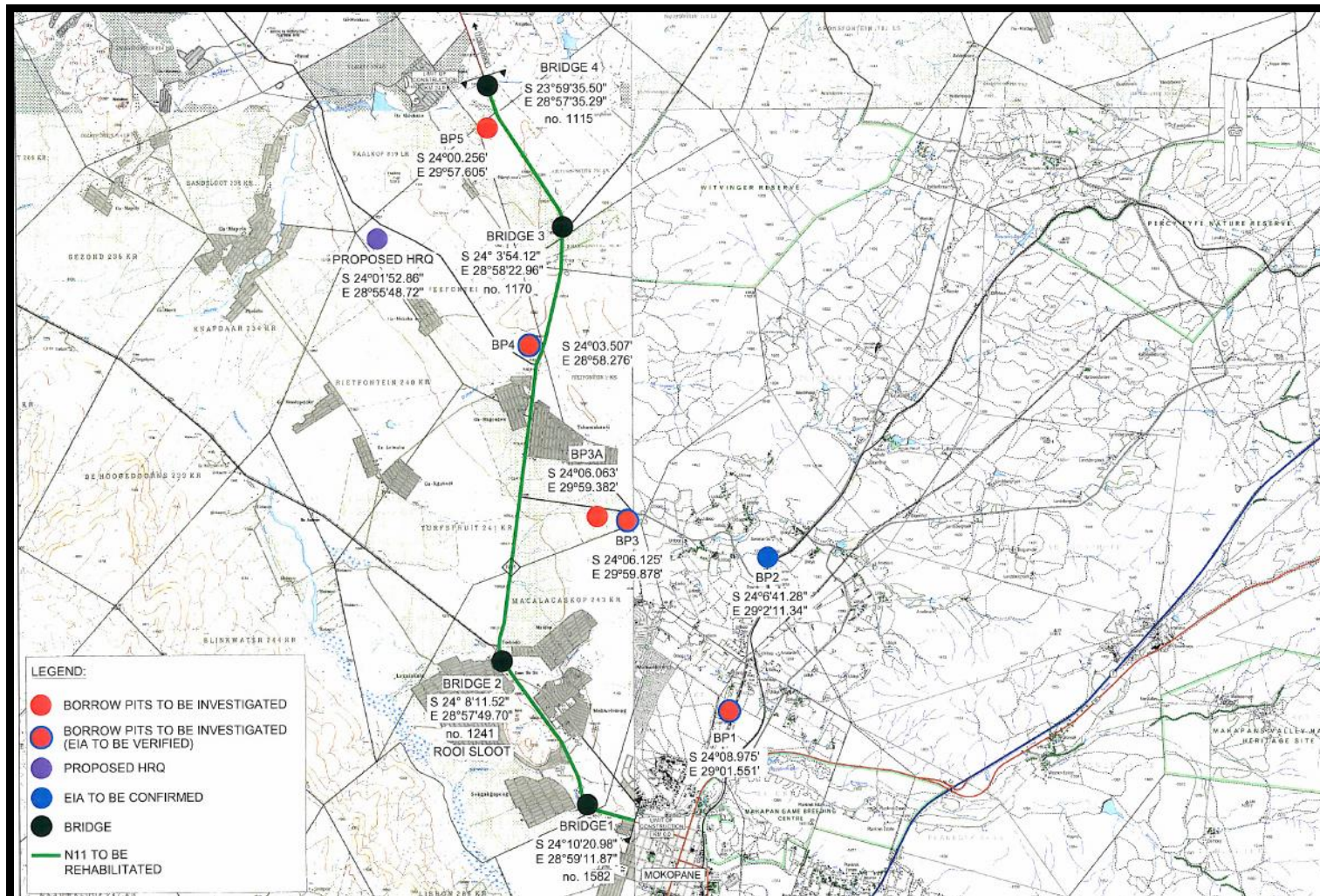
- Bank erosion from vegetation removal, overgrazing and trampling from cattle.
- Massive siltation and sedimentation accumulates in the perennial and annual (seasonal) rivers and streams.
- Extensive dumping and littering especially adjacent to rivers as well as existing borrow pits.
- Deterioration in water quality due to presence of pit-latrines as well as washing and bathing activities within the rivers.



**Figure1.** The majority of habitat immediately adjacent to the N11 as well as within the present road reserve consists of transformed bushveld vegetation. The vegetation has been heavily impacted on by surrounding rural communities including extensive vegetation clearance, wood harvesting, collecting of traditional medicinal plants as well as alien vegetation invasion

### **Geology and Soils**

The area is underlain by the gneisses and migmatites of the Hout River Gneiss (Randian Erathem) and the potassium-deficient gneisses of the Goudplaats Gneiss (Swazia Erathem). Sandstones and mudstones of the Matlabas Subgroup (Mokolian Waterberg Group) are also found. Soils include deep, greyish sands, eutrophic plinthic catenas, red-yellow apedal freely drained soils with high base status, clayey in the bottomlands. Land types are mainly Bd, Bc, Ae and Ia (Mucina & Rutherford 2006).



**Figure2.** Locality map of the proposed N11 road upgrading indicating borrow pits sites as well as bridge crossings.

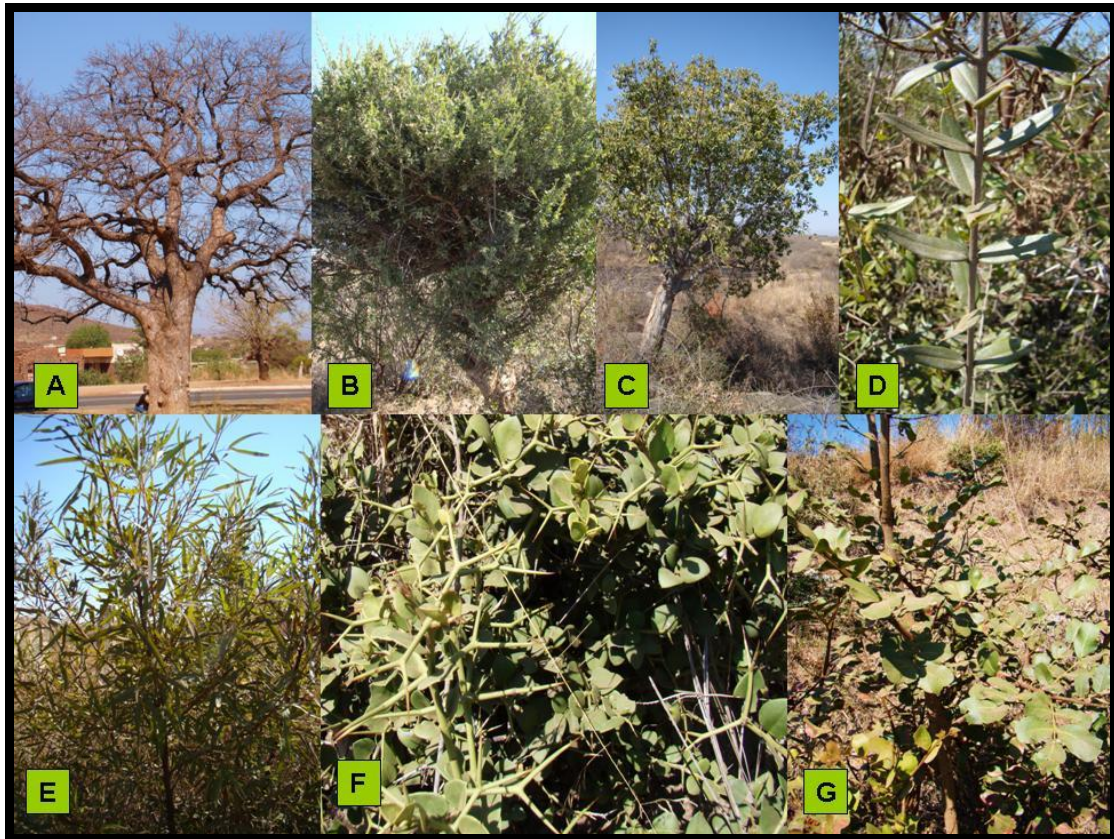
The vegetation within the current N11 road reserve is completely transformed and dominated by weedy plant and grass species. A few large Marula (*Sclerocarya birrea subsp. caffra*\*) remain within the current road reserve. The vegetation immediately adjacent to the N11 is also dominated by transformed or degraded habitats. These areas are utilised in various ways ranging from houses to ploughed lands, kraals to secondary grassland used for grazing purposes. As a result the natural vegetation has become degraded and is mostly transformed. The grassland areas used for grazing purposes are grazed to approximately 0.5-1m above ground level and are dominated by the anthropogenic grasses *Aristida stipitata subsp. graciliflora*, *Aristida canescens*, *Cynodon dactylon*, *Digitaria eriantha*, *Panicum maximum*, *Cymbopogon caesius*, *Urochloa mosambicensis*, *Eragrostis curvula*, *Imperata cylindrica*, *Hyparrhenia hirta*, *Imperata cylindrica* and *Melinis repens*. The grasses cover approximately 20-30% of the area and the forbs 5-10% (mainly alien invasive species). Large barren areas remain within the road reserve. Forbs were dominated by pioneer weedy plant species such as Tall Fleabane (*Conyza albida*), Flax-Leaf Fleabane (*Conyza bonariensis*), Common Black jack (*Bidens pilosa*), Tall Khaki weed (*Tagetes minuta*) Mexican Poppy (*Argemone ochroleuca*), *Verbena bonariensis* as well as pioneer grass species such as Rhodes Grass (*Chloris gayana*), Crab finger-Grass (*Digitaria sanguinalis*) Weeping Love Grass (*Eragrostis curvula*), Common Thatching Grass (*Hyparrhenia hirta*), Common Buffalo Grass (*Panicum maximum*) and Couch Grass (*Cynodon dactylon*).

