PRELIMINARY ECOLOGICAL HABITAT ASSESSMENT FOR THE NKANDLA-UMLALAZI SMART GROWTH VILLAGE KWAZULU-NATAL

Compiled for **SSI Engineers and Environmental Consultants Pty (Ltd)** by:
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DRAFT REPORT SUBMITTED: 18th JUNE 2012

*** DWA accredited to undertake wetland and riparian delineations (2008)**

1. INTRODUCTION:

The Masibambisane Rural Development Initiative (MRDI) is the composite body or organisation made up residents of Nkandla and Umlalazi municipality jurisdiction. Masibambisane has identified an opportunity for the development of a Smart Growth Centre (Mixed Use Development) in the area of Lindela under the chieftainship of Inkosi Shange. This initiative is intended to realize the establishment and access to structured precincts for community services, public facilities including government service departments, health and safety, education facilities, retail and commercial structure developments and also to stimulate agricultural activities.

SSI Engineers and Environmental Consultants (henceforth called SSI) have been appointed as independent environmental consultants to conduct a Basic Assessment for the proposed Nkandla-Umlalazi Smart Growth Village. SSI as an Independent Environmental Practitioner appointed Mr. C.L. Cook to provide a basic description of the vegetation and fauna and current ecological status/habitat integrity of the site and to provide appropriate management recommendations for the area of the proposed Nkandla-Umlalazi smart growth village.

Project Description:

The assignment is interpreted as follows: **Determine the current ecological status of the vegetation and fauna and the potential ecological impacts of the Nkandla-Umlalazi Smart Growth Centre on the immediate environment**. 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 Nkandla-Umlalazi Smart Growth site and adjacent land usage, and information on the natural environment.
- An initial site investigation (12thJuly 2012) to assess the current environmental status of the proposed Nkandla-Umlalazi Smart Growth site with special emphasis on remaining natural habitats.
- Identify problematic areas which require immediate attention as well as management, e.g. gully erosion, degraded areas, reclamation areas, alien vegetation.
- Make management recommendations and mitigatory measures for the current as well as potential environmental impacts especially pertaining to the Nkandla-Umlalazi Smart Growth Project.

1.1 OBJECTIVES OF THE PRELIMINARY ECOLOGICAL SURVEY/ HABITAT ASSESSMENT

- To provide a basic description of the vegetation and fauna occurring around the proposed Nkandla-Umlalazi Smart Growth project area.
- To provide a description of any threatened plant or animal (mammals, birds, reptiles and amphibians) occurring or likely to occur within the Nkandla-Umlalazi Smart Growth site project area.
- 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 Nkandla-Umlalazi Smart Growth project on the remaining natural vegetation and associated fauna.
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed Nkandla-Umlalazi Smart Growth project.

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 Nkandla-Umlalazi Smart Growth project area.
- Literature investigations with which to augment field data were necessary.
- Identification of potential ecological impacts that could occur as a result of the Nkandla-Umlalazi Smart Growth project 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 1 day (8 hours) during the winter months (July 2012). Due to financial as well as time constraints no comprehensive vegetation or faunal surveys conducted but merely a basic ecological/habitat assessment based on the brief one day site visit.
- The majority of habitats within the proposed Nkandla-Umlalazi Smart Growth site have already been completely transformed due to the existing developments as well as rural homesteads, small scale agricultural lands as well as heavily degraded due to extensive overgrazing by livestock (cattle and goats) and severe bush encroachment adjacent to the rivers and non-perennial drainage lines.
- The vegetation around the existing rural homesteads consists of completely transformed habitats and dominated by weedy pioneer plants (rurals) as well as alien invasive species. Certain homesteads have planted fruiting trees such as Mangoes as well as Avocados.
- Access to certain areas of the site was restricted due to severe thicket formation or bush encroachment by *Acacia nilotica, Acacia tortilis* as well as *Dichrostachys cinerea*.
- The majority of plant and animal species are extremely seasonal only emerging after sufficient heavy early summer rainfall (October-November). No comprehensive vegetation or faunal surveys have been conducted on the site.
- The majority of threatened faunal species are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons/ years.
- Limitation of historic data and available databases for the Nkandla-Umlalazi area.
- 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 2010-2012).

2. METHODOLOGY

A survey of the proposed Nkandla-Umlalazi Smart Growth project area was carried out by driving around the proposed areas by car and closer inspection of the non-perennial drainage lines and Mamba River as well as accessible natural habitats carried out on foot. As the site is situated around rural homesteads and agricultural areas the majority of natural vegetation consisting of Eastern Valley Bushveld (SVs6) has been transformed due to existing rural houses, livestock kraals and small scale agricultural lands. Severe degradation of the remaining vegetation due to surrounding anthropogenic activities including wood harvesting, collection of medicinal plants as well as extensive overgrazing by cattle and goats. Extensive bush encroachment by *Acacia nilotica* subsp. *kraussiana, Acacia tortilis* subsp. *heteracantha* and *Dichrostachys cinerea* within old agricultural lands as well as adjacent to the lower lying around the Mamba River and the non-perennial drainage lines. Remnant patches of indigenous riparian vegetation remains along the Mamba River as well as northern non-perennial drainage line. Large areas of the riparian vegetation have been removed during wood harvesting activities. The site was visited predominantly during daylight hours (8h30-16h30) on the 12thJuly 2012.

It must be stressed that due to time and financial constraints as well as inaccessibility of certain areas of the site such as the *Acacia* thickets adjacent to the Mamba River and non-perennial drainage lines; 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 Eastern Valley Bushveld in various stages of transformation and degradation, non-perennial drainage lines as well as accessible areas along the Mamba River.

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).

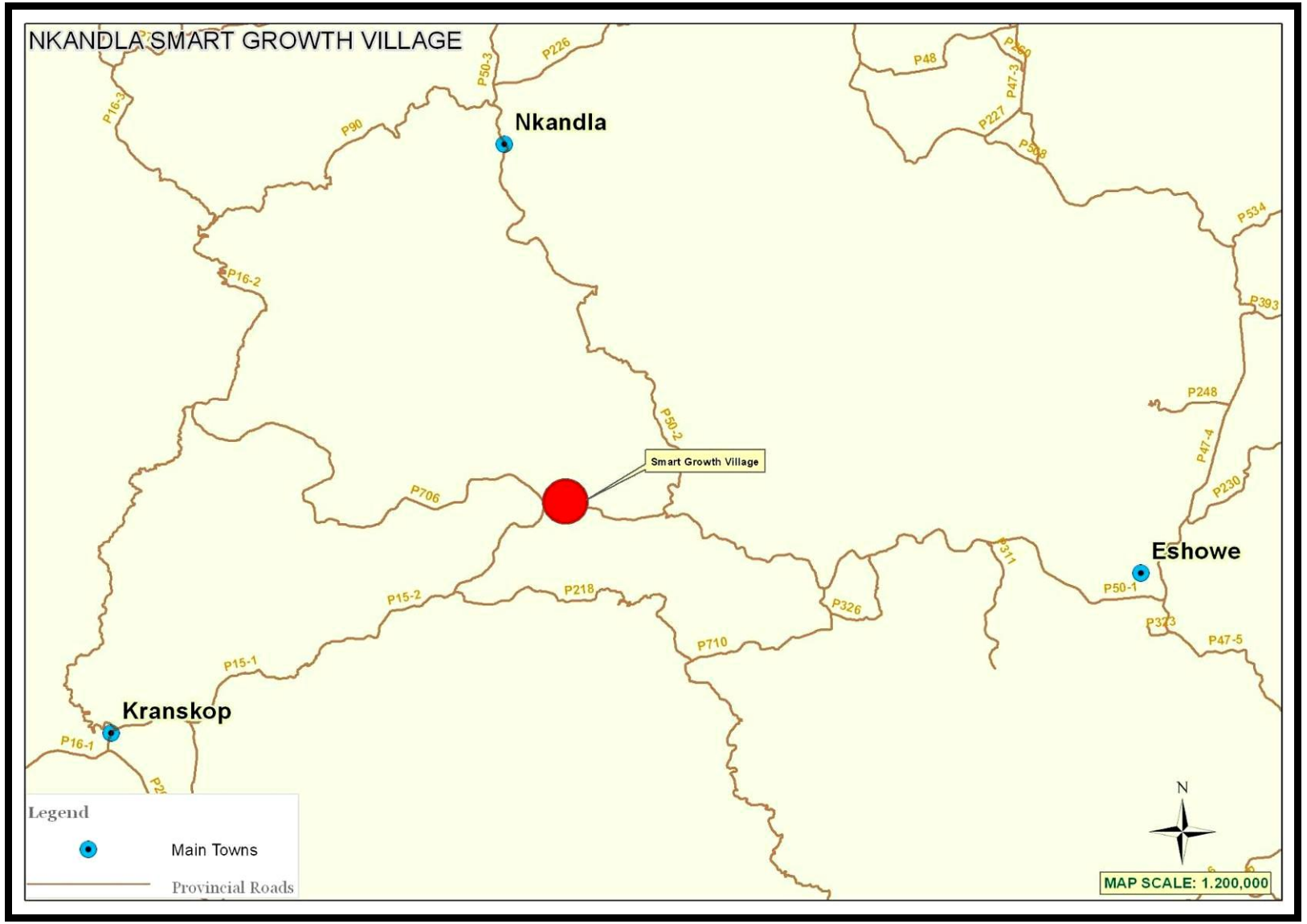

Figure1. Locality map of the Nkandla-Umlalazi Smart Growth village.

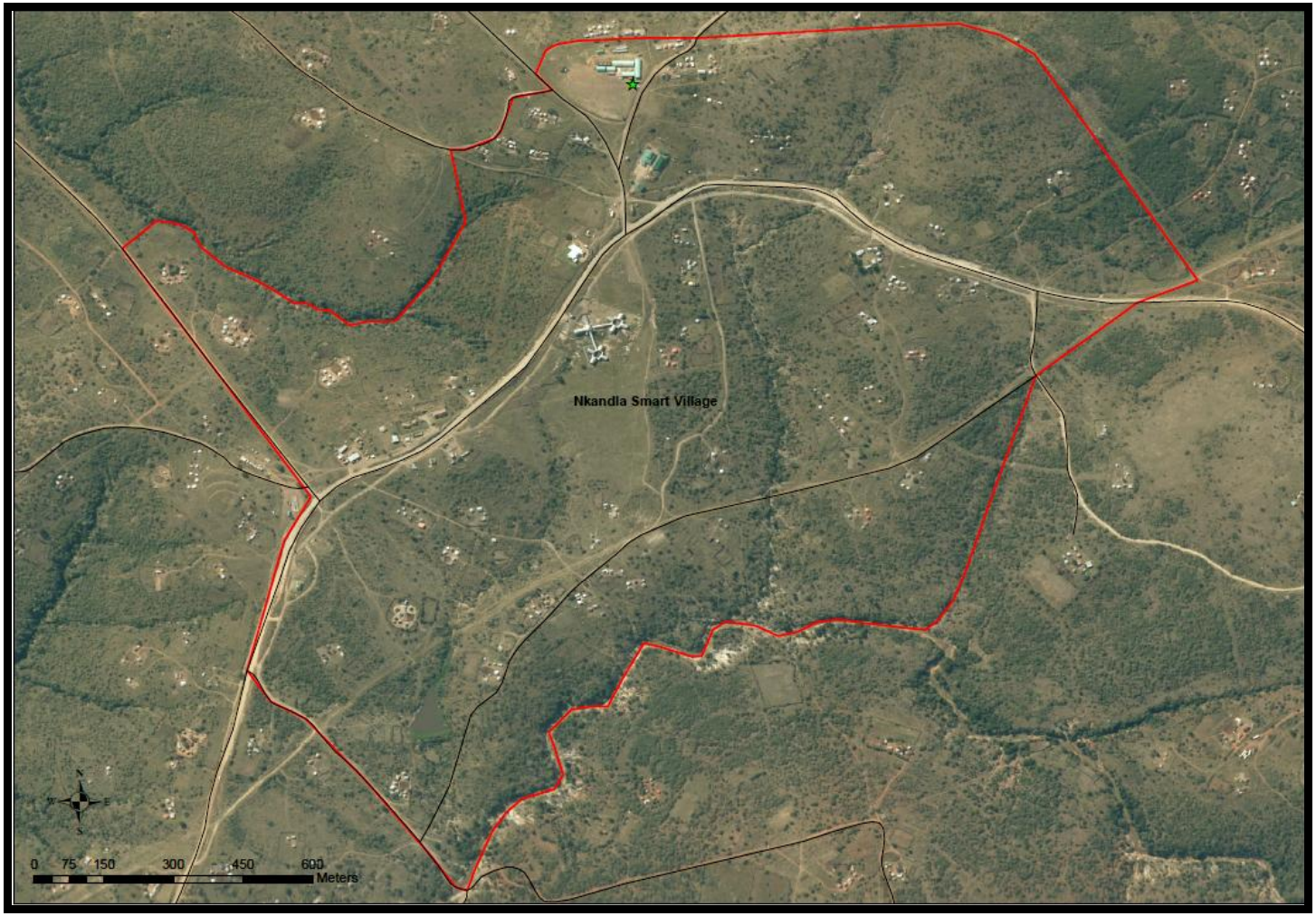

Figure2. A Google image of the proposed Nkandla-Umlalazi Smart Village.

