4. Results

4.1 Vegetation units and land cover types within the study area

The most recent vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2007), places the entire study area (Figure 22) within Granite Lowveld (SVI 3).

Vegetation/habitat types are mapped based on available information (aerial photography, soil types, geology) and will consist of structurally distinct vegetation units (wetland, grasslands, woodland) as well as transformed areas (cultivated land, areas of alien vegetation). Vegetation/habitat units will be graded according to biodiversity value and conservation status.

Figure 22: The KMAE study area is situated within the Granite Lowveld**.**

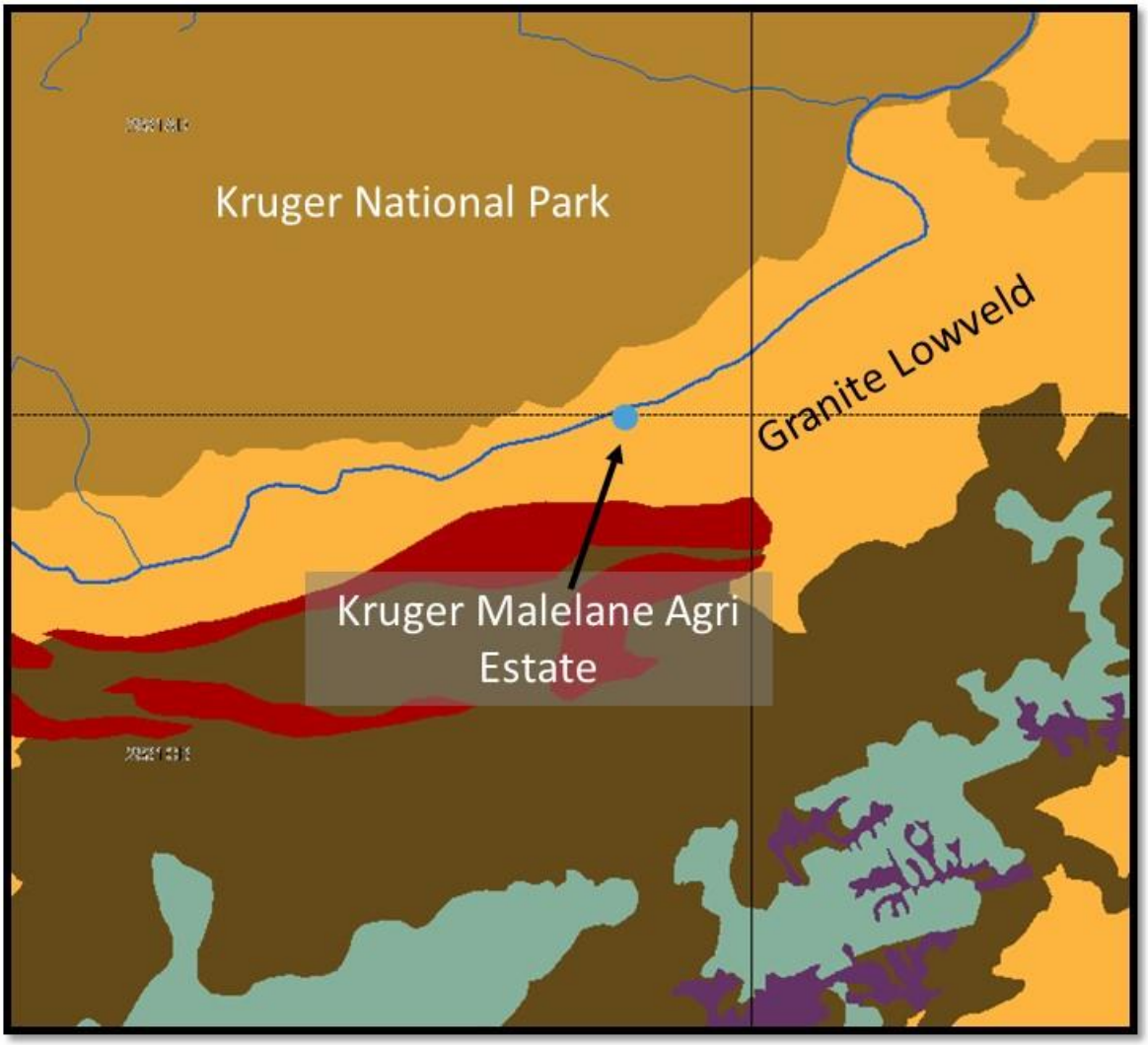


Figure 23 illustrates the land cover surrounding the KMAE project area. Most of the project area is transformed by cultivation and old lands.

The following broad-scale vegetation units are simply practical units that combine various plant communities which share structural and functional characteristics and have common management requirements.