**Dominant tree and shrub species** recorded adjacent to the road reserve as well as borrow pits included: *Acacia karroo*, *Acacia ataxacantha*, *Acacia gerrardii*, *Acacia nigrescens*, ***Acacia mearnsii***, *Acacia melifera*, *Acacia rehmanniana*, *Acacia tortilis*, *Acacia sieberana*, *Aloe marlothii*, *Boscia albitrunca*\*, *Combretum apiculatum*, *Carissa edulis*, *Cussonia spicata*, *Dicrostachys cinerea*, *Diospyros lycioides*, *Dombeya rotundifolia*, *Ehretia rigida*, ***Euclayptus grandis***, *Euphorbia ingens*, *Grewia flavescens*, *Grewia occidentalis*, *Gymosporia senegalensis*, ***Jacaranda mimosifolia***, *Lippia javanica*, ***Lantana camara***, ***Melia azederach*** *Peltophorum africanum*, ***Senna septemrionalis***, *Schotia brachypetala*, *Sclerocarya birrea subsp. caffra*, *Searsia (Rhus) lancea*, *Searsia (Rhus) leptodictya*, *Searsia (Rhus) pyroides*, ***Pinus sp.***, ***Ricinus communis***, ***Solanum mauritianum***, *Sclerocarya birrea*, *Ziziphus mucronata*, *Terminalia sericea* and ***Tecoma stans***. \*Species in bold are alien invasive species and must be removed.

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\* Protected tree species under the National Forests Act, 1998 (Act no. 84 of 1998)





**Figure 3.** A conglomerate of photographs displaying the dominant tree species observed along the N11 road reserve as well as proposed borrow pits and quarry site. **A:** Marula (*Sclerocarya birrea* subsp. *caffra*)\*; **B:** Shepherd's Tree (*Boscia albitrunca*)\*; **C:** Common Wild Fig (*Ficus thonningii*); **D:** Wild Olive (*Olea europaea* subsp. *africana*); **E:** Karree (*Searsia lancea*); **F:** Forest Num-num (*Carissa bispinosa*) and **G:** Weeping Boer Bean (*Schotia brachypetala*).

**Forb species** recorded on the site included: *Aloe greatheadii*, *Indigofera daleoides*, *Xerophyta retinervis*, ***Datura stumarium***, *Kalanchoe rotundifolia*, *Kalanchoe paniculata*, *Kalanchoe thyrsiflora*, *Cotyledon orbiculatum*, *Bidens pilosa*, *Heliotropium ciliatum*, ***Solanum sisymbriifolium***, *Senecio gerrardii*, *Pentzia pilufera*, *Cheilanthes hirta*, *Protasparagus setaceus*, *Hypoxis obtusa*, *Merremia tridentate*, *Dicerocaryum eriocarpum*, *Ceratotheca triloba*, ***Ricinus communis***, *Asclepias fruticosa*, *Momordica balsami*, ***Solanum panduriforme***, *Commelina africana*, *Commelina erecta*, *Sida cordifolia*, *Ipomoea sinensis*, *Ipomoea crassipes*, ***Agave Americana***, ***Ageratum conyzoides***, ***Arundo donax***, ***Ipomoea indica***, ***Ipomoea purpurea***, ***Thevetia peruviana***, ***Nerium oleander***, ***Psidium guajava***, *Hibiscus trionum*, *Schizoglossum cordifolium*, *Asclepias physocarpa*, *Turbina oblongata*, *Cassia comosa*, *Evolvulus alsinoides*, *Aptosimum procumbens*, *Pterodiscus speciosus*, *Harpagophytum procumbens*, *Ledebouria ovatifolia*, *Blepharis subvolubilis*, *Barleria sp.*, *Cucumis zeyheri*,

\* Protected tree species under the National Forests Act, 1998 (Act no. 84 of 1998)

*Cucumis metuliferus*, *Berkheya radula*, *Senecio coronatus*, *Senecio venosus*, *Senecio isatidioides*, *Vernonia hirsuta*, ***Ageratum houstonianum***, *Helichrysum caespititium*, *Sonchus oleraceus*, *Helichrysum umbraculigerum*, *Phragmites australis*, *Senecio latifolius*, *Stomatanthus africanus*, *Geigeria burkei*, *Indigofera sanguinea*, *Indigofera zeyheri*, *Tephrosia grandiflora*, *Pellaea viridise*, *Kalanchoe rotundifolia*, *Kalanchoe paniculata*, *Asparagus falcatus*, *Asparagus angusticladus*, *Bulbine abyssinica*, *Trachyandra saltii*, *Ledebouria floribunda*, *Anthericum longistylum*, *Chlorophytum bowkeri*, *Oxalis obliquifolia*, *Ornithogalum seineri*, *Ammocharis coranica*. \*Species in bold are alien invasive species and must be removed.

**Graminoid or Grass species** recorded on the site and an adjacent area included: *Aristida stipitata* subsp. *graciliflora*, *Aristida canescens*, *Aristida congesta*, *Cymbopogon excavatus*, *Cynodon dactylon*, *Digitaria* sp., *Eragrostis curvula*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Melinis nerviglumis*, *Panicum maximum*, *Setaria sphacelata*, *Melinis repens*, *Urochloa mosambicensis*.

### **Climate**

Summer rainfall area with very dry winters. Mean Annual Precipitation (MAP) is around 350-550mm. Frost fairly infrequent.

### **Conservation**

Makhado Sweet Bushveld is classified as a **Vulnerable** vegetation unit with only about 1% statutorily conserved, mainly in the Bellevue nature Reserve. Some 27% is transformed mainly by cultivation, with some urban sprawl and road-building. Conservation target is 19% conserved (Mucina & Rutherford 2006). Given the nature of this veld type, it is prone to overgrazing and subsequent erosion and bush encroachment. The vegetation in the area is already disturbed by overgrazing and poor veld management practices such as land clearing for subsistence crop farming, over-grazing, collection of wood for fuel purposes, erosion, trampling, bush-encroachment etc.

No Red Data species were observed during the field survey. Given the disturbed nature of the area, it is unlikely that any Red Data species would occur at or in the vicinity of the proposed development. One protected tree species was observed within the road reserve with several large (>4m) Marula *Sclerocarya birrea* subsp. *caffra* noted. Several small emerging Marula were observed around borrow pit 5. A single Shepherd's Tree (*Boscia albitrunca*) was observed within borrow pit 5 site. A permit will be required from the Department of Forestry for the removal of any protected tree species.

## BORROW PITS

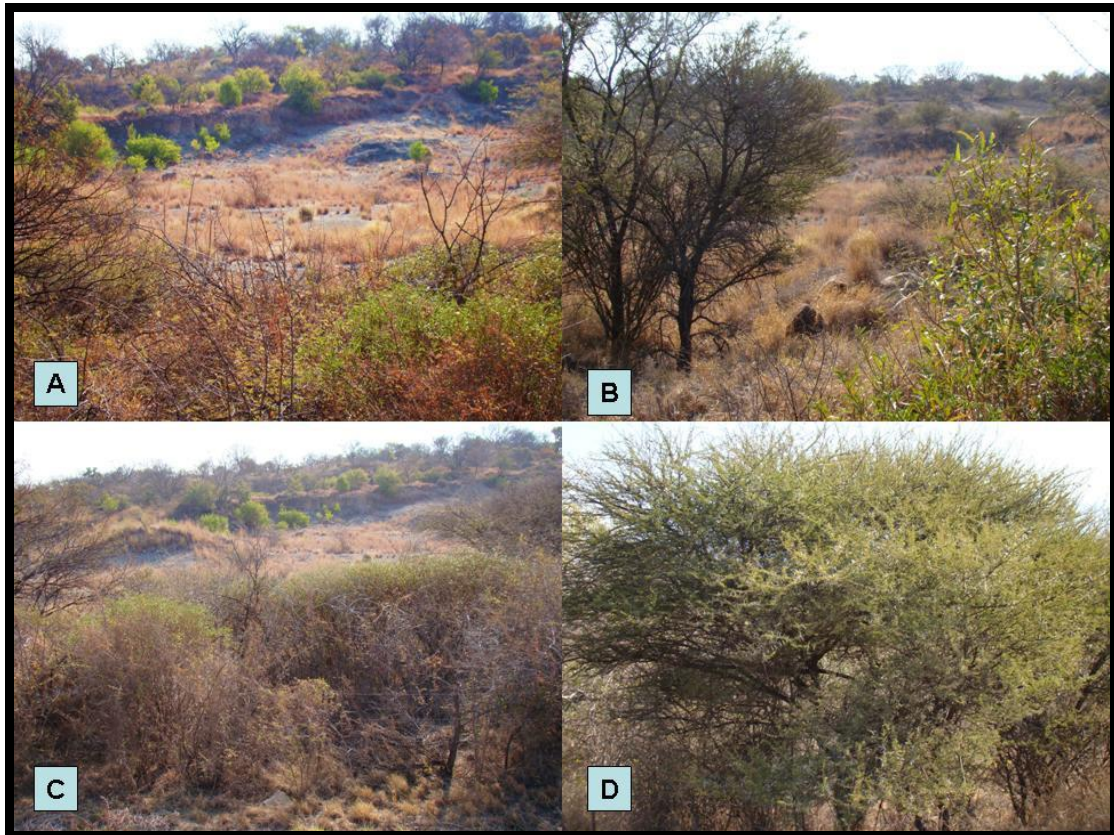
### Borrow Pit 1: New Borrow Pit

GPS Locality: 24°08'975" S 29° 01' 551" E



**Figure 4.** A conglomerate of photographs displaying the prevailing environmental conditions around the proposed borrow pit 1. **A:** The area around the proposed borrow pit is degraded bushveld and presently utilised for cattle grazing activities; **B:** Extensive littering occurs adjacent to the borrow pit area. **C:** Evidence of previous vegetation clearance with removal of the majority of tree and shrub species; **D:** Scattered large indigenous tree species were observed around the borrow pit area including *Sclerocarya birrea* as well as (**E**) *Euphorbia ingens*. Ideally no large indigenous tree (>4m) should be destroyed and the borrow pit should be positioned around remaining large tree species.

**Borrow Pit 2: Existing Borrow Pit**  
GPS Locality: 24°06' 50.8" S 29° 02' 09.8" E



**Figure 5.** A conglomerate of photographs displaying the prevailing environmental conditions around borrow pit 2. **A:** The area around the existing borrow pit is degraded bushveld with secondary succession vegetation and presently utilised for cattle grazing activities; **B:** The southern and eastern portions of the existing borrow pit has been re-colonised mainly by smaller *Acacia* species; **C:** Extensive bush encroachment adjacent to the fence by *Dichrostachys cinerea* **D:** Larger indigenous tree species occur such as and *Acacia karroo* and *Combretum apiculatum* occur around the periphery of the borrow pit and should not be destroyed as they provide important habitat for remaining arboreal faunal species as well as stabilizing the soils

**Borrow Pit 3A: Existing Borrow Pit**  
**GPS Locality: 24°05' 56.5" S 28° 59' 25.6" E**



**Figure 6.** A conglomerate of photographs displaying the prevailing environmental conditions around borrow pit 3A. **A:** The area around the existing borrow pit is degraded bushveld with extremely limited secondary succession vegetation; **B:** The steep embankments of the borrow pit are poorly vegetated and result in extensive soil erosion; **C:** The borrow pit is currently utilised for illegal dumping activities. Extensive litter as well as a decomposing cow were observed during the site visit; **D:** Surface water collects in a small seasonally inundated pool at the bottom of the borrow pit. The seasonal pool could provide suitable breeding habitat for certain amphibian species such as Guttural Toads (*Amietophrynus gutturalis*) and Sand Frogs (*Tomopterna spp.*).