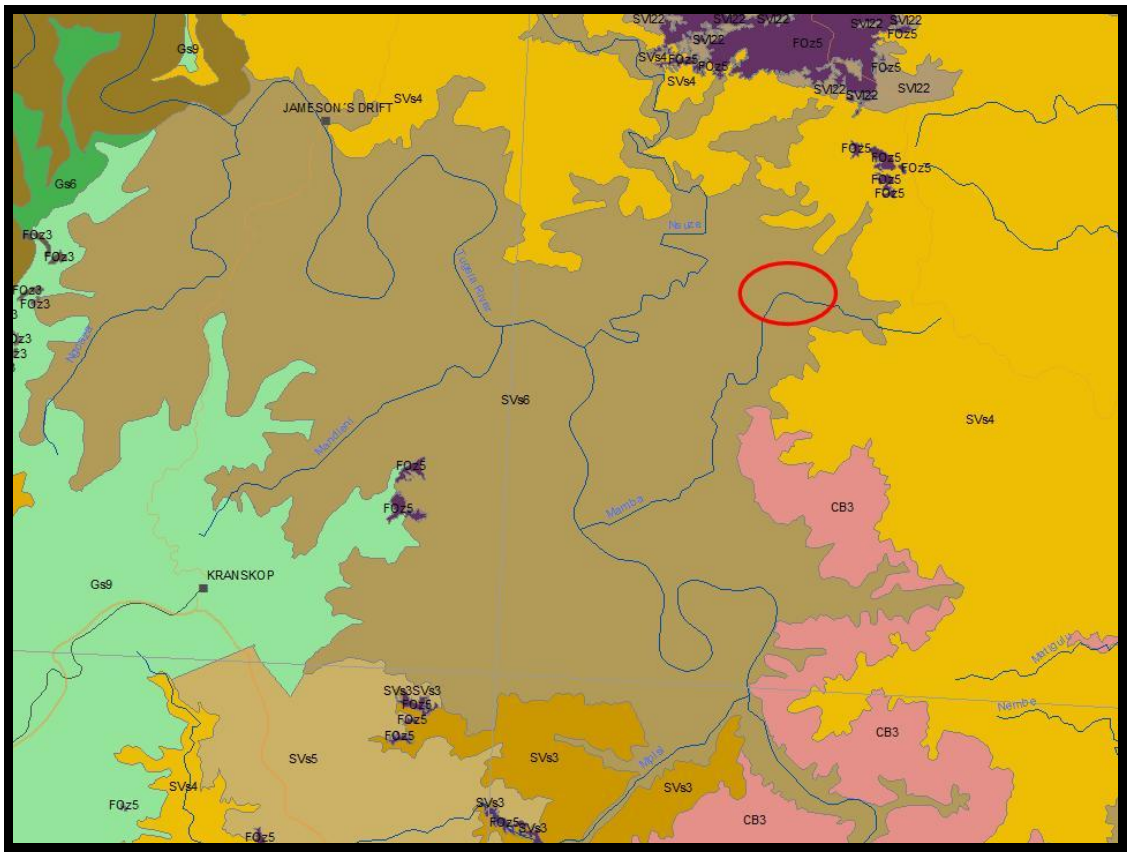

Figure3. The proposed Nkandla-Umlalazi Smart Growth Village falls within the Eastern Valley Bushveld (SVs6) vegetation unit (Mucina & Rutherford 2006).

3.1 STUDY AREA

Nkandla-Umlalazi Smart Growth Centre development centre is located on the border of the uMlalazi and Nkandla local municipalities and falls within the uThungulu District Municipality, 30km north east of the town of Kranskop, KwaZulu Natal province. Access to the site was along the P15-2 from Kranskop.

Eastern Valley Bushveld

Acocks (1988) called this vegetation type Valley Bushveld whereas Low & Rebelo (1996) called it Valley Thicket.

Distribution

It occurs in KwaZulu-Natal and Eastern Cape Provinces, in deeply incised valleys of rivers including the lower reaches of the Thukela, Mvoti, Mgeni, Mlazi, Mkhomazi, Mzimkulu, Mzimkulwana, Mtamvuna, Mtentu, Msikaba, Mzimvubu (and its several tributaries), Mthatha, Mbhashe, Shixini, Qhorha and Great Kei.

Vegetation and Landscape Features

Eastern Valley Bushveld is described by Mucina & Rutherford (2006) as being semi-deciduous savanna woodlands with pockets of thickets in a mosaic pattern, often succulent and dominated by *Euphorbia* and *Aloes*. Most of the river valleys run along a northwest-southeast axis which results in unequal distribution of rainfall on respective north-facing and south-facing slopes since the rain bearing winds blow from the south. The steep north-facing slopes are sheltered from the rain and also receive greater amounts of insolation adding to xerophilous*. The Endemic taxa include the tall shrub *Bauhinia natalensis* and the succulent herb *Huernia pendula* (Mucina and Rutherford 2006).

Existing impacts occurring within the Nkandla-Umlalazi site and surrounding area include:

- Extensive vegetation transformation around the homesteads, livestock enclosures, grazing pastures and small-scale agricultural lands.
- Extensive vegetation degradation due to overgrazing by cattle and goats with the grasses grazed to the ground.
- Extensive soil erosion (surface, rill and gully) especially along the non-perennial drainage lines as well as macro-channel banks of the Mamba River. This is due to poor stormwater management as well as uncontrolled livestock drinking activities along the river as well as removal of the riparian vegetation during wood harvesting activities.
- Alteration of then natural fire regime. Frequent fires at the incorrect time of year.
- Wood harvesting and tree clear-felling.
- Thicket formation and severe bush encroachment occurs in the old agricultural alnds as well as livestock enclosures as in the lower lying areas of the site by *Acacia spp.* and *Dichrostachys cinera*
- Numerous human and livestock 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 in certain sections of the Mamba River due to increased phosphates levels due to washing activities as well as siltation and sedimentation due to poor vegetation and soil conservation around the site.
- Bank erosion from vegetation removal, overgrazing and trampling from cattle.
- Massive siltation and sedimentation accumulates in the perennial and non-

* thriving in or adapted for a hot dry habitat

perennial (seasonal) rivers and drainage lines/streams.

- Extensive dumping and littering especially adjacent to homesteads.
- Deterioration in water quality due to presence of pit-latrines as well as washing and bathing activities within the Mamba river.

Geology and Soils

The area is underlain by the sediments of the Karoo Supergroup with the mudstones and lesser sandstones of the Adelaide and Tarkastad Subgroups (Beaufort Group) dominant and some Ecca Group Shale. Dominant land type Fa (Mucina and Rutherford 2006). The site is underlain by colluvial and residual soils that overlie weathered bedrock of the Natal Metamorphic Province. No groundwater seepage was observed although a perched groundwater table may occur where shallow sandy soils or lithosols on the granite bedrocks; especially during and after periods of heavy rainfall during the wet summer months. No evidence of hydric soils or hydrophilic or hygrophilous vegetation observed during preliminary site visit; except within the Mamba River. Four non-perennial or seasonal drainage lines feed into the Mamba River. The geotechnical investigations encountered granite bedrock in some areas where test pits were dug (Mashabane Rose Associates Feasibility Report 2012). Granite bedrock was observed within the active channel of the Mamba River as well as adjacent riparian zone. Low-lying rocky outcrops occur around the summits of the adjacent hills. Rock material has been removed from large portions of the site.

Climate

Summer rainfall area but with some rain during winter. Mean Annual Precipitation (MAP) is between 550-1 000mm. Frost is infrequent.

Conservation Status

The Eastern Valley Bush currently has the conservation status of being **Least Threatened**. Of the National Conservation Target of 25% only 0.8 % is statutorily conserved in the Luchaba Wildlife Reserve and small patches within the Oribi Gorge Nature Reserve. Approximately 15% has been transformed through cultivation. *Chromolaena odorata, Lantana camara* and *Caesalpinia decapatela* are the most problematic alien invader plants threatening this vegetation type (Mucina and Rutherford 2006).

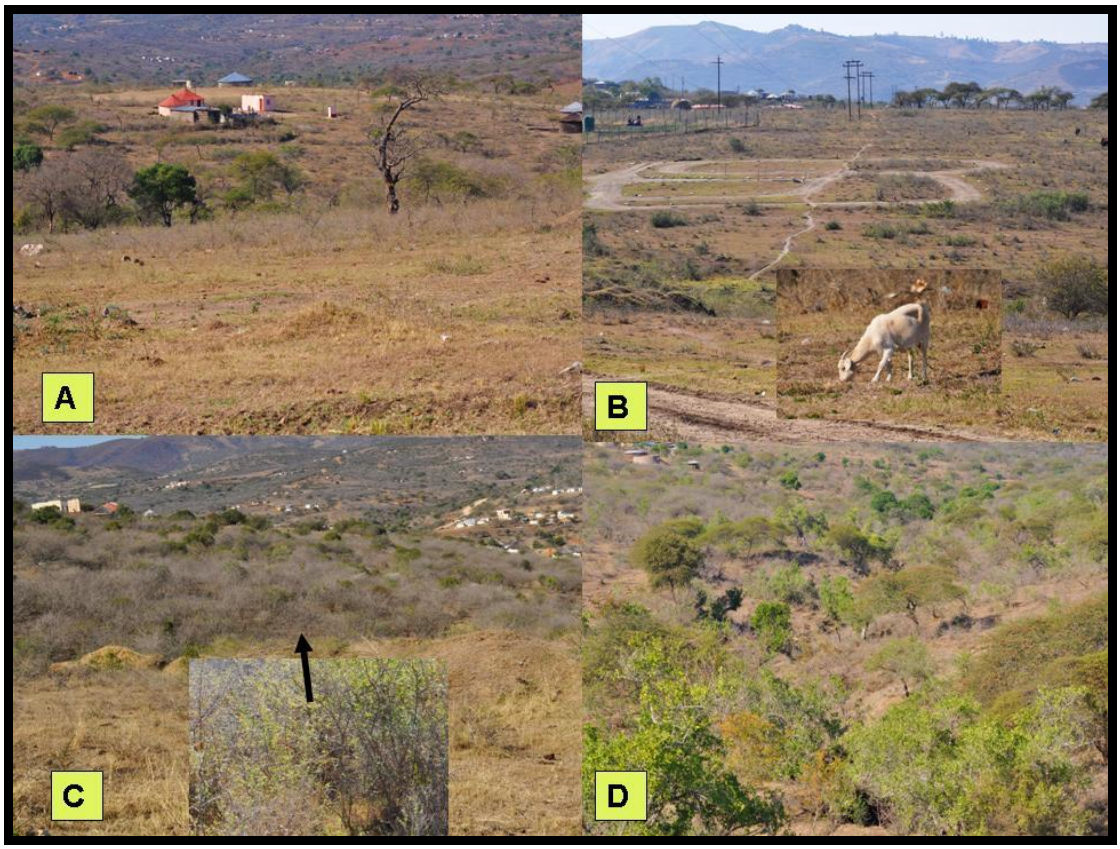

Figure4. A conglomerate of photographs displaying the major vegetation communities observed on the proposed Nkandla-Umlalazi Smart Growth site. A: The site is dominated by Eastern Valley Bushveld in various stages of transformation and degradation. **B:** Large areas adjacent to the residential homesteads as well as the adjacent areas around the Mamba One-Stop Development Centre are totally transformed and dominated by secondary succession grasses and pioneer weedy plant species. Extensive vegetation clearance for small-scale agricultural activities, wood harvesting, collection of traditional medicinal plants. Heavily overgrazed areas occur around the entire area especially by goats. **C:** Extensive bush encroachment occurs in certain areas especially towards the non-perennial drainage lines and Mamaba River. Encroaching species in these thickets include *Acacia nilotica* subsp. *kraussiana*, *Acacia tortilis* subsp. *heteracantha* and *Dichrostachys cinerea*. **D:** Remnant patches of Eastern Valley Bushveld occur along the riparian zones of the Mamba River as well as to a lesser extent along the non-perennial drainage lines.

3.2 TRANSFORMED AND DEGRADED EASTERN VALLEY BUSHVELD

Vegetation Type	Eastern Valley Bushveld (SVs 6)	**Tree cover**	0-5%
Soil	Light-Brown Sandy Soils	**Shrub cover**	0-100 %
Topography	Undulating Hillslopes	**Herb cover**	<5%
Land use	Homesteads and small-scale agricultural and livestock (cattle and goats) grazing activities	**Grass cover**	0-80%
Dominant Grass spp.	*Aristida congesta, Hyparrhenia hirta, Panicum maximum, Melinis repens, Sporobolus africanus, Hypoxis argentea, Eragrostis curvula, Eragrostis curvula, Cynodon dactylon*		
Dominant Herbs	*Tagetes minuta, Chamaechrista mimusoides, Cirsium vulgare*; Conyza albida, Ceratotheca triloba, Commelina africans, Helichrysum aureum, Datura strumonium*, Solanum sisymbrifolium, Tithonia diversifolia*, Stapelia gigantea, Ageratum conyzoides*, Kalanchoe rotundifolia*		
Dominant Trees and shrubs	*Acacia nilotica* subsp. *kraussiana, Acacia natalitia, Acacia tortilis* subsp. *heteracacntha, Dicrostachys cinerea, Sclerocarya birrea subsp.caffra, Gymnosporia sp., Grewia occidentalis, Boscia albitrunca, Erythrina caffra, Aloe matlothii, Euphorbia ingens Lantana camara*, Solanum mauritianum**		

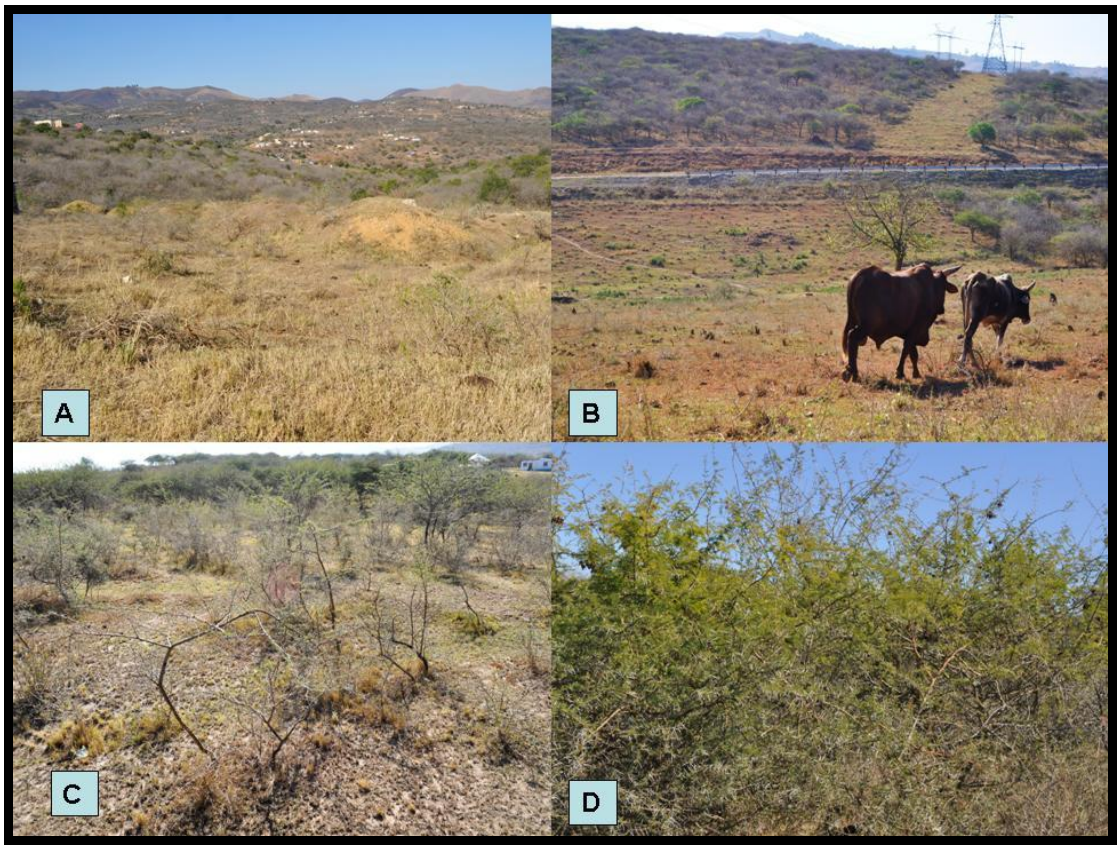

Figure5. A conglomerate of photographs displaying the current impacts on the vegetation within the Nkandla-Umlalazi Smart Growth Village. A: Extensive vegetation clearance including wood harvesting, sand harvesting, collection of traditional medicinal plants as well as loosely embedded rock material. **B:** Extensive overgrazing by cattle and goats has resulted in an extremely poor herb and grasses grazed down to the ground. The majority of grass species remaining are mainly unpalatable species. **C & D:** Severe bush encroachment occurs in certain areas especially towards the non-perennial drainage lines as well as Mamba River.

The transformed and degraded Eastern Valley Bushveld comprises the largest component of the vegetation within the Nkandla-Umlalazi Smart Growth Village project area. The area consists of existing residential houses, small-scale agricultural fields (old and current) that are mostly located on the mid-slopes as well as crest grassland plateaus. As a result the natural vegetation has become degraded and is mostly transformed. A few scattered large trees occur around the homesteads as well as around the old agricultural lands. Tree density as well as diversity increases towards the Mamba River. The grassland areas are heavily used for grazing purposes and the grasses grazed down to the ground. Dominant species include *Aristida congesta*, *Cynodon dactylon, Digitaria spp., Chloris virgata, Sporobolus africanus, Panicum maximum, Cymbopogon sp., Eragrostis curvula, Imperata cylindrica, Hyparrhenia hirta* and *Melinis repens.* The grasses cover varies from bare batches to approximately 70-80% of the site and the forbs and herbs layer is poorly

developed <5%. 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**, *Ambrosia artemisifolia, Ageratum houstonianum**, *Ageratum conyzoides**, *Conyza bonariensis* and *Parthenium hyserophorus.*

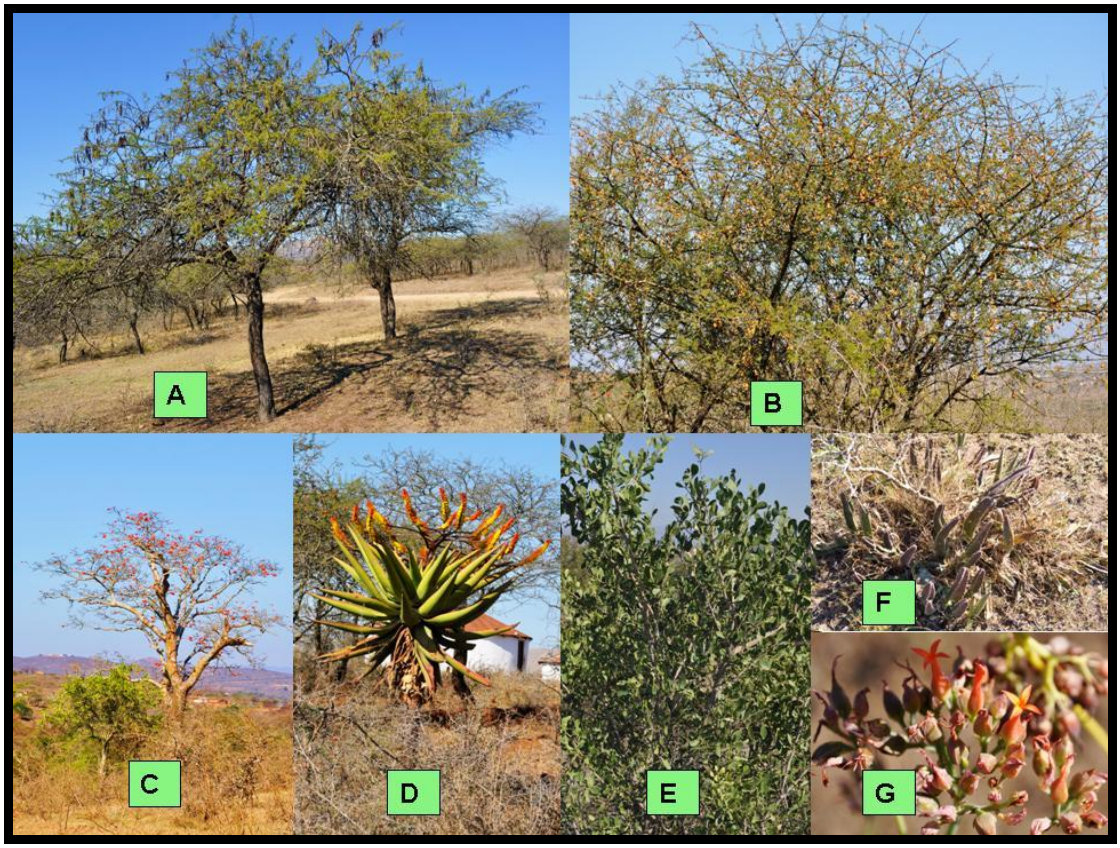

Figure6. Dominant vegetation observed on the Nkandla-Umlalazi Smart Growth site included: A: Scented-pod Thorn (*Acacia nilotica* subsp. *kraussiana*), **B:** Umbrella Thorn (*Acacia tortilis* subsp. *heteracantha*), **C:** Coastal Coral Tree (*Erythrina caffra*), **D:** Bottlebrush Aloe (*Aloe rupestris*), **E:** Confetti or Red Spikethorn (*Gymnosporia senegalensis*); **F:** Giant Stapelia (*Stapelia gigantea*) and **F:** Common Kalanchoe (*Kalanchoe rotundifolia*).

On the old agricultural fields, especially the lower-lying areas *Acacia nilotica* subsp. *kraussiana*, *Acacia tortilis* subsp. *heteracantha, Acacia Dichrostachys cinerea* are also present and have in some cases, closer to the non-perennial drainage lines and Mamba River, become densified (bush encroachment). A few scattered Giant Stapelia (*Stapelia gigantea*) colonies were observed at the base of shrubby Acacia's. This plant is used in traditional medicine to treat hysteria and pain as well as sorcery (witchcraft) as a poison reportedly capable of death (Pooley 2005). The most dominant herb was the succulent Common Kalanchoe (*Kalanchoe rotundifolia*). This succulent herb is poisonous to livestock and used in traditional medicines as an emetic (Pooley 2005).

Exotic and invasive plant species were categorised according to the framework laid out by The Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983). CARA defines weeds as alien plants, with no known useful economic purpose that should be eradicated. Invader plants, also considered by the Act, can also be of alien origin but may serve useful purposes as ornamentals, as sources of timber, or may have other benefits (Henderson, 2001). These plants need to be managed and prevented from spreading.

Alien and invasive plant species can be grouped three categories:

- Category 1 plants are weeds that serve no useful economic purpose and possess characteristics that are harmful to humans, animals or the environment. These plants need to be eradicated using the control methods stipulated in Regulation 15.D of the CARA.
- Category 2 plants are plants that are useful for commercial plant production purposes but are proven plant invaders under uncontrolled conditions outside demarcated areas.
- Category 3 plants are mainly used for ornamental purposes in demarcated areas but are proven plant invaders under uncontrolled conditions outside demarcated areas.

Alien invasive species recorded included *Agave americana* Ageratum conyzoides**, *Arundo donax**, *Caesalpinia decapetala**, *Chromolaena odorata**, *Ipomoea indica**, *Ipomoea purpurea**, *Lantana camara**, *Leucaena leucocephala**, *Montanoa hibiscifolia**, *Opuntia ficus-indica*, *Jacaranda mimosifolia**, *Rubus fruticosus**, *Rubus cuneifolius**, *Psidium guajava**, *Melia azedarach*, Mimosa pigra*, Ricinus communis*, Senna didymobotrya*, Solanum mauritianum*, Tithonia diversifolia*[*] are present throughout this large unit.

[*] exotic or alien invasive vegetation

Various human and livestock footpaths and informal two-spoor roads are present in these areas. The high levels of human activities on and surrounding the hillslopes including the removal of embedded rock material, harvesting of traditional medicinal plants, bush encroachment and extensive overgrazing by cattle and goats as well as on-going alien vegetation invasion significantly reduces the likelihood of any significant populations of any rare or threatened plants. No rare or threatened plant species were recorded within these transformed and degraded vegetation units during the brief field survey.