**Borrow Pit 3B: New Borrow Pit**  
**GPS Locality: 24°06' 03.2" S 28° 59' 48.8" E**



**Figure7.** A photograph displaying the prevailing environmental conditions around the proposed borrow pit 3B. The area around the proposed borrow pit consists of transformed or fallow agricultural lands dominated by secondary succession grasses. Extensive bush encroachment by *Dichrostachys cinerea* occurs adjacent to the secondary access road adjacent to the proposed borrow pit site.

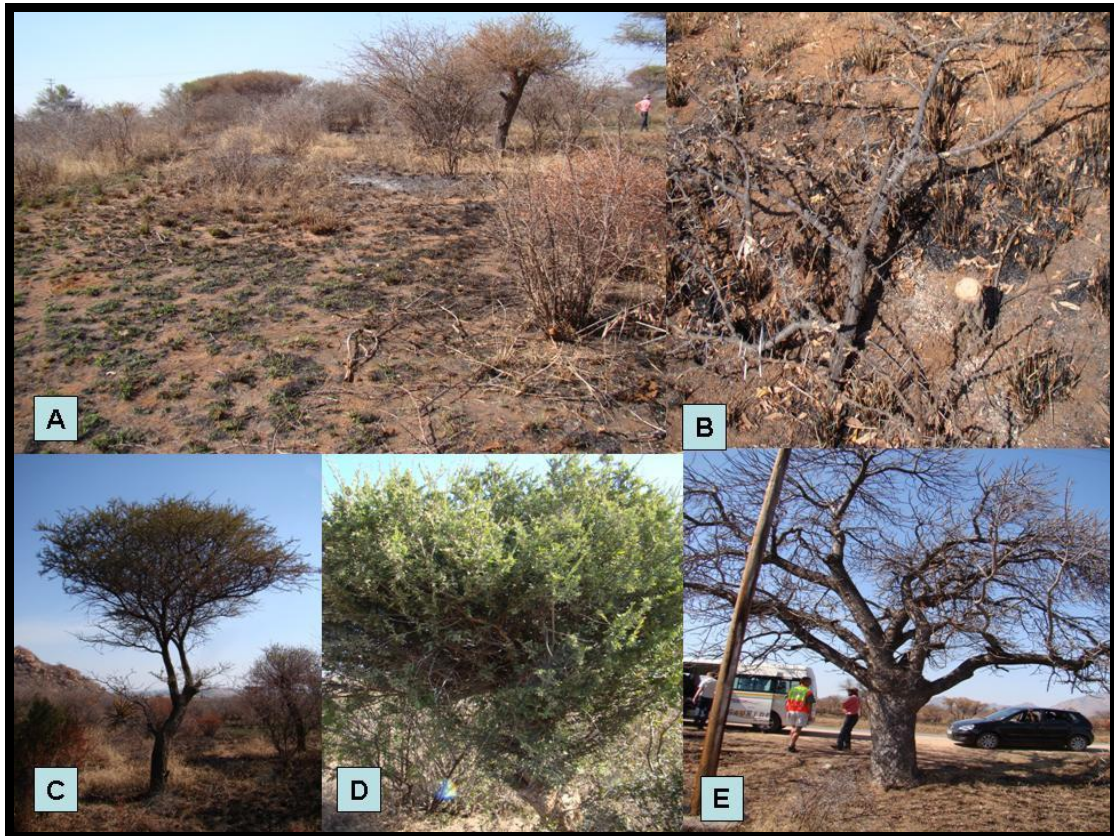
**Borrow Pit 4: Existing Borrow Pit**  
GPS Locality: 24°03' 32.7" S 28° 58' 24.8" E



**Figure8.** A conglomerate of photographs displaying the prevailing environmental conditions around borrow pit 4. **A:** The area around the existing borrow pit is degraded bushveld with extremely limited secondary succession vegetation; **B & C:** The borrow pit is presently operational with little or no vegetation present within the actively mined areas; **D:** A few scattered Category 1 alien invasive Castor-Oil Plants (*Ricinus communis*) were observed within the borrow pit

### Borrow Pit 5: New Borrow Pit

GPS Locality: 24°053' 32.7" S 28° 58' 24.8" E



**Figure 9.** A conglomerate of photographs displaying the prevailing environmental conditions around borrow pit 5. **A:** The area around the proposed borrow pit is degraded bushveld with extensive wood harvesting activities **B.** Several large indigenous tree species occur around the proposed site including *Acacia tortilis* subsp. *heteracantha* (**C**) as well as (**D**) Shepherd's Tree *Boscia albitrunca* and (**E**) Marula *Sclerocarya birrea* subsp. *caffra*. Several emerging Marula trees were observed within the proposed borrow pit area. These two tree species are protected according National Forests Act, 1998 (Act no. 84 of 1998). Permits will be required if these trees are to be removed during the mining operations. Ideally the borrow pit area should be positioned around all remaining large indigenous tree species.



## Proposed Quarry Site

GPS Locality: 24°02' 06.4" S 28° 55' 41.5" E



**Figure10.** A conglomerate of photographs displaying the prevailing environmental conditions around the proposed quarry site. **A:** The area around the proposed quarry site consists mainly of degraded bushveld with extensive wood harvesting activities **B.** The proposed quarry site is situated within an isolated patch of low-lying mostly embedded rocky outcrop. **C:** The rock sheets and boulders provide important habitat for rupicolous faunal species especially reptiles. **D:** The needless flattening of large Mountain Aloes *Aloe marlothii* subsp. *marlothii* for access to the quarry site is highly condemned by the consultant. Remaining large aloes should be carefully excavated and replanted adjacent to the quarry site or kept in a suitable "on-site" nursery and used for rehabilitation of the quarry after the cessation of mining activities. The proposed quarry will have a high negative impact on remaining plant and animal species occurring within the proposed mining area. Limited alternative habitat remains in the immediate area. It is imperative that the area is appropriately rehabilitated after the cessation of mining activities. This will require a site specific environmental rehabilitation plan/report compiled by a suitably qualified ecologist.

## N11 BRIDGE CROSSINGS

### Bridge Crossing 1: Dorps River

GPS Locality: 24°10' 21.1" S 28° 59'11.6" E



**Figure11.** A conglomerate of photographs displaying the current impacts observed at the Dorps River bridge crossing: **(A)**: The area around the current bridge is heavily degraded due to high levels of human disturbances within the Dorps River as well as adjacent riparian zone has resulted in habitat destruction and degradation as well as deterioration of water quality; **(B)**: Evidence of vegetation clearance and wood harvesting within the riparian zone as well as erosion channels from surface water from the road entering through eroded channels directly into the stream **(C)**: Extensive littering and illegal dumping activities within the active channel as well as macro-channel banks; **(D)**: Bush encroachment and thicket formation by *Acacia ataxacantha* within the remnant patches of riparian vegetation.

**Bridge Crossing 2: Rooisloot**  
**GPS Locality: 24°08' 11.9" S 28° 59'11.6" E**



**Figure12.** A conglomerate of photographs displaying the current impacts observed at the Rooisloot bridge crossing; **(A)**: The area around the current bridge is heavily degraded due to high levels of human disturbances within the active channel as well as macro-channel banks of the Rooisloot as well as adjacent riparian zone has resulted in habitat destruction and degradation as well as deterioration of water quality; **(B & C)**: Evidence of vegetation clearance and wood harvesting within the riparian zone as well as alien vegetation invasion, extensive littering and illegal dumping activities within the active channel as well as macro-channel banks; **(D)**: Erosion channels from surface runoff from the road entering through eroded channels directly into the Rooisloot; resulting in increased levels of siltation and sedimentation within the river.

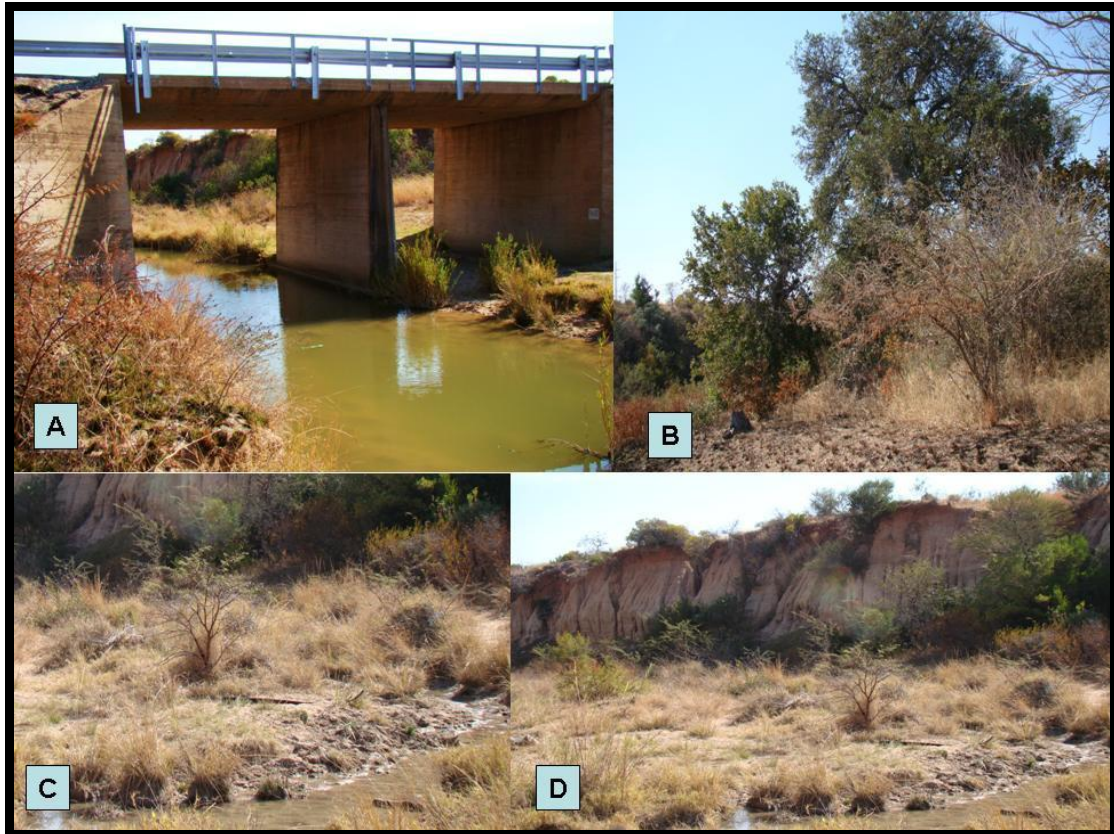
**Bridge Crossing 3: Unnamed non-perennial drainage line**

**GPS Locality: 24°03' 56.2" S 28° 52' 22.4" E**



**Figure13.** A conglomerate of photographs displaying the current impacts observed at the non-perennial or intermittent river crossing: **(A)**: The area around the current bridge is heavily degraded due to high levels of human disturbances within the active channel as well as macro-channel banks of the stream as well as adjacent riparian zone has resulted in habitat destruction and degradation as well as deterioration of water quality; **(B)** Erosion channels from surface water from the road entering through eroded channels directly into the stream resulting in increased levels of siltation and sedimentation. **(C)**: Remnant patches of indigenous riparian vegetation was observed approximately 50m downstream from the bridge. Coppicing stumps of Wild Olive (*Olea europaea* subsp. *africana*); **(D)**: Weeping Boer Bean (*Schotia brachypetala*) and **(E)**: Karree (*Searsia lancea*).

**Bridge Crossing 4: Groot Sandsloot**  
**GPS Locality: 23°59' 36.0" S 28° 57' 34.9" E**



**Figure14.** A conglomerate of photographs displaying the current impacts observed at the Groot Sandsloot River crossing: **(A)**: The area around the current bridge is heavily degraded due to high levels of human disturbances within the active channel as well as macro-channel banks of the river as well as adjacent riparian zone has resulted in habitat destruction and degradation as well as deterioration of water quality; **(B)**: Remnant patches of indigenous riparian vegetation was observed approximately 10m upstream (east) of the bridge. Species observed included *Ziziphus mucronata*, *Dombeya rotundifolia*, *Gymnosporia buxifolia*, *Searsia lancea*, *Sclerocarya birrea* subsp. *caffra* and *Schotia brachypetala*. It is imperative that the bridge expansion does not destroy any remaining natural riparian vegetation and construction activities are restricted downstream from the bridge (to the west); **(C)**: The riparian vegetation downstream from the bridge is heavily degraded with a few emerging *Acacia karroo* and *Acacia gerrardii*; **(D)**: Extensive bank erosion both upstream and downstream from the bridge crossing. Erosion preventative measures such as gabions or gabion mattresses should be installed adjacent to the bridge to prevent further bank erosion as well as the planting of indigenous (to the area) tree species within the riparian zone for bank stabilization.

## 4. PRELIMINARY FAUNAL SURVEY

The preliminary faunal survey focused mainly on mammals, birds, reptiles and amphibians of the study area. The survey focused on the current status of threatened animal species occurring, or likely to occur within the study area, describing the available and sensitive habitats, identifying potential impacts resulting from the development and providing mitigation measures for the identified impacts. Faunal data was obtained during a single site visit of the proposed development site carried out on foot on the 11<sup>th</sup> August 2011. All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify animals. Previous surveys, literature investigations; personal records and historic data supplemented the initial survey.

The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description. *The Mammals of the Southern African Subregion* (Skinner & Chimiba 2005) and *The Red Data Book of the Mammals of South Africa: A Conservation Assessment* (Friedmann and Daly (editors) 2004) for mammals. *Roberts-Birds of Southern Africa VIIth ed.* (Hockey, Dean and Ryan (editors) 2005) and *The Escom Red Data Book of Birds of South Africa* (Barnes 2000) for avifauna (birds). *A Complete Guide to the Frogs of Southern Africa* (du Preez & Carruthers 2009) and the *The Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter et al. 2004) for amphibians. *The Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and *South African Red Data Book- Reptiles and Amphibians* (Branch 1988) for reptiles.

The majority of vegetation adjacent to the proposed road alignment as well as borrow pits consists of completely transformed bushveld habitat with limited habitat diversity. The adjacent areas are utilised mainly for livestock grazing activities and suffers from extensive overgrazing, mostly from goats and cattle. Their grazing and trampling can encourage thicket growth by *Dichrostachys cinerea* by reducing grass cover. However, the opportunistic feeding patterns of goats can have a severe impact on both the composition and productivity of this ecoregion. In addition, goats are known to be more destructive than cattle at higher stocking densities (Skead 1988). High livestock densities also pose considerable threat to wildlife, since high numbers of domesticated animals generally cause a displacement of game, as there is less suitable habitat available. Furthermore, wild predators and scavengers such as the Black-backed Jackal, Caracal, Leopard and the Cape vulture have been eradicated by livestock farmers who see these animals as a threat to their livelihoods. Poisoned carcasses are often used for this purpose; this method is indiscriminate and therefore poses considerable threat to all predators and scavengers; especially the threatened

Cape Vulture. Poaching and illegal hunting (dogs) are further reducing the remnant faunal populations.

Given the disturbed nature of the area, it is unlikely that the current road reserve or borrow pit sites will host a great variety of animal species or viable populations. The new as well as existing borrow pits are situated between the agricultural and rural residential areas in transformed habitats and it is therefore unlikely that the area will support viable wildlife populations. Some Red Data species may occur in the area, but none were actually recorded (direct or indirect) within the road reserve or borrow pit sites and quarry during the survey. The bird species observed during the survey reflect common species of the area associated with human settlements. An adult Secretarybird was observed foraging on grasshoppers approximately 1km to the west of Borrow Pit 3A. As a result of the proximity of human settlements and habitat transformation and degradation of the environment, it is unlikely that animal distributions in the area reflect the original state.

**Existing Impacts on the fauna on and surrounding the site included:**

- The proposed N11 road widening is situated mainly within the existing road reserves or transformed bushveld (old agricultural lands) which are dominated by completely transformed vegetation with limited habitat diversity.
- High levels of human disturbances associated with the existing villages and habitat degradation and transformation due to present agricultural activities occur adjacent to the N11. This has resulted in impoverished habitats with limited faunal diversity.
- Existing villages, agricultural as well as informal access roads and pedestrian and livestock pathways occur around the N11 as well as borrow pits.
- Previous and current agricultural activities (oldlands) have transformed the majority of bushveld habitat adjacent to the N11 road reserve.
- Extensive overgrazing by livestock (especially cattle and goats) result in limited vegetative or grass cover or refuge habitat for remaining faunal species.
- Wood harvesting results in destruction of important habitat for arboreal faunal species.
- Frequent burning of remaining patches of grasslands severely restricts vegetative cover and potential refuge habitat for remaining faunal species.
- Hunting with dogs as well as cats around the villages. Dogs and cats have a high impact on remaining faunal species.
- Introduction of exotic and alien vegetation.
- Deterioration in water quality within the surrounding rivers and streams.

#### **4.1 AMPHIBIANS**

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Amphibians have declined dramatically in many areas of the world. These declines seem to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data.

Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile frogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently frogs are useful environmental bio-monitors (bio-indicators) and may act as an early warning system for the quality of the environment.

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in the Limpopo Province can be classified as explosive breeders. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles.

As the survey was undertaken for only 1 day during the early spring months (August), only a small proportion of species are present. Ideally, a herpetological survey should be undertaken throughout the duration of the wet season (November-March). It is only during this period that accurate frog species lists can be compiled. During this survey; fieldwork was augmented with species lists compiled from personal records; data from the South African Frog Atlas Project (SAFAP)(1999-2003) and published data, and the list provided below is therefore regarded as likely to be fairly comprehensive.

The most suitable breeding habitats for remaining frog species occurs within the valley bottoms or rivers. Two frog species was recorded during the brief field survey namely a Guttural Toad (*Amietophrynus gutturalis*) and Common River Frog (*Amietia angolensis*). No natural pans or seasonally inundated depressions were observed adjacent to the N11 or borrow pit sites. An artificially created seasonally inundated pool was observed within the existing borrow pit 3A. The proposed widening of the N11 road as well as the four bridges and six borrow pits will most likely have a medium-low, short-long term impact on frog species remaining in the area.



**Table1.** Frog species recorded on the actual site or are likely to occur in suitable habitat around the N11 as well as along the rivers.

<b>Common Name</b>	<b>Scientific Name</b>	<b>Status and Distribution</b>	<b>Habitat</b>
*Guttural Toad	<i>Amietophrynus (Bufo) gutturalis</i>	Common in southern Africa north of Gariep.	Permanent and semi-permanent ponds and backwaters in open grassland.
Eastern Olive Toad	<i>Amietophrynus garmani</i>	Common throughout north-eastern parts of southern Africa.	Permanent and semi-permanent ponds and backwaters
Common Platanna	<i>Xenopus laevis</i>	Common throughout southern Africa.	Permanent or semi-permanent bodies of water, natural or man-made.
Bushveld Rain Frog	<i>Breviceps adspersus</i>	Common within Limpopo Province	Terrestrial breeder laying eggs in a chamber underground.
*Common River Frog	<i>Amietia (Afrana) angolensis</i>	Common in central and southern Africa.	Permanent standing water and streams in grassland and open woodland.
Painted Reed Frog	<i>Hyperolius marmoratus marmoratus</i>	Common along streams and rivers within Limpopo Province	Reeds and other emergent vegetation along a wide variety of waterbodies including pans and rivers
Bubbling Kassina	<i>Kassina senegalensis</i>	Common throughout Southern Africa	Grassy margins of seasonally inundated pans as well as dams
Snoring Puddle Frog	<i>Phrynobatrachus natalensis</i>	Widely distributed along the eastern sections of Southern Africa	Shallow to fairly deep water in temporary pans and pools, vleis, dams and even slow-flowing streams
Plaintive Grass Frog	<i>Ptychadena anchietae</i>	Eastern Parts of South Africa	Vleis, inundated grassland and sedge pans, temporary roadside pools and rock puddles
Tremelo Sand Frog	<i>Tomopterna cryptotis</i>	Common species in Southern Africa	Streams, rivers or other places where water flows slowly but also in lotthic or standing water

### **Threatened species**

One red listed frog species is known from the Mokopane area namely the near-threatened; Giant Bullfrog (*Pyxicephalus adpsersus*). No suitable breeding areas (seasonal sedge and grass pans) were observed during brief survey. More comprehensive surveys conducted throughout the duration of the wet season are required in order to ascertain the current status of Giant Bullfrogs in the Mokopane area. No natural pans or seasonally inundated depressions were observed adjacent to the N11 road alignment or proposed borrow pits. Permanent waterbodies scattered around the villages are artificially created (old borrow pits, livestock drinking points) with limited marginal and emergent surface vegetation and extensive overgrazing and trampling around the margins. As the majority of the upgraded section of the N11 is situated in a rural-agricultural environment surrounded by residential and agricultural developments relatively few frog species are likely to occur in these areas. The continual disturbances to seasonal and permanent waterbodies (rivers) in the area will result in the disappearance of the more sensitive species, which require specific breeding habitats. The existing and proposed borrow-pits could potentially offer valuable breeding habitat for several frog species in the area. Unfortunately the current borrow pits were never rehabilitated and are heavily utilised for livestock drinking and grazing areas. Due to extensive overgrazing, trampling, erosion surrounding the existing borrow pits limited habitat is available for remaining amphibians.