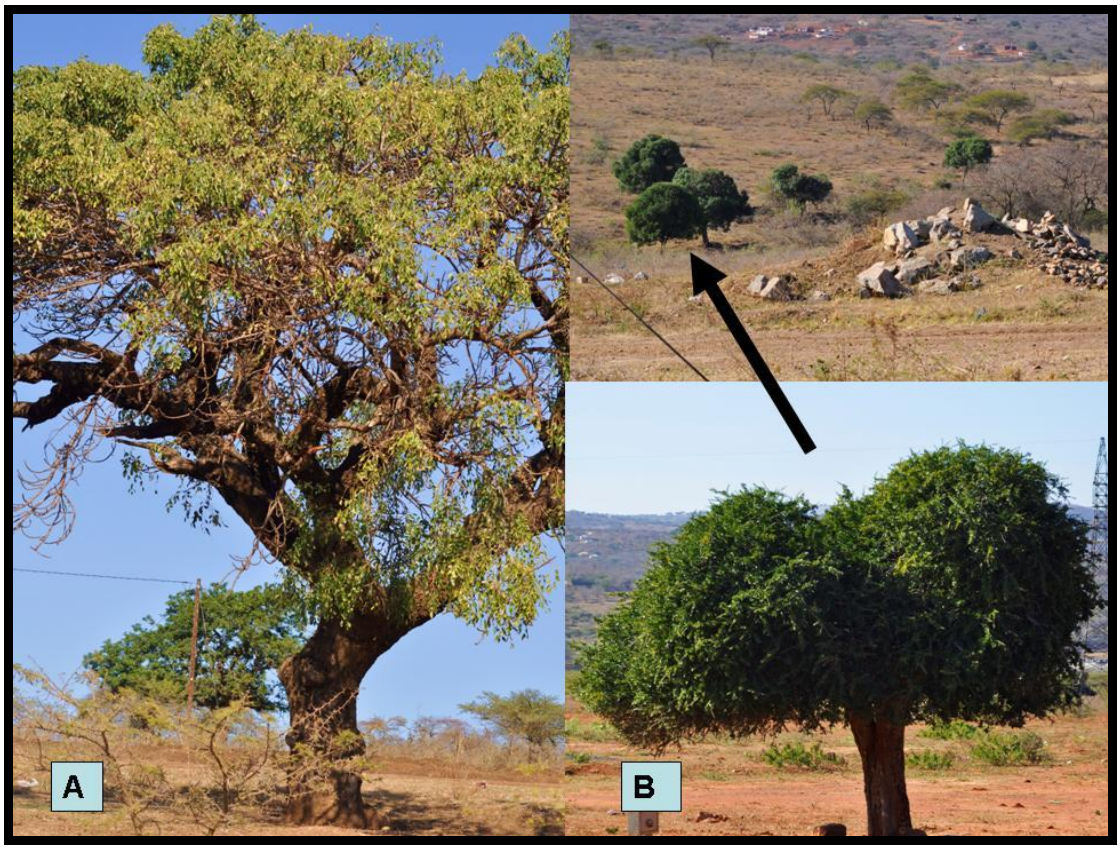

Figure7. Two protected tree species were recorded namely several scattered Marula *Sclerocarya birrea subsp. caffra* and Shepherd's Tree *Boscia albitrunca*.

Protected Tree Species

Two protected tree species were recorded namely several scattered Marula *Sclerocarya birrea subsp. caffra* and Shepherd's Tree *Boscia albitrunca*. In terms of the National Forests Act 1998 (Act No 84 of 1998) certain tree species can be identified and declared as protected. The Department of Water Affairs and Forestry (now Department of Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under

a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any protected tree species.

3.3 THE MAMBA RIVER, NON-PERENNIAL DRAINAGE LINES & ASSOCIATED RIPARIAN ZONES

Vegetation Type	Eastern Valley Bushveld (SVs 6)	**Tree cover**	0-80%
Soil	Light-Brown Sandy Soils and darker clays within Mamba River	**Shrub cover**	0-20 %
Topography	Undulating Hillslopes	**Herb cover**	<5%
Land use	Homesteads and small-scale agricultural and livestock (cattle and goats) grazing activities. Wood harvesting along Mamba River and non-perennial drainage lines	**Grass cover**	0-40%
Dominant Grass spp.	*Aristida congesta, Hyparrhenia hirta, Panicum maximum, Melinis repens, Sporobolus africanus, Imperata cylindrica, Eragrostis curvula, Eragrostis curvula, Cynodon dactylon;*		

Dominant Herbs	*Tagetes minuta*, Chamaechrista mimusoides, Cirsium vulgare*; Conyza albida*, Ceratotheca triloba*, Commelina africans, Helichrysum aureum, Datura strumonium*, Solanum sisymbrifolium*, Tithonia diversifolia*, Ageratum conyzoides*, Kalanchoe rotundifolia*
Dominant Trees and shrubs	*Acacia nilotica* subsp. *kraussiana, Acacia natalitia, Acacia tortilis* subsp. *heteracacntha, Acacia robusta, Acacia ataxacatha, Dicrostachys cinerea, Sclerocarya birrea subsp.caffra, Combretum molle, Cussonia spicata, Olea europaea, Dombeya rotundifolia, Schotia brachypetala, Spirostachys africana, Gymnosporia senegalensis, sp., Grewia occidentalis, Syzigium cordatum, Ficus sur, Celtis africana, Trema orientalis, Erythrina caffra, Aloe matlothii, Euphorbia ingens Lantana camara*, Solanum mauritianum*, Ziziphus mucronata, Ehretia rigida* subsp. *rigida, Euclea crispa* subsp. *crispa.*

Riparian habitats, also known as riparian areas, include plant communities adjacent to and affected by surface and subsurface hydrologic features, such as rivers, streams, lakes, or drainage ways. These areas may be a few metres wide near streams or more than a kilometre in floodplains. Both perennial and non-perennial streams support riparian vegetation. Because riparian areas represent the interface between aquatic and upland ecosystems, the vegetation in the riparian area may have characteristics of both aquatic and upland habitats. Many of the plants in the riparian area require plenty of water and are adapted to shallow water table conditions. Due to water availability and rich alluvial soils, riparian areas are usually very productive. Tree growth rate is high and the vegetation under the trees is usually lush and includes a wide variety of shrubs, grasses, and wildflowers.

Why are riparian areas important?

Riparian areas perform a variety of functions that are of value to society, especially the protection and enhancement of water resources, and provision of habitat for plant and animal species.

Riparian areas:

- store water and help reduce floods
- stabilize stream banks;
- improve water quality by trapping sediment and nutrients;
- maintain natural water temperature for aquatic species;
- provide shelter and food for birds and other animals;
- provide corridors for movement and migration of different species;

* exotic or alien invasive vegetation

- act as a buffer between aquatic ecosystems and adjacent land uses;
- can be used as recreational sites; and
- provide material for building, medicinal plants, crafts and curios.

Not all riparian areas develop the same way and may not perform these functions to the same extent. It is important that a riparian area's capacity to provide the benefits listed is not reduced. Many of these areas are best managed as natural areas, rather than being converted to other uses. The riparian vegetation along the non-perennial drainage lines and Mamba River are heavily impacted from surrounding anthropogenic activities. Wood harvesting occurs throughout the area. Several of the large riparian species have been removed in certain sections during previous sand mining as well as small-scale agricultural activities. Severe macro-channel bank erosion occurs below stormwater discharge pipes as well as from uncontrolled livestock (especially cattle) drinking activities.

Remnant patches of indigenous open and closed woodland riparian vegetation occurs along the northern non-perennial drainage line as well as the upper sections of the Mamba River. Dominant riparian species included *Acacia nilotica* subsp. *kraussiana, Acacia natalitia, Acacia robusta, Acacia tortilis* subsp. *heteracacntha, Acacia ataxacatha, Dicrostachys cinerea, Sclerocarya birrea subsp.caffra, Combretum molle, Cussonia spicata, Olea europaea, Dombeya rotundifolia, Schotia brachypetala, Spirostachys africana, Gymnosporia senegalensis, sp., Grewia occidentalis, Syzigium cordatum, Ficus sur, Celtis africana, Trema orientalis, Erythrina caffra, Aloe matlothii, Euphorbia ingens Lantana camara*, Solanum mauritianum*, Ziziphus mucronata*.

No red data plant species were observed during the brief field survey although suitable habitat remains within these protected wooded pockets for certain red listed plant species. More intensive surveys are required in order to ascertain the current conservation status of threatened plant and tree species in these areas. No development is proposed along the non-perennial drainage lines as well as Mamba River and riparian zone (see separate riparian assessment report).

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 Nkandla-Umlalazi Smart Growth Centre 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 12th of July 2012. 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 & Chimimba 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 VII th 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 Gudie 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 Nkandla-Umlalazi Smart Growth Centre is completely transformed and dominated by secondary succession patches of heavily grazed grassland with limited scattered tree species around the rural homesteads and adjacent agricultural lands. Extensive thickets of *Acacia* spp. and *Dichrostachys cinerea* have invaded transformed or degraded areas such as old lands, road reserves and old livestock enclosures. High levels of habitat degradation occur around the area with wood harvesting, rock removal, sand harvesting, alien invasive plant vegetation as well as extensive overgrazing and soil erosion. The Mamba River and associated open and closed wooded riparian zone as well as the riparian zones along the non-perennial drainage lines offer the most favourable habitat for remaining animal species (especially birds).

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

- The proposed Nkandla-Umlalazi Smart Growth Centre housing project is situated within a rural agricultural environment which is dominated by transformed and heavily degraded Eastern Valley Bushveld vegetation dominated by limited secondary succession grasslands with scattered trees with no understory vegetation as well as extensive bush encroachment/ thickets with consist of limited habitat diversity or impoverished habitats.

- As the site is situated around rural homesteads and agricultural areas the majority of natural vegetation consisting of Eastern Valley Bushveld has been transformed due to existing rural houses, livestock kraals and small scale agricultural lands. Severe degradation of the remaining vegetation due to surrounding anthropogenic activities including wood harvesting, collection of medicinal plants as well as extensive overgrazing by cattle and goats. This has resulted in impoverished habitats with limited faunal diversity due to habitat destruction and habitat fragmentation.

- Extensive bush encroachment by *Acacia nilotica* subsp. *kraussiana, Acacia tortilis* subsp. *heteracantha* and *Dichrostachys cinerea* within old agricultural lands as well as adjacent to the lower lying around the Mamba River and the non-perennial drainage lines.

- Remnant patches of indigenous riparian vegetation remains along the Mamba River as well as northern non-perennial drainage line. Large areas of the riparian vegetation have been removed during wood harvesting activities

- Littering occurs adjacent to the main road P16-2 as well as residential erven as well as school.

- Frequent burning of remaining patches of grasslands as well as extesive overgrazing (ground level) severely restricts vegetative cover and potential refuge habitat for remaining faunal species.

- Hunting with dogs as well as feral cats around the houses. Dogs and cats have a high impact on remaining faunal species. Children were observed hunting birds with catapults during the site visit.

- Introduction of exotic and alien invasive vegetation.

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 fogs 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 acts 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 Kwazulu-Natal 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 daylight hours of the winter months only a small proportion of species are present (winter breeders). Only one frog species was recorded during brief site inspection namely a Common River Frog (*Amietia angolensis*) which was flushed from the riparian zone of the Mamba River. Ideally, a herpetological survey should be undertaken throughout the duration of the wet season (November-Mach) including several nocturnal surveys. 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.

Figure8. **Frog species recorded (*) or likely to occur within the Nkandla-Umlalazi Smart Growth Centre included**: **A:** Natal Tree Frog (*Leptopelis natalensis*); **B:** Painted Reed Frog (*Hyperolius marmoratus marmoratus*); **C:** *Common River Frog (*Amietia angolensis*) and **D**: Bubbling Kassina (*Kassina senegalensis*).

Table1. Frog species recorded on the actual site or are likely to occur on the site.

Common Name	**Scientific Name**	**Status/ Distribution**	**Habitat**
*Common River Frog	*Amietia* (*Afrana*) *angolensis*	Common in central and southern Africa.	Permanent standing water and streams in grassland and open woodland. Recorded within the Mamba River.
Guttural Toad	*Amietophrynus* (*Bufo*) *gutturalis*	Common in southern Africa north of Gariep.	Permanent and semi-permanent ponds and backwaters in open grassland.
Red Toad	*Schismaderma carens*	Found throughout South Africa and southward throughout	Breeds in deep muddy pools and dams as well as reed invaded backwaters within rivers.