### **4.2 REPTILES**

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe during field surveys. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to the high levels of habitat destruction and degradation in the area due to agricultural and livestock grazing activities coupled with increased levels of disturbances around the villages are all causal factors in the alteration of reptile species occurring on the site and surrounding areas. As a result of human presence in the area as well as on the site; coupled with habitat destruction and high levels of disturbances, alterations to the original reptilian fauna are expected to have already occurred. Removal of large riparian tree species agricultural activities and dead trunks for firewood collection destroys numerous habitats for remaining arboreal reptile species. Clearing of rock material for agricultural lands and for building materials destroys vital habitat for numerous rupicolous reptile species including the Agamids, Cordylids, Geckonids and Skinks. The majority of snake species hibernate in old tree trunks, termite mounds or under suitable rocks. A few scattered rocky outcrops or rock piles are found around the current N11 road alignment. A few scattered termite mounds were observed adjacent to the proposed borrow pits increasing in number where agricultural activities have ceased. Indiscriminate killing of snake species occur all around human settlements and results in the alteration of species composition, with the disappearance of the larger and the more sluggish snake species. The frequent

burning of the limited overgrazed grassland vegetation has a high impact on remaining reptiles. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

Three reptile species were recorded during the survey, namely a Striped Skink *Trachylepis (Mabuya) punctatissima*, Variable Skink (*Trachylepis varia*) and Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*). Low reptile diversity is expected from the actual N11 road footprint and immediate adjacent area. A probable species list is provided in Table2 below.

**Table 2:** Reptile species that occur or are likely to occur in the study area due to suitable habitat, and may therefore be present. Actual species lists will most likely contain far fewer species due to high levels of habitat transformation.

COMMON NAME	SCIENTIFIC NAME
Cape Skink	<i>Trachylepis (Mabuya) capensis</i>
*Striped Skink	<i>Trachylepis (Mabuya) punctatissima</i>
Variable Skink	<i>Trachylepis (Mabuya) variata</i>
Marsh or Helmeted Terrapin	<i>Pelomedusa subrufa</i>
*Yellow-throated Plated Lizard	<i>Gerrhosaurus flavigularis</i>
Flap-Necked Chameleon	<i>Chamaeleo dilepis</i>
Nile Monitor	<i>Varanus niloticus</i>
Giant plated Lizard	<i>Gerrhosaurus validus</i>
Common Rough-scaled Lizard	<i>Ichnotropis squamulosa</i>
Ground Agama	<i>Agama aculeate distanti</i>
Southern Rock Agama	<i>Agama atra atra</i>
Herald or Red-lipped Snake	<i>Crotaphopeltis hotamboeia</i>

Snouted Cobra	<i>Naja annulifera</i>
Black Mamba	<i>Dendroaspis polylepis</i>
Mozambique Spitting Cobra	<i>Naja mossambicus</i>
Common or Rhombic Night Adder	<i>Causus rhombeatus</i>
Boomslang	<i>Dispholidus typus</i>
Puff Adder	<i>Bitis arietans</i>
Common or Rhombic Egg Eater	<i>Dasypeltis scabra</i>
Dusky-Bellied Water Snake	<i>Lycodonomorphus laevisissimus</i>
Brown Water Snake	<i>Lycodonomorphus rufulus</i>
Brown House Snake	<i>Lamprophis fuliginosus</i>
Spotted House Snake	<i>Lamprophis guttatus</i>
Aurora House Snake	<i>Lamprophis aurora</i>
Cape Wolf Snake	<i>Lycophidion capense</i>
Spotted or Rhombic Skaapsteker	<i>Psammophylax rhombeatus</i>
Striped Skaapsteker	<i>Psammophylax tritaeniatus</i>
Cape Centipede Eater	<i>Aparallactus capensis</i>
Sundevall's Shovel-snout	<i>Prosymna sundevalli</i>
Green Water Snake	<i>Philothamnus hoplogaster</i>
Sundevalls' Garter Snake	<i>Elapsoidea sunderwalli</i>
Common Slug-eater	<i>Duberria lutrix</i>
Bibron's Blind Snake	<i>Typhlops bibronii</i>

Cape and Eastern Thread Snake	<i>Leptotyphlops conjunctus</i>
Peters' Thread Snake	<i>Leptotyphlops scutifrons</i>

\* recorded during brief field survey

### Threatened Species

No endangered reptile species were recorded during the brief survey, but favourable habitat exists adjacent to the N11 for African Rock Pythons (*Python natalensis*) especially in the mountains. The high levels of vehicular traffic as well as human disturbances as well as presence along the N11 road and road reserve restricts the likelihood of any larger pythons in the area. Pythons are protected in South Africa (SA RDB, Vulnerable) and their numbers have declined due to habitat destruction, killed for their skins (fashion), illegally collected for pets and the pet industry. The majority of pythons are indiscriminately killed due to fear and ignorance or due to road fatalities. Pythons are also collected for traditional medicinal purposes.

The Nile Monitor, (*Varanus niloticus*), and White-throated Monitor, (*Varanus albigularis*) are protected by Provincial Legislature (Cites, Appendix II). They are killed as an alternative food source or randomly killed by farmers (raid chicken runs). Numerous endemic gecko and lizard species occur throughout the Limpopo Province.

No threatened reptile species are likely to occur on the site or the immediate open areas surrounding the N11 or borrow pit sites due to extensive habitat transformation and degradation. The proposed quarry site contains suitable habitat for rupicolous reptile species. Low reptile diversity is expected along the majority of the proposed upgraded section of the N11 due to extensive habitat destruction, high levels of human disturbances and limited habitat diversity. The proposed widening of the N11 road as well as the four bridges and six borrow pits will have a medium-low, short-long term impact on reptile species occurring in the area.

The proposed quarry site will have a high; short-long term impact on remaining rupicolous reptile species occurring within the site. No alternative habitat remains in the immediate area. The site is however situated adjacent to a large platinum mine as well as adjacent rural communities which have impacted on the reptile remaining in the area; especially snakes.

### 4.3 AVIFAUNA/BIRDS

Due to time constraints and timing of survey no comprehensive bird lists could be compiled. During the site visitation (total of 4hrs), 45 bird species were recorded. Species recorded during field survey are common, widespread and typical of a degraded bushveld habitat.



**Figure15.** Several old swallow nests were observed under the current Rooisloot bridge. Construction activities should ideally be undertaken during the winter months after the swallows have completed their nesting/breeding activities. Nests should not be unnecessarily damaged or disturbed as the nests may be re-used by some species of swallows.

### SENSITIVE OR ENDANGERED SPECIES

Several bird species of conservation and bio-diversity importance occur, or possibly could occur on the site. The major causal factors for population declines include habitat loss, transformation and degradation through afforestation, destruction of riverine and wetland\marsh habitat; agricultural and livestock modification; poisoning (persecuted directly and indirectly); shooting (especially raptors); invasion of alien vegetation and human made structures (lines, pylons, drownings in reservoirs, road fatalities etc.).

**Table3.** List of threatened and near-threatened bird species that occur or could occur along the N11 or near proposed borrow pit sites according to Barnes (2000).

Robert's Nr.	Common Name	Scientific Name	Conservation Status
123	Cape Vulture	<i>Gyps coprotheres</i>	Vulnerable
132	Tawny Eagle	<i>Aquila rapax</i>	Vulnerable
140	Martial Eagle	<i>Polemaetus bellicosus</i>	Vulnerable
118	Secretarybird	<i>Sagittarius serpentarius</i>	Near-threatened
167	Pallid Harrier	<i>Circus macrourus</i>	Near-threatened
238	Blackbellied Korhaan	<i>Eupodotis melanogaster</i>	Near-threatened
430	Halfcollared Kingfisher	<i>Alcedo semitorqata</i>	Near-threatened
772	Redbilled Oxpecker	<i>Buphagus erythrorhyncus</i>	Near-threatened

A single Secretarybird (*Sagittarius serpentarius*) was observed foraging of grasshoppers approximately 1km west of borrow pit 3A. More intensive surveys conducted throughout the summer months will deliver more comprehensive species lists. The majority of birds were recorded in the remaining bushveld areas adjacent to the proposed borrow-pits. Only a few urban exploiting bird species were observed around the villages. The majority of raptors have been destroyed due to the presence of livestock such as chickens in the area. Several adults and children with catapults were observed hunting birds. The proposed widening of the N11 road will have a **medium-low, short-long term impact** on bird species occurring in the area.

#### 4.5 MAMMAL SURVEY

Due to timing combined with time constraints a comprehensive mammal survey was not possible. Fieldwork was augmented with previous surveys in similar habitats as well as published data. A list of mammal species recorded around the proposed sites is included in the Appendix (see Table 4).

**Table4. Mammal species likely to occur on the site and surrounding area.**

COMMON NAME	SCIENTIFIC NAME
Woodland Dormouse	<i>Graphiurus murinus</i>
Multimammate Mouse	<i>Mastomys coucha</i>
Pouched Mouse	<i>Saccostomus campestris</i>
Spiny Mouse	<i>Acomys spinosissimus</i>
House Mouse	<i>Mus musculus</i>
Single-striped Mouse	<i>Lemniscomys rosalia</i>
Namaqua Rock Mouse	<i>Aethomys namaquensis</i>
Bushveld Gerbil	<i>Tatera leucogaster</i>
Rock Elephant-shrew	<i>Elephantulus myurus</i>
Short-snouted Elephant-shrew	<i>Elephantus brachyrynchus</i>
Chacma Baboon	<i>Papio ursinus</i>
Striped Polecat	<i>Ictonyx striatus</i>
Banded Mongoose	<i>Mungos mungo</i>
Dwarf Mongoose	<i>Helogale parvula</i>
Small-spotted Genet	<i>Genetta genetta</i>
Black-backed Jackal	<i>Canis mesomelas</i>
Common Duiker	<i>Sylvicapra grimmia</i>
Kudu	<i>Tragelaphus strepsiceros</i>
Bushbuck	<i>Tragelaphus scriptus</i>
Impala	<i>Aepycerus melampus</i>
Steenbok	<i>Raphicerus campestris</i>
Warthog	<i>Phacochoerus aethiopicus</i>
Bushpig	<i>Potamochoerus porcus</i>
Porcupine	<i>Hystrix africaeaustralis</i>
Springhare	<i>Pedetes capensis</i>
Rock Dassie	<i>Provcavia capensis</i>
Vervet Monkey	<i>Cercopithecus aethiops</i>
Tree Squirrel	<i>Paraxerus cepapi</i>
Cape Clawless Otter	<i>Aonyx capensis</i>



Although the majority of habitat surrounding the borrow-pit sites is severely transformed the remaining bushveld habitat adjacent to the settlements offers favourable habitat for certain smaller mammal species. No larger mammals were observed during brief field survey. Evidence of Scrub Hares *Lepus saxatilis* and Slender Mongoose *Galerella sanguinea* were the only mammals observed during the brief survey. Several rodent burrows (possibly Bushveld Gerbil) were observed around the sandier sections adjacent to Borrow pit 5. The majority of larger mammals would have located suitable habitat away from the site, or have been destroyed by poaching and hunting. The presence of dogs and cats around the site has a detrimental effect of the smaller and larger mammal populations (indiscriminate killing). It is highly unlikely that the effected road area and the existing and proposed borrow pits will form critical habitat for any threatened mammal species. The proposed widening of the N11 road will most-likely have a medium-low, short-long term impact on mammal species occurring in the area.

## 5. SENSITIVE HABITATS



All remaining large indigenous tree species (>4m) and shrubs (>2m) should be retained wherever possible and included in the proposed borrow pit areas. Trees form vital habitats for numerous faunal species adapted to their arboreal habitat as well as playing a vital role in erosion stabilisation. Impacts on the sloping areas such as the macro-channel banks of the Groot Sandsloot must be strictly regulated preventing possible further deterioration of the environment. The soils of the site are highly erodable; extensive erosion could result without a protective vegetative layer. Habitats such as the rock outcrops, trees, stumps, termitaria and leaf litter are all vital habitats for numerous animal species.



The low-lying granite outcrops and sheets occur around the proposed quarry site provide favourable refuges for certain rupicolous snake and lizard species. Reptile species recorded from under loosely embedded rocks on the low-lying rocky areas included Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Montane Speckled Skink (*Trachylepis (Mabuya) punctatissima*), Variable Skink (*Trachylepis (Mabuya) varia*) Ground Agama (*Agama aculeata*) and Transvaal Thick-toed Gecko (*Pachydactylus affinis*). Scattered rocky outcrops are important habitats for numerous rupicolous animal species including scorpions, arachnids, geckos, skinks, snakes and smaller mammals.



The riparian zone comprises plant communities contiguous to and affected by surface and subsurface hydrological features of perennial or intermittent water bodies (rivers and streams). Riparian areas have one or both of the following characteristics: 1) distinctly different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more rigorous or robust growth form. The vegetation is dependant on the river for a number of functions including growth, temperature control, seed dispersal and germination and nutrient enrichment (Kemper, 2000). The vegetation comprises a distinct composition of species, often different from that of the surrounding terrestrial vegetation. Tree species are positioned according to their dependence or affinity for water, with the more water loving (mesic species) being located closest to the river channel, often with their roots in the water, and the less water loving terrestrial species further away from the river (Kemper, 2000).

Certain sections along the Groot Sandsloot are more typical of the natural riparian vegetation, whilst others such as the Rooisloot have been severely altered due to riparian zone degradation. Impacts include the change in species composition due to:

- Reed encroachment
- Exotic species encroachment (*Melia azedarach*, *Lantana camara*)
- Encroachment of terrestrial species
- Loss of indigenous trees and shrubs
- Flooding of terrestrial and riparian vegetation.

Change in age structure of trees and shrubs due to loss of different size classes of shrubs and trees. There have been changes in the physical character of certain sections of the riparian zone mainly due to physical scars due to vegetation

clearances, wood harvesting, erosion and restriction of riparian zone. Changes in the flow regime of the rivers will further impact the sensitive riparian zone upstream and downstream.

The riparian zone, of which vegetation is a major component, has a number of important functions including:

- Enhancing water quality in the river by the interception and breakdown of pollutants
- Interception and deposition of nutrients and sediments
- Stabilisation of riverbanks and macro-channel floor
- Flood attenuation
- Provision of habitat and migration routes for fauna and flora
- Provision of fuels, building materials and medicines for communities (if done on a sustainable basis!!)
- Recreational areas {fishing (rod and line not shade or gill nets); birdwatching; picnic areas etc.}

The entire riparian strips and its associated flora are sensitive and important habitats for numerous animal species. Trees are vital habitats for numerous arboreal animal species. Large numbers of birds were recorded in these woody habitats. The riparian vegetation plays a vital role in the re-colonization of aquatic macro-invertebrates. The majority of macro-invertebrates are only aquatic during their larval period and are terrestrial for their adult stages. Trees and shrubs provide vital refuge, foraging and migratory passages for species migrating to and away from the river. Fringing vegetation including trees, shrubs, reeds and forbs are vital habitats for numerous aquatic macro-invertebrates and fish species as well as for numerous animal species (reptiles, amphibians, birds and mammals).

All rivers and their associated riparian vegetation are sensitive habitats and disturbances and anthropomorphic induced impacts, activities around the Dorps, Rooisloot, seasonal tributary, Groot Sandsloot rivers should be strictly limited. Activities such as washing, uncontrolled cattle drinking areas, uncontrolled hunting and poaching, removal of riparian tree species, gill nets should be prevented as they will eventually result in the collapse of the aquatic ecosystem on which the nearby and downstream communities are dependent on for water supply.

## 6. ENVIRONMENTAL MANAGEMENT RECOMMENDATIONS

The proposed upgraded and widened N11 road and associated increased vehicular traffic may impact on the terrestrial fauna in various ways. The major impacts occurring during the construction phase involve the loss and fragmentation of habitats, with a consequent loss of biodiversity and possibly loss of remnant faunal species or of plant species of conservation concern. This may result from direct land clearance, or occur indirectly via loss or changes in habitats due to consequent changes in drainage patterns, increased fire risk, or secondary impacts associated with socio-economic factors resulting from changes in surrounding land use. During the operational life of the road, small accumulative impacts also occur, including ongoing road mortalities, increased disturbance (noise and light), dust generation, air pollution, chemical contamination from petroleum and rubber products, increased litter, changes in the incidence of fire, and the introduction of alien vegetation. All of these factors may impact the surrounding fauna and ecological processes in different ways. As the majority of the proposed upgraded N11 road follows the existing road and reserve comprising of transformed or heavily degraded habitats the potential impacts to remaining fauna is significantly reduced as well as the presence of any threatened plant species is highly unlikely.

At a local Mokopane scale the proposed N11 road upgrade comprising of transformed habitats and vegetation provides extremely limited suitable habitat for remaining animal species and no suitable habitat for any threatened faunal species. Due to high levels of human disturbance on the site and surrounding areas the majority of sensitive or rare species have disappeared or found suitable habitat away from the area. The proposed 24 km widening of the N11 road as well as bridges will have an impact of **medium-low; short-long term significance** on the remaining fauna if construction activities are restricted to the new road reserve; especially when the N11 bisects a river.

**The following general recommendations are made to minimise the impacts of proposed road construction on the immediate environment and remaining fauna:**

- Prior to construction and vegetation clearance a suitably qualified zoologist should closely examine the proposed borrow pit construction areas (especially the quarry site) for the presence of any animal burrows (including spiders and scorpions), rocky outcrops, logs, stumps and other debris and relocate any affected animals to appropriate habitat away from the borrow pits or quarry site.
- Close site supervision must be maintained during construction.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction within the road servitude and access to the undeveloped areas, especially the surrounding hills and open bushveld,

rivers must be strictly regulated (“no-go” areas during construction as well as operational activities).

- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) and surface water in the area. Mobile toilets must be provided in order to minimize un-authorized traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the road servitude to prevent further invasion.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.

**The following mitigation measures for the four bridge crossings are provided as guidelines:**

- Construction activities of the bridges should be scheduled to take place during low flow periods of the valley bottom wetland (winter months); when as little of the construction area and exposed sediment is in contact with the flow as possible.
- The original geometry, topography and geomorphology in both cross-sectional and longitudinal profile should be reinstated, above and below the river crossing.
- Appropriate mitigatory measures for controlling sediment input into the rivers will be required during the construction phase. The use of hay bales packed in rows across diversions and active flow areas during construction may be one way of limiting sediment inputs. They also help to buffer the pH. The bales will need to be removed and disposed of after construction. Other alternative methods of controlling sediment should also be considered such as sediment fences etc.
- All coffer dams, causeway and construction materials should be removed from the rivers immediately after construction at the site is completed.
- Where necessary and according to risks in terms of bank erosion, gabions or storm water control structures should be used to disperse storm water flows and prevent further bank erosion. Appropriate gabion structures or gabion mattresses should be installed to prevent further bank erosion.
- Where necessary and according to slope and risks in terms of bank erosion, disturbed areas should be re-vegetated using either a specified seed mix and/or appropriate indigenous trees (see attached list).

- Where appropriate, large individual indigenous trees should be avoided during construction and should be marked on site.
- The existing environmental management plan, should be audited during construction, and monitored for a period thereafter, until full rehabilitation is assured and stability demonstrated.