		Kwazulu-Natal to Port Edward.	
Painted Reed Frog	*Hyperolius marmoratus marmoratus*	Common along Kwazulu-Natal Coast	Reeds and other emergent vegetation along a wide variety of waterbodies including pans and rivers
Water Lily Frog	*Hyperolius pusillus*	Common in the low-lying coastal areas (Eastern Cape and Kwazulu-Natal) but further inland in the southern parts of Limpopo it is found at higher altitudes.	Shallow pans, ponds, vleis and dams with water lilies (*Nymphaea sp*.) or at least some floating vegetation.
Tinker Reed Frog	*Hyperolius tuberilinguis*	Common in the Eastern parts of Southern Africa from Swaziland up to Port Edward	Reed beds on the periphery of rivers or dense vegetation surrounding seasonal pans
Natal Tree Frog	*Leptopelis natalensis*	Common in Kwazulu-Natal	Permanent and Seasonal ponds situated in coastal forest, sand forest or coastal bushveld and occasionally grassland
Bubbling Kassina	*Kassina senegalensis*	Common throughout Southern Africa	Grassy margins of seasonally inundated pans as well as dams
Snoring Puddle Frog	*Phrynobatrachus natalensis*	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
Sharp-Nosed Grass Frog	*Ptychadena oxyrynchus*	Eastern Parts of South Africa	Vleis, inundated grassland and sedge pans, temporary roadside pools and rock puddles
Natal Sand Frog	*Tompoterna natalensis*	Common species in Kwazulu-Natal,	Streams, rivers or other places where water flows

		Mpumalanga, Gauteng.	slowly but also in lothic or standing water
Bronze Caco	*Cacosternum nanum*	Common species in Kwazulu-Natal	Vleis, inundated grassland and sedge pans, temporary roadside pools and rock puddles
Plaintive Rain Frog	*Breviceps verrucosus*	Eastern Parts of South Africa	Terrestrial breeder with eggs laid in moist leaf litter.
* recorded during brief survey			

Threatened species

One red listed frog is known from the 2831 DA Quarter Degree Grid Cell (QDGC) namely the Natal Kloof Frog (*Natalobatrachus bonebergi*). The Natal Kloof Frog is classified as **Endangered** and is restricted to the coastal forests of southern Kwazulu-Natal and northern Eastern Cape provinces, at altitudes below 900 m (Minter *et al.* 2004). Suitable habitat in the form of forest streams and pools with rocky beds especially, but not exclusively in ravines. No suitable habitat remains within the section of the Mamba River in the immediate areas for Natal Kloof Frogs. Due to extensive habitat transformation, degradation and fragmentation low amphibian diversity is expected on the site. No natural pans or seasonally inundated depressions were observed on the site. The majority of the frog species will be associated with the non-perennial drainage lines as well as the Mamba River.

4.2 REPTILES

All reptile species are sensitive to major habitat alteration and fragmentation. 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 and dead trunks for firewood collection destroys numerous habitats for many arboreal reptile species. Clearing of rock material 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. Several rock piles as well as low-lying rocky outcrops occur on the summit and upper hillslopes and offer suitable habitat for certain rupicolous reptile species. A few scattered termite mounds were observed within the mid slopes increasing in number where agricultural activities have ceased. Indiscriminate killing of snake species occur all around human settlements. The indiscriminate killing of all snake species 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. hree reptile species were recorded during the survey all within the wooded riparian zone of the Mamba River, namely a juvenile Nile Monitor (*Varanus niloticus*) a female Southern Tree Agama (*Acanthocercus atricollis* and a a Variable Skink *Trachylepis* (*Mabuya*) *varia*. A probable species list is provided in Table2 below.

Figure9. Reptile species recorded (*) or likely to occur on the site. A: Rock Monitors (*Varanus albigularis*) and **B:** Nile Monitors* (*Varanus niloticus*) may still occur around the site. Both species are hunted and killed due to raiding chicken runs as well as for food. **C:** South African Python (*Python natalensis*); especially dispersing juveniles could remain in the closed woodland riparian vegetation along the Mamba River. **D:** A female Southern Tree Agama* (*Acanthocercus atricollis*) was observed on the trunk of an *Acacia robusta*. Due to extensive habitat transformation and degradation as well as high levels of human activities alteration to the original reptile species composition (especially snakes) has already occurred. Remaining reptile species are restricted to the scattered large trees as well as remnant bushveld along the Mamba River and non-perennial drainage lines.

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	*Trachylepis* (*Mabuya*) *capensis*
Striped Skink	*Trachylepis* (*Mabuya*) *punctatissima*
*Variable Skink	*Trachylepis* (*Mabuya*) *varia*
Yellow-throated Plated Lizard	*Gerrhosaurus flavigularis*
Flap-Necked Chameleon	*Chamaeleo dilepis*
Southern Rock Agama	*Agama atra atra*
*Southern Tree Agama	*Acathocercus atricollis*
*Nile Monitor	*Varanus niloticus*
Herald or Red-lipped Snake	*Crotaphopeltis hotamboeia*
Green Mamba	*Dendroaspis angusticeps*
Common or Rhombic Night Adder	*Causus rhombeatus*
Boomslang	*Dispholidus typus*
Spotted Bush Snake	*Philothamnus senivariegatus*
Common or Rhombic Egg Eater	*Dasypeltis scabra*
Dusky-Bellied Water Snake	*Lycodonomorphus laevissimus*
Brown Water Snake	*Lycodonomorphus rufulus*
Brown House Snake	*Lamprophis fuliginosus*

Green Water Snake	*Philothamnus hoplogaster*
Common Slug-eater	*Duberria lutrix*
Bibron's Blind Snake	*Typhlops bibronii*
Cape and Eastern Thread Snake	*Leptotyphlops conjunctus*
Peters' Thread Snake	*Leptotyphlops scutifrons*

*** recorded during brief field survey**

THREATENED REPTILE SPECIES

Table3. Red data reptile species which have been recorded or suitable habitat exists on the site and immediate adjacent areas.

Common Name	Scientific Name	SA Red Data Status	IUCN STATUS
Southern African Python	*Python natalensis*	Vulnerable	*Vulnerable

*It is unlikely that pythons will retain this threat classification when reassessed using the latest IUCN criteria, since it appears to be relatively common in certain areas and has a widespread distribution (Alexander and Marais 2007).

Southern African Python *(Python natalensis)*

The Southern African Python (*Python natalensis*) is protected in South Africa (SA RDB, Vulnerable) and their numbers have declined due to habitat destruction, killed for their skins (fashion), 'muti', 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.

Habitat and Ecology: Pythons live in a wide variety of habitats, but are most common in moist, rocky, well-wooded valleys. They are frequently found in and around water, in which they bask and ambush food. They are also excellent climbers. They hunt mainly at night or in the twilight, but can also be found basking, and occasionally even hunting during the day. The diet of juveniles consists mainly of small rodents and ground living birds, although they will also take fish and water

or nile monitors (leguaans). The adults feed mainly on medium-sized mammals, including dassies, hares, cane rats, duikers, etc. The larger specimens will take larger mammals, and there are accurate, and often graphically illustrated, reports of Southern African Pythons killing and swallowing very large prey items. The largest recorded prey item for any large constrictor is that of a 59 kg impala swallowed by a 4.88 m African python (Rose, 1955). Other records include, among many others, a 6 m python consuming 6 goats (Taylor, 1981), a 5 m python that ate a pointer watchdog and two of her puppies (Jensen, 1980), and a 4.28 m python devouring a six-month old female impala (illustrated in Branch, 1984). F. W. Fitz Simons (1930) even records pythons killing leopards, and a python constricting a crocodile is illustrated in Halliday and Adler (1986).

The python is the only African snake large enough to consider humans edible, albeit very rarely. There are a number of anecdotal reports of human predation by pythons. In addition to the dangers of constriction, pythons have a mouthful of large, recurved and needle-sharp teeth that can deliver a powerful and lacerating bite. Adults are also irascible, and rarely settle well into captivity.

Man is now the python's main predator, killing them for food, 'muti', skins and, short-sightedly, to rid himself of a 'pest'. Other enemies include crocodiles, honey badgers or ratels, mongoose and meerkats, etc. Pienaar, *et al.* (1983) record a young python (825 mm) in the stomach of a Cape File snake. Pythons are often killed crossing roads, and when engorged with food they are especially vulnerable to attacks by packs of wild dogs and hyaenas.

Many African tribes prize python fat and skin for use in tribal medicines and witchdoctor's 'muti', whilst a large python represents a tasty and substantial food item (see photograph in Patterson and Bannister, 1987). All pythons, but particularly juveniles, are desired by the pet trade, and would find a ready market if not protected by law. Pythons are frequently electrocuted on the lower wires of electric fences which are erected around the increasing number of game farms.

No endangered reptile species were recorded during the brief field survey although suitable habitat occurs within the closed woodland vegetation unit and the remnant patches of riparian vegetation along the Mamba River and non-perennial drainage lines. The proposed Nkandla-Umlalazi Smart Growth Centre if restricted to the transformed and degraded hillslopes of the site should not negatively impact on the remaining Southern African Python populations. No Southern African Pythons or evidence of pythons was observed during the brief field survey. Remaining Python populations would have been impacted on during the previous agricultural activities as well as adjacent rural/agricultural activities and associated high levels of disturbance. The conservation of the Mamba River and riparian zone should

conserve the majority of suitable habitat for any remaining Southern African Pythons on the site. The Mamba River and associated riparian zone as well as non-perennial drainage lines could potentially act as an important dispersal or biological corridor for remaining pythons; especially dispersing juvenile pythons. As a precautionary measure an educational programme on Southern African Pythons should be implemented for the community and all future property owners. If any pythons are discovered on the site the relevant conservation authorities should be informed and the python relocated in suitable habitat away from the site. It is regarded as unlikely that study area comprises critical habitat for Southern African Pythons, at a global or provincial scale, or that the proposed development of the transformed and degraded hillslopes of the site, will have an impact of more than **low significance** on the conservation status of this specie should it indeed occur.

4.3 AVIFAUNA/BIRDS

Twenty-four (24) bird species were recorded during the brief field survey (total 8 hours). Species recorded during the field survey are common, widespread and typical of a woodland environment. The majority of bird species were recorded along the Mamba River and wooded riparian zone. High levels of human disturbance as well as habitat transformation and degradation on the site and within the Mamba River would result in the disappearance of the more secretive or sensitive bird species. The majority of bird species were recorded from the closed woodland vegetation units.

Table4: Bird species recorded during brief field survey (8hrs).

Roberts' Number	**Common name**	**Scientific Name**
94	Hadedah Ibis	*Bostrychia hagedash*
196	Natal Spurfowl	*Pternistis natalensis*
203	Helmeted Gunieafowl	*Numida meleagris*
297	Spotted Thick-Knee	*Burhinus capensis*
352	Red-Eyed Dove	*Stretopelia semitorquata*
354	Cape Turtle Dove	*Streptopelia capicola*
355	Laughing Dove	*Streptopelia senegalensis*
361	African Green-Pigeon	*Treron calvus*
371	Purple-Crested Turaco	*Gallirex porphyreolophus*
391	Burchell's Coucal	*Centropus burchellii*
424	Speckled Mousebird	*Colius striatus*
435	Brown-Hooded Kingfisher	*Halycon albiventris*
541	Fork-Tailed Drongo	*Dicrurus ludwigii*

545	Black-Headed Oriole	*Oriolus larvatus*
548	Pied Crow	*Corvus albus*
568	Dark-capped (Black-eyed) Bulbul	*Pycnonotus barbatus*
736	Southern Boubou	*Laniarius ferrugineus*
750	Olive Bush-Shrike	*Telophorus olivaceus*
758	*Common Myna	*Acridothermes tristis*
796	Cape White-Eye	*Zosterops pallidus*
801	*House Sparrow	*Passer domesticus*
814	Masked Weaver	*Ploceus velatus*
815	Lesser Masked Weaver	*Ploceus intermedius*
846	Common Waxbill	*Estrilda astrild*

Threatened species

Several threatened bird species have been recorded in the grid square within which the study area is situated. No threatened bird species were recorded during the brief survey within the Nkandla-Umlalazi Smart Growth Centre site area due to high levels of habitat transformation and degradation as well as human disturbances. The site may occasionally be utilised for temporary foraging areas for Lanner Falcons as well as Martial Eagles. The woodlands along the Mamba River form marginally suitable foraging habitat for African Crowned Eagles. All raptors are perceived as a threat to chickens and livestock and are killed. If however the unlikely occurrence of any threatened bird species it is highly unlikely that the transformed and heavily degraded areas proposed Nkandla-Umlalazi Smart Growth Centre will form critical habitat for any threatened bird species or negatively impact on any threatened bird species. The conservation and adequate rehabilitation of the Mamba River and the non-perennial drainage lines could potentially benefit remaining bird species.