## **7. POTENTIAL IMPACTS ON THE REMAINING NATURAL HABITATS/ENVIRONMENT**

### **7.1. Hydrology**

#### **Surface water**

##### ***Status quo***

The areas adjacent to the N11 and around the proposed new borrow pits are already very disturbed with clearance of vegetation for dryland agriculture and overgrazing being the major existing impacts. There are signs of erosion due to denuded soil surfaces which, in turn, results in increased run-off and sedimentation of water courses. This affects the surface water quality.

Due to the lack of a functional water supply system, residents rely on, amongst others, the seasonal and perennial water courses for a supply of potable water, as well as for personal hygiene, washing of clothes, domestic livestock water supply etc. Water is also collected in buckets and drums from communal stand pipes and seepage areas. It is evident that the water quality in such areas is often poor and polluted and may harbour water-borne diseases etc. Furthermore, a lack of proper sanitation and sewage services also increases the potential of pollution of surface water.

##### ***Construction phase***

During the construction period, there may be an increase in run-off which is associated with a greater surface area of denuded vegetation. However, given the disturbed nature of the immediate area, this will not be significant. Once more, compaction of soil may have an impact by increasing run-off and a reduction in infiltration. Since construction will be dry season surface runoff should be reduced. The excavation of soil, stockpiling and the use of materials associated with construction activities may also reduce the quality of the surface water near the sites. In this regard, refurbishment, repair and servicing of equipment should be performed at least 50m from the nearest surface water and on oil pans or other sealed surfaces to prevent contamination of the soil and run-off.

##### ***Operational phase***

If the present land use practices and mismanagement continues, surface water quality will continue to be poor. However, the upgrade of the road will have a negligible influence on the surface water quality. The new borrow pits could potentially have a positive impact for the surrounding locals. After the completion of mining and excavation activities the borrow pits will act as reservoirs for



surrounding runoff. Erosion preventative mechanisms and natural succession of vegetation must be implemented around borrow pits. The constant overgrazing and trampling by livestock (cattle and goats) will result in massive erosion of surrounding soils and siltation and sedimentation of dammed water. Stormwater runoff should ideally be channelled through natural grasses and sedges surrounding the borrow pits. The borrow pits could acts as potential sediment traps reducing sedimentation in surrounding seasonal tributaries. An environmental education and awareness programme should be implemented to make residents aware of the importance of soil and water conservation and good veld management practices. This is beyond the scope of the current project though.

Phase	Surface water						
	Nature	Extent	Duration	Intensity	Probability	Significance	Confidence
<b>Construction</b>	Sedimentation	Local	Short term	Low/Medium	Medium/High	Low	High
	Runoff	Local	Short term	Low/Medium	High	Low	High
<b>Operation</b>	No significant impact						

### Mitigation

- Structures such as culverts, drains and erosion protection mechanisms should consider existing drainage channels, development in flood-prone areas (e.g. 1:50 year floodline) and the depth of the groundwater table.
- Excavated soil should be properly stockpiled to avoid wash-away during rain.
- All material used for construction purposes should be stored in such a manner that it would not contaminate the surface water which drains from the site.
- Adequate supervision and training should be provided to all operators to react quickly in emergency spillage situations.
- All spills must be cleaned up immediately.

## 7.2. Groundwater

### **Status quo**

Many residents rely on groundwater as a source of water for household purposes. The groundwater quality is not known. There are perennial rivers as well as seasonal watercourses where villages collect water for household purposes.

### **Construction phase**

It is not foreseen that the construction activities and excavations at the borrow pits will have a significant impact on the groundwater quality. During the construction phase, special care will be taken not to damage any seepage areas especially adjacent to the watercourses.

### **Operational phase**

No significant impact on the groundwater table is foreseen during the operation phase

Phase	Groundwater						
	Nature	Extent	Duration	Intensity	Probability	Significance	Confidence
<b>Construction</b>	No significant impact						
<b>Operation</b>	No significant impact						

The mitigation measures are the same as for surface water.

## 7.3. Vegetation

### **Status quo**

The vegetation at the sites reflects the disturbed nature of the environment and is characterised by vegetation indicative of over-grazed land and poor veld management practices. Trees are also chopped down to collect wood for fuel purposes. No sensitive, unique or Red Data listed species were recorded at or near any of the sites. Two protected tree species were recorded along the current N11 road reserve as well as within the borrow pit 5 site.

**Construction phase**

Since the vegetation of the widened N11 is mainly within the current road reserve and within the proposed borrow pits are heavily degraded the impact on the vegetation is minimised. One protected tree species was observed within the road reserve with several large (>4m) Marula *Sclerocarya birrea* subsp. *caffra* noted. Several small emerging Marula were observed around borrow pit 5. A single Shepherd’s Tree (*Boscia albitrunca*) was observed within borrow pit 5 site. A permit will be required from the Department of Forestry for the removal of any protected tree species. There were no sensitive, unique or Red Data species recorded within the other borrow pit sites. Nevertheless, during construction clearance of vegetation should be minimised. All large Aloes, geophytes and bulbous plants in the effected areas should be removed and replanted in suitable habitat. No other special mitigation measures are required during the construction phase.

**Operational phase**

The impact on the vegetation would be minimal during the operational phase of the borrow pits and no mitigatory measures are required in this regard. Ideally all indigenous tree species removed from the road reserve should be replaced.

Phase	Vegetation						
	Nature	Extent	Duration	Intensity	Probability	Significance	Confidence
Construction	Clearing	Local	Short/medium term	Low	High	Low	High
Operation	No significant impact						

**Mitigation**

- All construction activities should be strictly limited to the construction servitude area. Vegetation clearance should be restricted to the actual road servitude especially within the river crossings.
- It is recommended that the construction programme preferably commence during the dry winter months, when the valley bottom wetland’s base flow is lower and the risk of soil and bank erosion is lowest. All earthworks shall be undertaken in such a manner so as to minimize the extent of any impacts.
- No trees should be felled for fuel purposes during the construction period.
- No trees must be disturbed outside the road reserve as well as borrow pit areas.

- No trees must be removed unless it occurs specifically on the route re-alignment or if it may pose a threat with regard to road safety.
- The entire borrow pits must be appropriately rehabilitated and re-vegetated after the cessation of mining activities.

## 7.4 Fauna

### **Status quo**

As a result of the proximity of human settlements in the area and the disturbed nature of the environment, it is unlikely that animal distributions in the area reflect the original state. High levels of human disturbances associated with the existing villages and habitat degradation and transformation due to present agricultural activities occur around the proposed borrow pits. This has resulted in impoverished habitats with limited faunal diversity.

### **Construction phase**

The new borrow pits and the conversion of heavily transformed bushveld/grassland will directly, and indirectly, impact on the smaller sedentary species (insects, arachnids, reptiles, amphibians and mammals) adapted to their ground dwelling (terrestrial) habitats. Larger, more agile species (birds and mammals) will try and re-locate in suitable habitats away from the development. Construction workers should be restricted to the construction areas and prevented from entering into natural areas preventing possible disturbances to remaining plants and animals. No animals should be killed unnecessarily throughout the duration of the project. The edges surrounding the borrow pits should be gently sloped preventing possible drowning of animals, livestock and children in the area. No significant impact if mitigations are adhered to.

Phase	Fauna						
	Nature	Extent	Duration	Intensity	Probability	Significance	Confidence
<b>Construction</b>	Animals falling in excavations	Local	Short	Low	Probable	Low	High
<b>Operation</b>	No significant impact						

## Mitigation

- No areas outside the road reserve must be destroyed since these will serve as grazing areas and may harbour smaller animal species.
- No animals may be caught or killed by the construction workers.

## 7.5 REHABILITATION

The traditional definition of rehabilitation aims at returning the land in a given area to some degree of its former state after a particular process has resulted in its damage. The proposed six borrow pit sites as well as the quarry site must be appropriately rehabilitated after the cessation of mining activities. Appropriate rehabilitation plans should be compiled for each borrow pit and re-vegetated using indigenous (to the area) vegetation.

**Rehabilitation methods are detailed in Table 5 below.**

**Table 5:** Recommended rehabilitation measures.

Step	1.1.1 Method	1.1.2 Equipment
1	Remove all construction material from the area where construction has been completed.	To be undertaken by hand.
2	Topsoil that has been stockpiled during construction must be applied to the area to undergo rehabilitation. The depth of the topsoil layer to be applied depends on the natural depth of topsoil in the area, and the amount of topsoil that may have been lost during construction.	Topsoil must be applied from the topsoil stockpiled during construction.
3	The naked ground should be seeded with a stabilising grass mix, suited to the conditions. The quantity of seed used will depend on the slope, with a steeper slope requiring a heavier application of seed. For slopes: <ul style="list-style-type: none"> <li>• &gt;15°: 25-50 kg/ha</li> <li>• &lt;15°: 15-25 kg/ha</li> </ul> The natural seed bank in the topsoil will supplement the seed mix applied	The seed mix should consist of pioneer grass species of the area, and will also depend on what species are commercially available during the season required. A standard seed mix would consist of the following species (in decreasing order of proportion constituting the seed mix)*: <ul style="list-style-type: none"> <li>• <i>Andropogon chinensis</i></li> <li>• <i>Aristida congesta</i></li> <li>• <i>Cynodon dactylon</i></li> <li>• <i>Cymbopogon plurinodes</i></li> </ul>

\* see attached species list

		<ul style="list-style-type: none"> <li>• <i>Eragrostis curvula</i></li> <li>• <i>Eragrostis gummiflua</i></li> <li>• <i>Themeda triandra</i></li> <li>• <i>Setaria spp.</i></li> <li>• <i>Imperata cylindrica</i></li> <li>• <i>Sporobolus fimbriatus</i></li> </ul> <p>and sedges such as <i>Schoenoplectus spp.</i> and <i>Juncus spp.</i> should be used for the bridge crossings</p>
4	The areas which have been seeded must be regularly watered directly after seeding until the grass cover becomes established. Watering is to be done in a manner that ensures that no erosion of the topsoil and seed mix takes place.	A hosepipe must be available on site.
5	If the grasses have not established after a period of two months after seeding, the areas should be reseeded. If necessary, another dressing of topsoil should be applied prior to seeding.	As above.
6	Slope stabilisation measures may be necessary in places where grass has not been able to establish and there is an erosion risk. The measures implemented depend on the situation, and can be varied as necessary.	Various slope stabilisation measures are available and vary in effectiveness according to the situation including <ul style="list-style-type: none"> <li>• Logs/bark held in place with pegs</li> <li>• Rows of <i>Cynodon dactylon</i>, <i>Panicum maximum</i>, <i>Imperata cylindrica</i>, <i>Hyparrhenia filipendula</i> held in place with pegs.</li> </ul>
7	All alien vegetation is to be appropriately removed and disposed of. Alien species that have been encountered along the proposed route include <i>Syringa</i> , <i>Melia azedarach</i> , Brazilian Glory Pea or Red Sesbania <i>Sesbania punicea</i> , Castor-Oil Plant ( <i>Ricinus communis</i> ), Lantana	Removal will to a large extent be done by hand. Saws may be necessary in certain cases and specific herbicides may be required (if used, the use of these must be strictly controlled)