4.4 MAMMALS

No small mammal trapping was conducted due to severe time and financial constraints as well as the limitations. Fieldwork was augmented with previous surveys in similar habitats as well as published data. The area was initially traversed on foot to ascertain the presence of available refuges. Limited suitable refuges such as burrows, artificially created rock piles, stumps were observed. The majority of mammal species likely to occur around the homesteads are urban exploiters such as the House Rat and House Mouse as well as feral cats. Several mounds of the African Molerat as well as burrows on the Natal Multimammate Mouse were observed in the sandier sections adjacent to the non-perennial drainage lines. Evidence of Water Mongoose (Latrine) as well as Cape Clawless Otters scats were observed along the Mamba River. Evidence of Common Duiker and Porcupine were observed within the closed wooded pockets adjacent to the Mamba River streams. Vervet Monkeys were observed foraging adjacent to the river. Several Slender Mongooses were observed crossing the informal access roads.

Mammal species recorded within the study area as well as those that may occur within the study area, on the basis of available distribution records and known habitat requirement, are included in the Table 4 below.

Table5: Mammal species recorded during field survey. Species in bold were recorded during the brief survey Identification was determined by visual observations and animal tracks (footprints and droppings).

COMMON NAME	SCIENTIFIC NAME
Common Molerat	***Cryptomys hottentotus***
Natal Multimammate Mouse	***Mastomys natalensis***
Scrub Hare	*Lepus saxtalis*
Striped Mouse	*Rhabdomys pumilio*
Grey Climbing Mouse	*Dendromus melanotis*
Brant's Climbing Mouse	*Dendromus mesomelas*

Highveld Gerbil	*Tatera brantsii*
Namaqua Rock Mouse	*Aethomys namaquensis*
***House mouse**	***Mus musculus***
***House Rat**	***Rattus rattus***
*** Dog**	***Canis familiaris***
*** Cat**	***Felis catus***
Common Duiker	***Sylvicapra grimmia***
Bushbuck	*Tragelaphus scriptus*
Vervet Monkey	***Cercopithecus aethiops pygerythrus***
Water Mongoose	***Atilax paludinosus***
Cape Clawless Otter	***Aonyx capensis***
Slender Mongoose	***Galarella sanguinea***
Striped Polecat	*Ictonyx striatus*
Large-spotted Genet	*Genetta tigrina*
Porcupine	***Hystrix africaeaustralis***

* introduced species

Threatened species

No sensitive or endangered mammals were recorded within the study area. The majority of larger mammal species are likely to have been eradicated or have moved away from the area due to high levels of habitat transformation and degradation. This is mainly a result of increased development pressure and human disturbances such as hunting and poaching with dogs and wire snares. Smaller mammal species are extremely vulnerable to snares and poaching activities as well as dogs and feral cats. It is highly unlikely that the proposed Nkandla-Umlalazi Smart Growth site constitutes significant habitat for any species of threatened mammal species as well as mammals in general.

4.5 CONCLUSION

The Nkandla-Umlalazi Smart Growth site is dominated by degraded and transformed Eastern Valley Bushveld dominated by anthropogenic grasses and pioneer weedy plant species and invaded by alien invasive plant species. The remnant patches of bushveld occurs adjacent to the non-perennial drainage lines as well as riparian zone of the Mamba River. The sandy soils in the old agricultural alnds provides suitable habitat for certain rodent species such as the Highveld Gerbil, House Rats (villages) as well as Multimammate Mouse. Rodents construct burrows in the sandy soils and attract other predators such as the Slender Mongoose. Bird species around the existing residential areas are restricted to granivorous or seed eating birds such as Laughing Dove, Cape Turtle Dove as well as urban exploiters such as the Common Mynah and House Sparrow. The majority of bird species recorded during the site visit were observed in the remnant pockets of indigenous woodland patches along the Mamba River. Reptile species are extremely sensitive to habitat destruction and transformation. Low reptile diversity is expected within the areas adjacent to the existing residential erven, informal shacks, old lands and current agricultural lands. Species recorded during the brief field assessment included Cape Skink (*Trachylepis capensis*), Variable Skink (*Trachylepis varia*), Southern Tree Agama (*Acanthocercus atricollis*) and Nile Monitor (*Varanus niloticus*). Medium-Low amphibian diversity is expected along the non-perennial streams/drainage lines due to limited habitat diversity as well as habitat degradation. The Mamba River offers suitable habitat for certain frog species including Common River Frogs (*Amietia angolensis*), Painted Reed Frog (*Hyperolius marmoratus marmoratus*) and Snoring Puddle Frog (*Phrynobatrachus natalensis*).

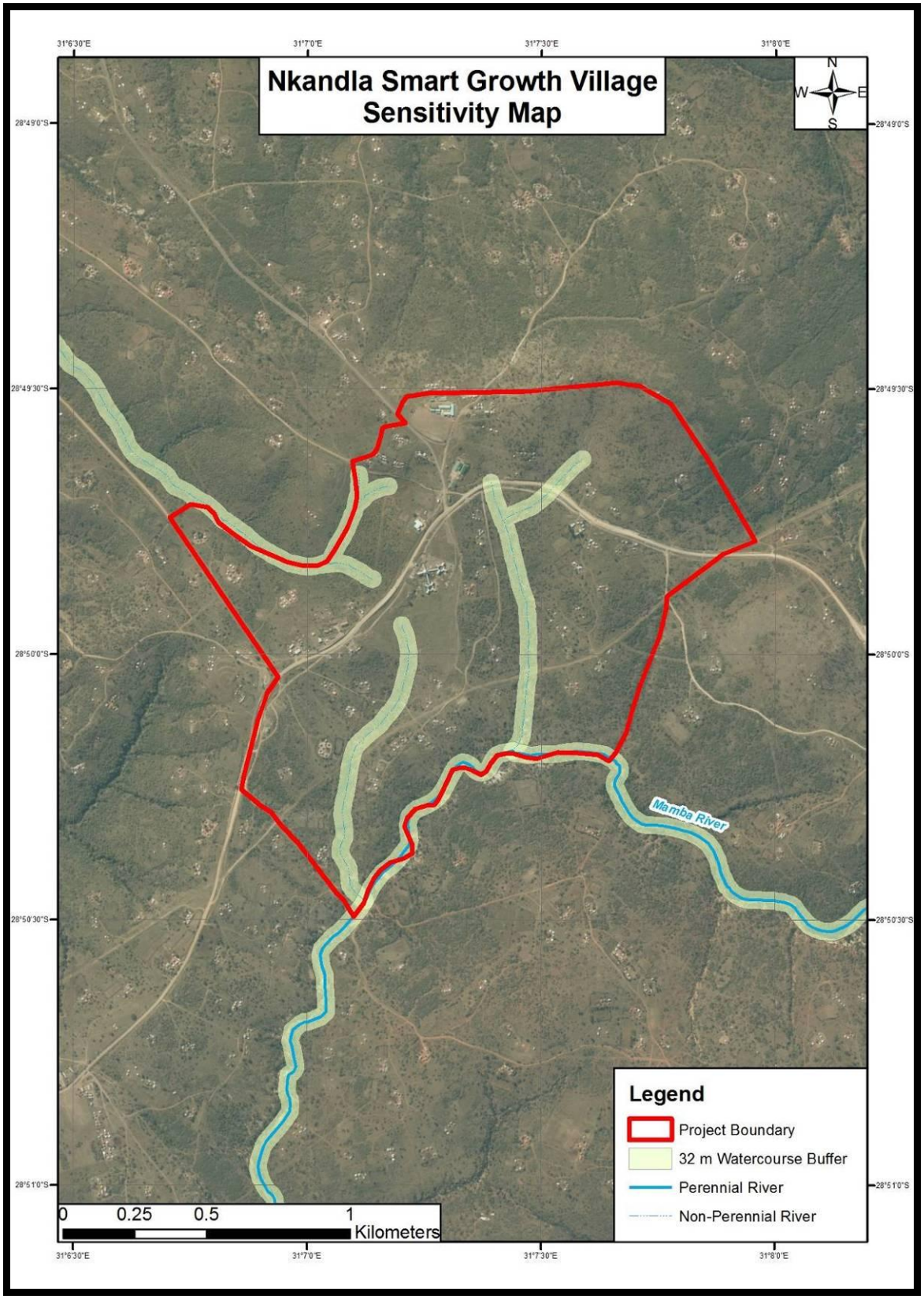

Figure10. Preliminary riparian delineation and sensitivity map for the proposed Nkandla-Umlalazi Smart Growth project. The Mamba River and non-perennial drainage lines are considered as **sensitive habitats** with **high conservation potential** due to ecological as well as hydrological functioning.

5. SENSITIVE HABITATS

5.1 MAMBA RIVER, NON-PERENNIAL DRAINAGE LINES AND ASSOCIATED OPEN AND CLOSED WOODLAND RIPARIAN ZONES

The perennial Mamba River as well as non-perennial drainage lines and associated riparian vegetation are considered to be of conservation importance for the following reasons:

- The indigenous riparian vegetation along rivers within Kwazulu-Natal, and rivers in general throughout the Savanna Biome, is in danger of being completely replaced by alien invasive species. Any remaining areas of indigenous riparian vegetation within Kwazulu-Natal must therefore be regarded as sensitive and of high conservation importance.
- Rivers and drainage lines are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment (O'Keefe 1986). Any impact on the riverine area within the study area is therefore also likely to impact on upstream and downstream areas.
- Riparian zones have the capacity to act as biological corridors connecting areas of suitable habitat in birds (Whitaker & Metevecchi, 1997), mammals (Cockle & Richardson 2003) reptiles and amphibians (Maritz & Alexander 2007). Riparian zones may act as potential refugia for certain fauna and could allow for possible re-colonisation of rehabilitated habitats. The riparian vegetation plays a vital role in the re-colonisation of aquatic macro-invertebrates as well as reptiles and amphibians (Maritz & Alexander 2007). The riparian vegetation provides vital

refuge, foraging and migratory passages for species migrating to and away from the rivers. 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).

- The riparian vegetation is dependant on the river for a number of functions including growth, temperature control, seed dispersal, germination and nutrient enrichment. Riparian 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 mesic species (water-loving) 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.

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); and
- recreational areas (fishing - rod and line not shade or gill nets; bird watching; picnic areas etc.).

The Mamba River and the non-perennial drainage lines must be considered as sensitive habitats due to ecological and hydrological functioning as well as providing suitable habitat as well as biological or dispersal corridors for remaining faunal species. No further developments or major vegetation clearance should be allowed within 32 m from the outer edge of the riparian zone. The 32 m buffer zone should be rehabilitated and planted with indigenous (to the area) plant, shrub and tree species (see attached species lists). No indigenous riparian tree species should be destroyed and vegetation clearance should be restricted to the removal of the transformed alien invaded sections as well as thinning out of the *Acacia-Dichrostachys* thickets adjacent to the non-perennial drainage lines. This will allow for suitable dispersal areas along the Mamba River and the non-perennial drainage lines.

6: POTENTIAL IMPACTS ON THE FAUNA AND PROPOSED ENVIRONMENTAL MANAGEMENT RECOMMENDATIONS

6.1. Destruction of Faunal Habitat

At a local scale the proposed Nkandla-Umlalazi Smart Growth project offers limited suitable habitat for faunal species (mainly birds) in the form of the wooded riparian zone of the Mamba River and non-perennial drainage lines. As the proposed site is situated within a rural-agricultural environment the majority of vegetation has been transformed or severely degraded and favourable habitat is fragmented. Alteration to the original faunal composition has already occurred and the secretive or sensitive species have been killed or located suitable habitat away from the site. The remaining fauna associated with the site require the conservation of the closed woodland pockets along the perennial Mamba River and non-perennial drainage lines with a 32m Eastern valley bushveld buffer zone. This could potentially form an appropriate natural biological corridor connecting the site with similar habitats around the site and should conserve the majority of suitable habitat for faunal species likely to occur on the site and immediate surrounding area. It is important that all activities are adequately managed and restricted in the conserved sensitive habitats.

The proposed development of the degraded and transformed Eastern Valley Bushveld will most likely result in a **medium-low**, **short, medium** and **long-term negative** impact on the affected environment as well as faunal (extremely limited) species occurring within these impoverished habitats. Impacts on the site will depend on the areas to be developed as well as adequate management of the remaining woodland riparian zones along the Mamba River and non- perennial drainage lines. Should the project be approved, it is therefore recommended that the following mitigation measures be implemented:

The site should be linked with the available municipal infrastructure if sufficient capacity exists. Further, direct and indirect impacts include increased access and human presence into the areas and disturbances of sensitive or secretive species associated with the woodland riparian zone of the Mamba River and non-perennial drainage lines on the site. Increased human pressure and activities in these sensitive habitats could result in further environmental degradation if environmentally sensitive practices are not followed and maintained throughout all stages of the development.

Mitigation and Recommendations

During the CONSTRUCTION phase workers must be limited to areas under construction and access to the undeveloped areas, especially the Mamba River and riparian zone and non-perennial drainage lines must be strictly regulated (ideally fenced off and "no-go" areas during construction activities). Provision of adequate toilet facilities must be implemented to prevent the possible contamination of surface (Mamba River and non-perennial drainage lines) and ground (borehole) water in the area. All temporary soil stockpiles, litter and rubble must be removed on completion of construction activities. No dumping of waste material in surrounding open areas. All alien invasive plant and tree species should be removed from the site especially along the Mamba River and non-perennial drainage lines; preventing further invasion.

During the OPERATIONAL PHASE it is important that the proposed activities within the Mamba River and non-perennial drainage lines are strictly managed. Low disturbance activities such as hiking, bird watching and hiking are recommended for these sensitive areas. No quad-bikes, motorcycles or off road vehicles should be permitted within the riparian zone adjacent to the Mamba River and non-perennial drainage lines. No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site. No air rifles or pellet guns should be permitted. The baiting of selected predators (caracal and black-backed jackal) and subsequent capturing and possible destroying of caught animals should not be allowed.

6.2 Horticultural Activities

Landscape architects, and the developer, have an opportunity to conserve certain faunal biodiversity present on the site and possibly increase the biodiversity of certain animal species (birds). Vegetation has been reported to be the single most important habitat component for all species of animals. Linked to this, is the preservation, maintenance and creation of tracts of natural and ornamental vegetation in all stages of ecological succession, interconnected by corridors or green belts for escape, foraging, breeding and exploratory movements. Landscaping projects around the Mamba One-Stop Development Centre, residential and commercial areas are all too frequently characterized by lack of any indigenous vegetation or exotic fruiting trees. The resulting pattern and structure is one of limited vegetation diversity, trees of uniform size, even age stands and little or no under-story planting. Only a few species of animals (urban exploiters) will occupy these limited niches, leading to decreased faunal biodiversity.

Mitigation and recommendation

Only indigenous (to the area) tree and species should be used for horticultural purposes (see attached species lists). No horticulture activities should be allowed in the proposed conserved areas along the Mamba River except for rehabilitation purposes. All remaining large indigenous tree species should be conserved wherever possible with any future development planned around them. Two protected tree species were recorded namely several scattered Marula *Sclerocarya birrea subsp. caffra* and Shepherd's Tree *Boscia albitrunca*. The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any protected tree species. No exotic invasive lawn species of grasses should be used on the site especially around the non-perennial drainage lines or Mamba River or any areas that adjoin natural grassland vegetation. The use of Kikuyu *Pennisetum clandestinum* is not recommended and non-invasive indigenous grasses such as *Cynodon dactylon, Panicum ecklonii, Panicum maximum* (local to the area) should rather be used.

A Re-vegetation and Rehabilitation Manual should be prepared for the use of contractors, landscape architects and groundsmen. Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited. All alien vegetation should be eradicated over a five-year period. Invasive species should be given the highest priority.

Where the removal of alien species may leave spoil exposed, alternative indigenous species should be established before eradication takes place. The attention of property owners must be drawn to the most recent Declared Weeds List (2001) in the *Conservation of Agricultural Resources Act* 43 of 1983 and the associated penalties and prohibitions. Horticultural activities such as fertilisers, herbicide and pesticide runoff, increase in alien vegetation and weedy species, dumping of refuge and building material must be strictly managed and be environmentally sensitive and should meet the following requirements:

- No horticultural activities for the proposed conserved areas of the site and limited to indigenous (to the area) water-wise plant species around the residential and commercial areas around the proposed development.
- Limited irrigation by water-wise gardening (use indigenous to the area plants which are adapted to the local conditions).
- Strict fertiliser, pesticide and herbicide control (limited usage for proposed development)
- Invertebrate pests on the site should be controlled in the following manner:
- The least environmentally damaging insecticides must be applied. Pyrethroids and Phenylpyrazoles are preferable to Acetylcholines. Use

insecticides that are specific to the pest (species specific) in question. The lowest effective dosages must be applied. Suppliers advice should be sought. Do not irrigate for 24 hours after applying insecticides in areas where there is a chance of contaminating water-courses. Fungal pathogens should be used in preference to chemical insecticides.

- Reduction of weed and erosion by minimum tillage gardening practices (groundcovers and mulching better in all respects).
- No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas must be strictly regulated and managed.

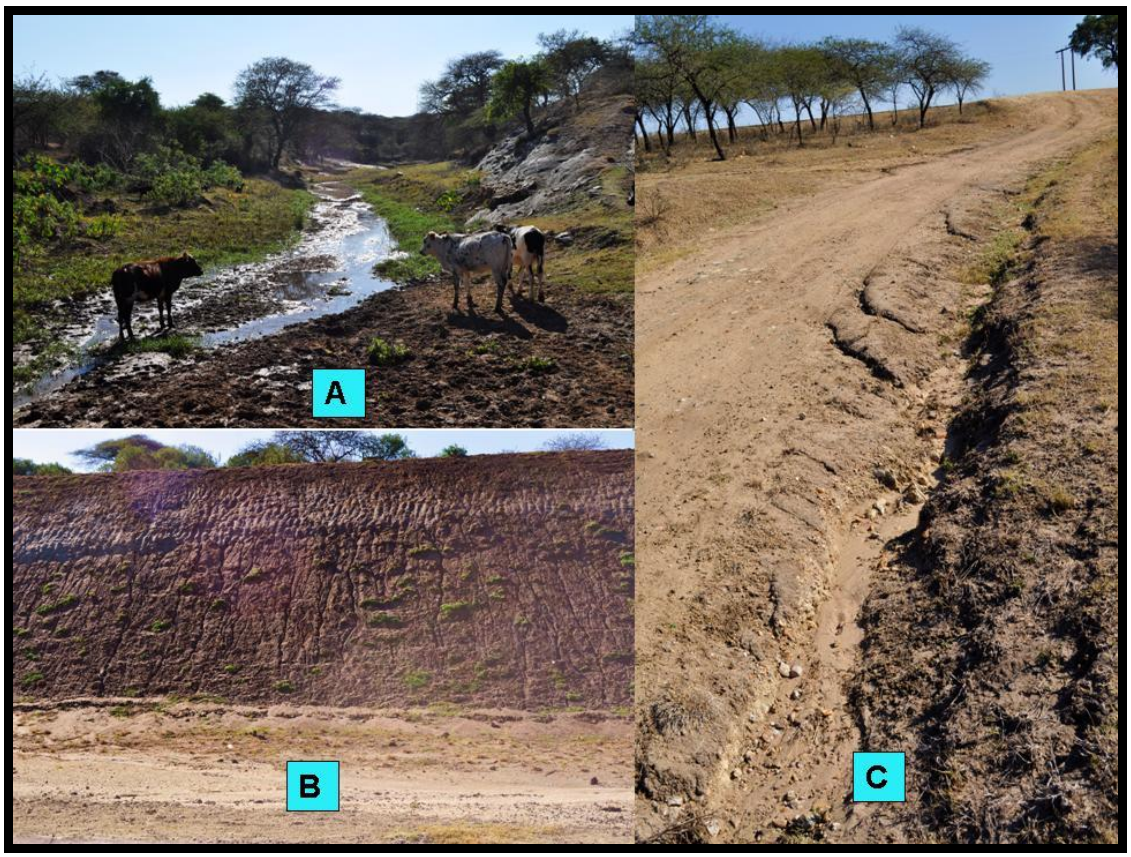

Figure11. Poor soil conservation was observed around the entire site. A: Extensive bank erosion along the Mamba River due to uncontrolled livestock drinking as well as removal of riparian vegetation. **B:** Several erosion rills were observed on the poorly re-vegetated embankments of the recently upgraded P15-2. **C:** No stormwater management measures occur on the site and runoff enters through eroded channels into the heavily eroded (incised) non-perennial drainage lines.

6.3 Erosion and Surface runoff

Urban and commercial development is characterised by large areas of sealed surfaces such as roads, houses etc. Impermeable surface cover ranges from 15% to 60% of suburban areas to almost 100% in central business districts. Infiltration is considerable reduced with an increase in surface run-off. Run-off is generally discharged to surface water systems and often contains pollutants. Pollutants range from organic matter, including sediments, plant materials and sewage, to toxic substances such as heavy metals, oils and hydrocarbons. Construction activities associated with urban development can lead to massive short term erosion unless adequate measures are implemented to control surface run-off. Sheet erosion occurs when run-off surface water carries away successive thin layers of soil over large patches of bare earth. This type of erosion is most severe on sloping soils, which are weakly structured with low infiltration, which promotes rapid run-off. It occurs on the site where vegetation has been destroyed. Continual erosion in sheet-eroded slopes is a common cause of gully erosion. Gully erosion results from increased flow along a drainage line, especially where protective vegetation has been removed and soils are readily transported. A gully has steep, bare sides and is often narrow and deep. Once formed, a gully usually spreads upstream through continual slumping of soil at the gully head. Gully erosion can be associated with salting as the saline sub-soils are readily eroded.

Mitigation and recommendations

Vegetation plays a critical role in the hydrological cycle by influencing both the quantity and quality of surface run-off. It influences the quantity of run-off by intercepting rainfall, promoting infiltration and thus decreasing run-off. Vegetation can influence water quality in two ways: by binding soils thus protecting the surface layer, and by intercepting surface run-off thus buffering the Mamba River and non-perennial drainage lines against suspended and dissolved substances. When the speed of the run-off is reduced, suspended particles can settle out and dissolve substances, such as nutrients, can be assimilated by plants. The vegetation has a filtering effect. Storm-water and runoff should be channelled through natural grassland buffer areas or into shallow seasonal retention/attenuation ponds reducing the erosional force and the potential risk of contamination and erosion of the Mamba River. The eroded areas adjacent to the Mamba River as well as non-perennial drainage lines should be appropriately rehabilitated and re-vegetated (especially below stormwater discharge pipes and culverts) in order to prevent further erosion and siltation of downstream habitats.

The timing of clearing activities is of vital importance. Clearing activities and earth scraping should preferably be restricted to the dry season in order to prevent erosion and siltation. The dry months are also the period when the majority of species are either dormant or finished with their breeding activities. Future soil stockpiling areas must follow environmentally sensitive practices and be situated a sufficient distance away from drainage areas. Severely eroded areas should be stabilised with gabions with sediment trapping material and adequately rehabilitated. The careful position of soil piles, and runoff control, during all phases of development, and planting of some vegetative cover after completion (indigenous groundcover, grasses etc.) will limit the extent of erosion occurring on the site. Sufficient measures must be implemented to prevent the possible contamination of the surface water and surrounding groundwater.

6.4 Migratory Routes (Fencing)

The migratory movements of several animal (frog, reptile and mammal) species could be completely disrupted by the erection of numerous walls around properties, fences and road networks, which restrict natural movements between suitable foraging and breeding areas. This could potentially result in the disruption of natural gene flow between populations and could result in a high impact on the highly mobile species. Fencing off of residential areas and private property also plays a critical role in impeding the natural migration of the majority of animal species. A trade off thus exists between safety and security on the one hand and movement of animal species on the other.

Mitigation and recommendations

Ideally no fences should occur along the Mamba River and non-perennial drainage lines or alternatively an outer barbed wire fence should be erected preventing livestock (especially goats). Fences should not restrict the natural migratory movements of certain animals and must be restricted to the immediate area of the proposed development. The preservation, maintenance and creation of tracts of natural vegetation (biological or migratory corridors) in all stages of ecological succession along the Mamba River and, interconnected by corridors or green belts for escape, foraging, breeding and exploratory movements along the non-perennial drainage lines needs to be considered. It is critical that sufficient corridors are created along the Mamba River connecting to similar habitat to the north and south.