	( <i>Lantana camara</i> ), Giant Reed ( <i>Arundo donax</i> ), Bugweed ( <i>Solanum mauritianum</i> ), Peanut Butter Cassia ( <i>Senna diymobotrya</i> ), Jacaranda ( <i>Jacaranda mimosifolia</i> )*, Morning Glory ( <i>Ipomoea purpurea</i> ), Paraffin Bush ( <i>Chromolaena odorata</i> ), Yellow Oleander ( <i>Thevetia peruviana</i> ), Oleander ( <i>Nerium oleander</i> ), Montanoa ( <i>Montanoa hibiscifolia</i> ), Indian Shot ( <i>Canna indica</i> ), <i>Ageratum conyzoides</i> , <i>Caesalpinia decapetala</i> , <i>Ipomoea indica</i> , <i>Psidium guajava</i> ,.	
8	The N11 road servitude must be regularly inspected during the operational phase and alien vegetation that had re-emerged, must be removed / follow-up treatment applied.	On-going alien vegetation removal programme (beyond the scope of the project)

## 7.6 POISONOUS PLANTS



**Figure16.** The Oleander (*Nerium oleander*) and the Yellow Oleander (*Thevetia peruviana*) are both poisonous plants and are potentially lethal to livestock as well as humans. They are common within the rural homesteads situated along the N11 road reserve. Two leaves and around 4 seeds of the Yellow Oleander can be fatal to a child.

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## 9. APPENDIX

**Table6.** Grass species list for rehabilitation purposes (ideally grass species endemic to the area should be used)

*Alloteropsis semialata ssp. Eckloniana*  
*Alloteropsis semialata ssp. Semialata*  
*Andropogon appendiculatus*  
*Andropogon chinensis*  
*Anthephora pubescens*  
*Aristida adscensionis*  
*Aristida canescens ssp. canescens*  
*Aristida congesta ssp. congesta*  
*Aristida diffusa ssp. burkei*  
*Aristida scabrivalvis ssp. scabrivalvis*  
*Aristida transvaalensis*  
*Arundinella nepalensis*  
*Avena sp.*  
*Bewsia biflora*  
*Brachiaria brizantha*  
*Brachiaria eruciformis*  
*Brachiaria serrata*  
*Bromus leptoclados*  
*Bromus sp.*  
*Cenchrus ciliaris*  
*Cymbopogon caesius*  
*Cymbopogon pospischilii*  
*Cyperus esculentus*  
*Digitaria debilis*  
*Digitaria diagonalis var. diagonalis*  
*Digitaria eriantha*  
*Digitaria monodactyla*  
*Digitaria sp.*  
*Digitaria ternate*  
*Digitaria tricholaenoides*  
*Diheteropogon amplexens var. amplexens*  
*Ehrharta erecta var. erecta*  
*Elionurus muticus*  
*Enneapogon cenchroides*  
*Enneapogon scoparius*  
*Eragrostis chloromelas*  
*Eragrostis curvula*  
*Eragrostis planiculmis*

*Eragrostis racemosa*  
*Eragrostis sp.*  
*Eustachys paspaloides*  
*Helictotrichon turgidulum (Stapf) Schweick.*  
*Hemarthria altissima*  
*Heteropogon contortus.*  
*Hyparrhenia anamesa*  
*Hyparrhenia cymbaria*  
*Hyparrhenia filipendula var. pilosa*  
*Hyparrhenia hirta*  
*Hyparrhenia quarrei*  
*Hyparrhenia tamba*  
*Imperata cylindrical*  
*Koeleria capensis*  
*Leersia hexandra*  
*Lolium multiflorum*  
*Lolium temulentum*  
*Loudetia simplex*  
*Melinis nerviglumis*  
*Melinis repens ssp. Repens*  
*Monocymbium ceresiiforme*  
*Panicum maximum*  
*Panicum miliaceum*  
*Panicum natalense.*  
*Paspalum dilatatum*  
*Paspalum notatum*  
*Paspalum scrobiculatum*  
*Pennisetum thunbergii*  
*Pennisetum villosum*  
*Perotis sp.*  
*Poa annua*  
*Poa pratensis*  
*Pogonarthria sp.*  
*Potamogeton pusillus*  
*Schizachyrium sanguineum*  
*Setaria lindenbergiana*  
*Setaria megaphylla*  
*Setaria nigrirostris*  
*Setaria sp.*  
*Setaria sphacelata var. sphacelata*  
*Setaria sphacelata var. torta*  
*Sorghum bicolor ssp. arundinaceum*  
*Sorghum halepense*

*Sorghum versicolor*  
*Sporobolus africanus*  
*Sporobolus discosporus*  
*Sporobolus fimbriatus*  
*Sporobolus natalensis*  
*Sporobolus nitens*  
*Sporobolus sp.*  
*Sporobolus stapfianus*  
*Stipagrostis uniplumis var. neesii*  
*Stipagrostis zeyheri ssp. Sericans*  
*Themeda triandra Forssk.*  
*Trachypogon spicatus*  
*Tragus berteronianus*  
*Triraphis andropogonoides*  
*Tristachya rehmannii*  
*Typha capensis*  
*Urelytrum agropyroides*  
*Urochloa mosambicensis*  
*Urochloa panicoides P.Beauv.*

**Table7.** Suggested indigenous trees for road reserve as well as riparian zone rehabilitation for the four bridge crossings (species indigenous to the area are indicated with a ☺. It is strongly recommended that only these are planted as far as possible)

Botanical Name	Common Name
☺ <i>Acacia karroo</i>	Sweet Thorn
☺ <i>Acacia natalitia</i>	Pale-bark Sweet Thorn
☺ <i>Acacia tortilis</i>	Scented Thorn
☺ <i>Acacia robusta</i>	Robust Acacia
☺ <i>Acacia tortilis</i>	Umbrella Thorn
☺ <i>Apodytes dimidiata</i>	White Pear
<i>Calodendron capense</i>	Cape Chestnut
☺ <i>Celtis africana</i>	White stinkwood
☺ <i>Combretum erythrophylum</i>	River Bushwillow
☺ <i>Cussonia paniculata</i>	Highveld cabbage
☺ <i>Diospyros lycoides</i>	Blue bush
☺ <i>Dombeya rotundifolia</i>	Wild pear
<i>Ekenbergia capensis</i>	Cape ash
☺ <i>Erythrina lysistemon</i>	Corral Tree
☺ <i>Ficus thoningii</i>	Common Veld Fig
☺ <i>Ficus sycomorus</i>	Sycamore fig
☺ <i>Grewia occidentalis</i>	Cross berry

☺ <i>Gymnosporia buxifolia</i>	Common Spikw-Thorn
<i>Halleria lucida</i>	Tree fuschia
☺ <i>Harpephyllum caffrum</i>	Wild plum
☺ <i>Kiggelaria africana</i>	Wild peach
☺ <i>Leucosidea sericea</i>	Ouhout
☺ <i>Olea europaea subsp. africana</i>	Wild olive
<i>Pappea capensis</i>	Jacket plum
☺ <i>Pittosporum viridiflorum</i>	Cheesewood
<i>Podocarpus henkelli</i>	Henkell's yellowwood
☺ <i>Pterocarpus rotundifolius</i>	Round leaved kiaat
☺ <i>Searsia/Rhus chiridensis</i>	Red Currant
<i>Searsia/Rhus prinoides</i>	Dogwood
☺ <i>Searsia/Rhus leptodictya</i>	Mountain karee
☺ <i>Searsia/Rhus lancea</i>	Karee
☺ <i>Searsia/Rhus pyroides</i>	Common wild currant
<i>Salix mucronata</i>	Safsaf willow
☺ <i>Schotia brachypetala</i>	Weeping boer-bean
☺ <i>Syzigium cordatum</i>	Water berry
☺ <i>Trichilia emetica</i>	Natal mahogany
☺ <i>Vepris lanceolata</i>	White ironwood
☺ <i>Ziziphus mucronata</i>	Buffalo thorn

**Table8.** Indigenous shrub species marked with ☺ should be used for re-vegetation along the N11 Road.

<i>Botanical Name</i>	<i>Common Name</i>
☺ <i>Aloe arborescens (gabions)</i>	
☺ <i>Aloe greatheadii</i>	
☺ <i>Aloe marlothii</i>	
☺ <i>Bauhinia species</i>	Pride-of de-Kaap
☺ <i>Buddleja salinga</i>	False olive
☺ <i>Buddleja salvifolia</i>	Sagewood
<i>Burchellia bubaline</i>	Wild pomegranate
☺ <i>Carissa macrocarpa</i>	Bird num-num
<i>Dietes species</i>	Wild iris
☺ <i>Dovyalis caffra</i>	Kei apple
☺ <i>Ehretia rigida</i>	Puzzle bush
<i>Erica species</i>	Heaths
<i>Euryops species</i>	Golden daisies
<i>Felicia species</i>	Wild daisy
☺ <i>Grewia flava</i>	Wild currant
☺ <i>Helichrysum kraussii</i>	Everlastings
☺ <i>Leonotis leonorus</i>	Wild dagga

<i>Leucospermum species</i>	Pincushions
☺ <i>Mackaya bella</i>	Forest bell bush
☺ <i>Pavetta lanceolata</i>	Forest's pride bush
☺ <i>Plectranthus species</i>	Spur flowers
☺ <i>Plumbago auriculata</i>	Cape leadwort
<i>Protea caffra</i>	Sugarbush
<i>Psychotria capensis</i>	Black birdberry
☺ <i>Rhamnus prinoides</i>	Dogwood
<i>Strelitzia nicolai</i>	
<i>Strelitzia reginae</i>	Crane flower
☺ <i>Tecoma capensis</i>	Cape honeysuckle
☺ <i>Thunbergia natalensis</i>	Natal bluebell