6.5 Artificial Lighting

Artificial lighting will most likely result in a moderate to high negative short, medium and long- term impact on all nocturnal animal species. Numerous species will be attracted towards the light sources and this will result in the disruption of natural cycles, such as the reproductive cycle and foraging behaviour. The lights may destabilise insect populations, which may alter the prey base, diet and ultimately the well-being of nocturnal insectivorous fauna. The lights may attract certain nocturnal species to the area, which would not normally occur there, leading to competition between sensitive and the more common species.

Mitigation and recommendations

During the construction phase, artificial lighting must be restricted to areas under construction and not directed towards the Mamba River or non-perennial drainage lines in order to minimize the potential negative effects of the lights on the natural nocturnal activities. Where lighting is required for safety or security reasons, this should be targeted at the areas requiring attention. Yellow sodium lights should be prescribed as they do not attract as many invertebrates (insects) at night and will not disturb the existing wildlife. Sodium lamps require a third less energy than conventional light bulbs.

6.6 Threatened animals

At a local scale the proposed site comprises marginally suitable habitat for certain faunal species including certain red data/listed faunal species.

Mitigation and recommendations

As a precautionary mitigation measure it is recommended that the contractors be made aware of the possible presence of certain threatened animal species (South African Python) prior to the commencement of construction activities. In the event that any of the above-mentioned species are discovered relevant conservation authorities should be informed and activities surrounding the site suspended until further investigations have been conducted and the python released in suitable habitat away from the site

6.7 Exotic Animals

The introduction and invasion of exotic ducks, cats, dogs, rabbits and birds (mynas) must be prevented as they have negative impacts on remaining animal species.

Mitigation and Recommendation

No domestic animals and livestock should ideally be allowed in the undeveloped open areas of the site including the woodland riparian zones of the Mamba River and non-perennial drainage lines.

6.8 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.

Mitigation Measures

Only seed specified in this specification shall be used for vegetation establishment on the embankments. The seed shall be certified, fresh and of good quality. The method of establishing grass on the bank slopes shall be hydro seeding. In flat areas the sub-contractor shall have the option of using mechanical means (tractor –planter) of distributing the seed. The sub-contractor shall be responsible for the quality of the established vegetation independent of which method of establishment is used.

- Exposed areas should be rehabilitated with a grass mix that blends in with the surrounding vegetation. The grass mix should consist of indigenous grasses, shrubs and trees adapted to the local environmental conditions.

- The use of the exotic invader Kikuyu Grass (*Pennisetum clandestinum*) is not recommended and should be prohibited. Kikuyu require extensive maintenance as well as large amounts of water. The use of an indigenous species such as *Cynodon dactylon* is recommended; it occurs naturally in the area as well as being non-invasive and requiring less water than exotic species.

- The grass mix should consist of a mix of quick covering grasses (pioneer species), mat-forming grasses (e.g. *Digitaria eriantha, Chloris gayana*) and tufted grasses (e.g. *Eragrostis curvula*) to ensure prompt and adequate coverage of the exposed soil while long term stability of the grass sward is also achieved. Re-vegetated areas should be monitored every 3 months for the first 12 months and twice a year thereafter.

- Re-vegetated areas showing inadequate surface coverage (less than 30% within 9 months after re-vegetation) should be prepared and re-vegetated from scratch.

- Damage to re-vegetated areas should be repaired promptly.

- Shaping of remaining and exposed soil profile to blend in with the gradients of the surrounding landscape.

- Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish.

- Disturbed areas around the site and school should be re-vegetated using a specified seed mix and/or appropriate indigenous grasses, forbs, shrubs or trees.

For cuts and fills the following is recommended:

- Cut slopes will not have slopes steeper than 1 vertical: 3 horizontal. If slopes are steeper than 1:3 the slopes must be benched or designed for proper vegetation establishment.
- Fill slopes should be designed to a slope of 1 vertical: 2 horizontal. Special measures must be designed to ensure vegetation establishment on slopes steeper than 1:2.
- For flat areas and slopes up to 1:3 normal hydro seeding and grass seed mixtures as per the specification below should be used.
- For slopes between 1:3 and 1:1.5 hydro seeding with additional establishment requirements is to be used.
- For slopes steeper than 1:1.5 a design needs to be provided for erosion prevention which could also include an element of vegetation establishment.

Hydro seeding

The types and mixtures of seed to be used shall be as specified in these vegetation specifications and detailed below. Cellulose pulp (Voermol) should be added to the hydro seeding mixture at a rate of 25kg of pulp per kiloliter of water used. Hydro seeding shall be carried out with an approved hydro seeding machine at a rate of application of not less that the specified seed mixture weight per hectare

Seed mixtures

Two different specifications shall apply for flat areas and for sloped areas.

Flat Areas

The seed mixture to be used on the flat platforms, temporary deviations and slopes with an angle of up to 1:3 shall be:

Aristida junciformis subsp. galpinii	2kg/ha
Chloris gayana	4kg/ha
Cynodon dactylon	6kg/ha
Digitaria eriantha	5kg/ha
Eragrostis curvula	2kg/ha
Melinis repens	2kg/ha
Panicum maximum	3kg/ha
Themeda triandra	5kg/ha
Total:	29 kg/ha

Sloped Areas

The seed mixture to be used on cut and fill slopes with an angle steeper than 1:3 shall be:

Aristida junciformis subsp. galpinii	2kg/ha
Chloris gayana	3kg/ha
Cynodon dactylon	6kg/ha
Digitaria eriantha	5kg/ha
Eragrostis curvula	2kg/ha
Imperata cylindrica	3kg/ha
Panicum maximum	3kg/ha
Themeda triandra	5kg/ha
Total:	29kg/ha

Certain cuts and fills are difficult to vegetate with normal hydro seeding practices. Before hydro seeding is undertaken the following preparation work would have to be completed:

- Manure would be spread by hand at a rate of 4 tones per hectare,
- Sandbags would be prepared by filling the bags with a mixture of topsoil, fertilizer and seed.
- The sandbags would be pegged with 50 mm Wood pegs onto the slopes in horizontal lines, three meters apart. The sandbags would form a catwalk on the slopes.
- Fertilizer, as previously specified would be spread by hand onto the slopes.
- Mulching with locally harvested grass cuttings (if available) would be done directly onto the slope. The rate of application would be 1,5 tones per hectare.

- A hessian net would be fixed onto the slopes between the sandbags. The net would be 20% shade.
- Hydro seeding would be done over the nets onto the slope with the previously specified seed mixture (see above for species list).
- The nets would be removed approximately 6 weeks after seeding or as determined by the Environmental Manager.

For slopes between 1:3 and 1:1.5 the seed mixture specified for sloped areas should be used during hydro seeding. In addition to the hydro seeding one of the following or a combination of the following methods should be implemented to ensure sustainable vegetation growth. For slopes steeper than 1:1.5 a design method of erosion protection and stabilization needs to be provided. For these slopes (steeper than 1:1.5) the vegetation establishment provides an aesthetic purpose and not a functional one.

Topsoil filled geo membrane tube/sausages

A geo membrane tube with a diameter of 15cm and length of 150 or 300cm is filled with topsoil. Prior to filling the tube the topsoil is mixed with seed and fertilizer as specified in 2.3.4.1. The tube is tied and sealed placed onto sloped or eroded areas and 1 meter intervals. The tubes are fixed with wooden/steel pegs into the ground to prevent it from washing away.

Grass bales

In eroded areas, gullies and slopes grass bales would be placed to reduce the flow speed of water and to retain siltation. The bales would be secured by means of wooden/steel pegs that would be driven through the bales into the ground.

Rehabilitation methods are detailed in Table 6 below.

Table6: 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: • >15º: 25-50 kg/ha • <15º: 15-25 kg/ha 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)*: • *Andropogon chinensis* • *Aristida junciformis* • *Cynodon dactylon* • *Cymbopogon plurinodes* • *Eragrostis curvula* • *Eragrostis gummiflua* • *Themeda triandra* • *Setaria spp.* • *Imperata cylindrica* • *Sporobolus fimbriatus* and sedges such as *Cyperus immensus*, *Schoenoplectus* spp. and *Juncus spp.* should be used
4	The areas which have been seeded must	A hosepipe must be available on

* see attached species list

	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.	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 • Logs/bark held in place with pegs • Rows of *Cynodon dactylon*, *Panicum maximum*, *Imperata cylindrica*, *Hyparrhenia filipendula* held in place with pegs.
7	All alien vegetation is to be appropriately removed and disposed of. Alien species that have been encountered included Syringa *Melia azedarach,* Brazilian Glory Pea *or* Red Sesbania *Sesbania punicea*, Castor-Oil Plant (*Ricinus communis*), Lantana (*Lantana camara*), Giant Reed (*Arundo donax*), Bugweed (*Solanum mauritianum*), Peanut Butter Cassia (*Senna diymobotrya*), Jacaranda *Jacaranda mimosifolia**, Morning Glory (*Ipomoea purpurea*), Paraffin Bush (*Chromolaena odorata*), Yellow Oleander (*Thevetia peruviana*), Oleander (*Nerium oleander*), Montanoa (*Montanoa hibiscifolia*), Indian Shot (*Canna indica*), *Ageratum conyzoides*, *Caesalpinia decapetala*, *Campuloclinium macrocephalum*, *Chromolaena odorata*, *Ipomoea indica*, *Leucaena leucocephala*,	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)

	Psidium guajava, *Rubus cuneifolius*, *Rubus fruticosus*, *Mimosa pigra, Tithonia diversifolia*.	
8	The proposed Nkandla-Umlalazi Growth Centre site must be regularly inspected during the operational phase and alien vegetation that have re-emerged, must be removed and a follow-up treatment applied.	On-going alien vegetation removal programme (beyond the scope of the project)

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8. APPENDIX

Table7. Grass species list (ideally grass species endemic to the area should be used for the re-vegetation)

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 amplectens var. amplectens
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.

Table8. Suggested indigenous trees for riparian rehabilitation (species indigenous to the area are indicated with an ☺. It is strongly recommended that only these are planted as far as possible)

Botanical Name	**Common Name**
Acacia karroo	Sweet Thorn
Acacia caffra	Common Hook Thorn
☺ *Acacia natalitia*	
☺ *Acacia tortilis*	Umbrella Thorn
☺*Acacia sieberiana* var. *woodii*	Paper Bark
☺ *Albizia adianthifolia*	Flatcrown
☺ *Apodytes dimidiate*	White Pear
☺ *Bridelia micrantha*	Mitzeeri
☺ *Calodendron capense*	Cape Chestnut
Cassia abbreviata	Long-tailed cassia
☺*Celtis africana*	White stinkwood
☺*Combretum erythrophylum*	River Bushwillow
☺*Cussonia spicata*	Natal cabbage
☺*Diospyros lycoides*	Blue bush
☺*Dombeya rotundifolia*	Wild pear
☺ *Ekenbergia capensis*	Cape ash
☺*Erythrina caffra*	Coastal Corral Tree
☺ *Ficus natalensis*	Natal Fig
☺ *Ficus sur*	Cluster Fig
☺*Ficus sycomorus*	Sycamore fig
☺*Grewia occidentalis*	Cross berry
☺ *Gymnosporia buxifolia*	Common Spikw-Thorn

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

Table9. Indigenous shrub species marked with ☺ should be used for re-vegetation along the pipeline servitude.

Botanical Name	**Common Name**
☺*Aloe arborescens*	
☺*Aloe greatheadii*	
☺ *Aloe marlothii*	
☺ *Bauhinia natalensis*	Dainty Bauhinia
Buddleja salinga	False olive
☺*Buddleja salvifolia*	Sagewood
Burchellia bubaline	Wild pomegranate
☺*Carissa macrocarpa*	Bird num-num
☺*Dietes species*	Wild iris
☺*Dovyalis caffra*	Kei apple
☺*Ehretia rigida*	Puzzle bush
Erica species	Heaths
Euryops species	Golden daisies
Felicia species	Wild daisy
☺*Grewia flava*	Wild currant
☺*Helichrysum kraussii*	Everlastings

☺*Leonotis leonorus*	Wild dagga
Leucospernum species	Pincushions
☺*Mackaya bella*	Forest bell bush
☺ *Pavetta lanceolata*	Forest's pride bush
☺*Plectranthus species*	Spur flowers
☺*Plumbago auriculata*	Cape leadwort
Protea caffra	Sugarbush
Psychotria capensis	Black birdberry
☺*Rhamnus prinoides*	Dogwood
☺*Strelitzia nicolai*	Natal Wild Banana
Strilitzea reginae	Crane flower
☺*Tecoma capensis*	Cape honeysuckle
☺*Thunbergia natalensis*	Natal bluebell