The broad-scale vegetation units consist of two units of transformed vegetation/habitat and one unit comprising untransformed riverine habitat (Figure 23). These three units are listed below, and each unit is later described in more detail.

Vegetation units and land cover type:

Untransformed vegetation/habitat

1. Untransformed Riverine – Riparian and aquatic
    1a. Adjacent Crocodile River
    1b. Small stream on the eastern boundary

Transformed vegetation/habitat

2. Agriculture – Fallow lands
3. Infrastructure – housing

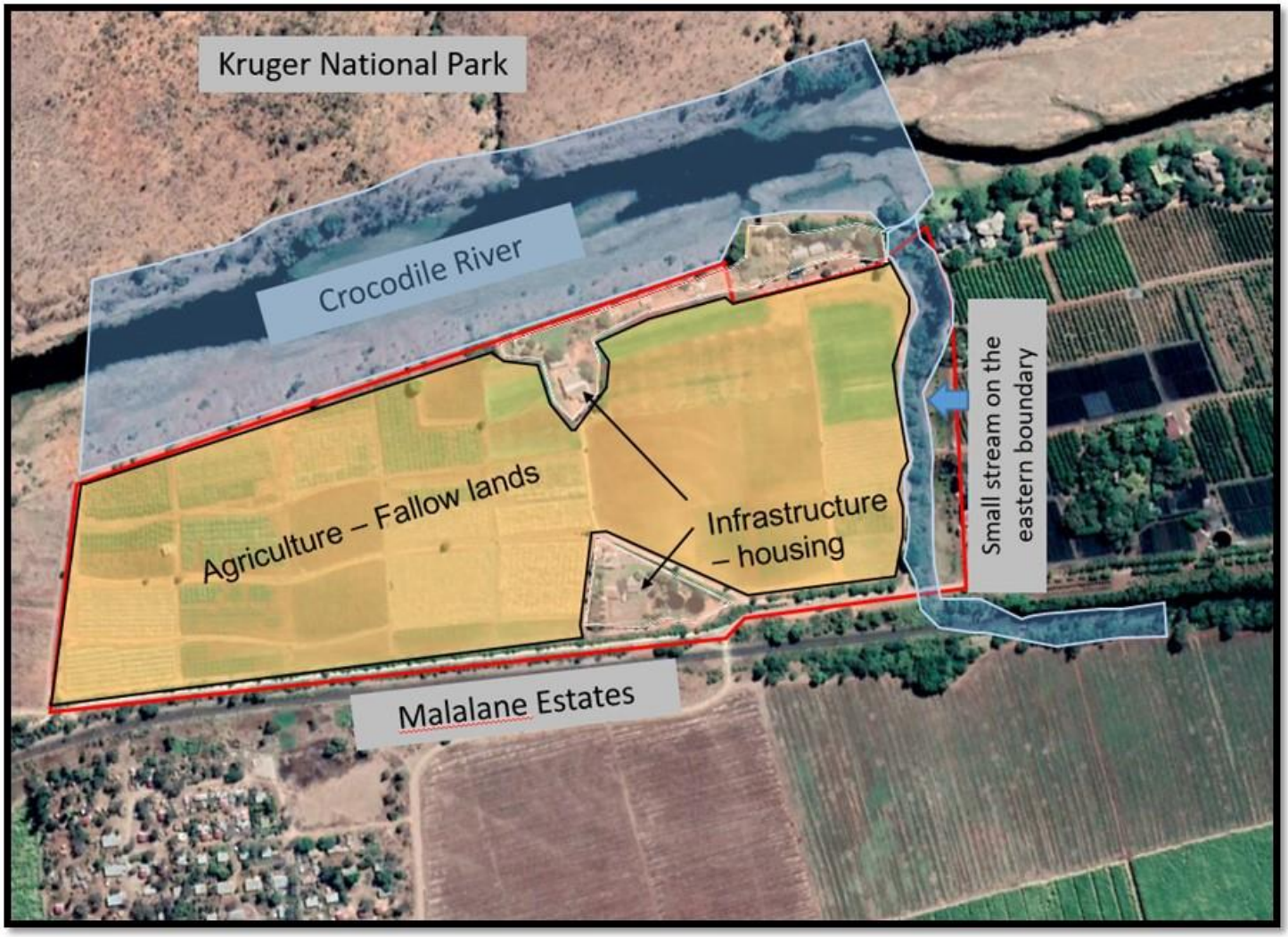


Figure 23: The broad-scale vegetation units or ground cover of the KMAE project area.

1. Untransformed Riverine – Riparian and aquatic

1a. Adjacent Crocodile River

The untransformed (primary) riverine habitat adjacent to the project area is confined to the macro-channel of the Crocodile River streambed and associated riparian zone.

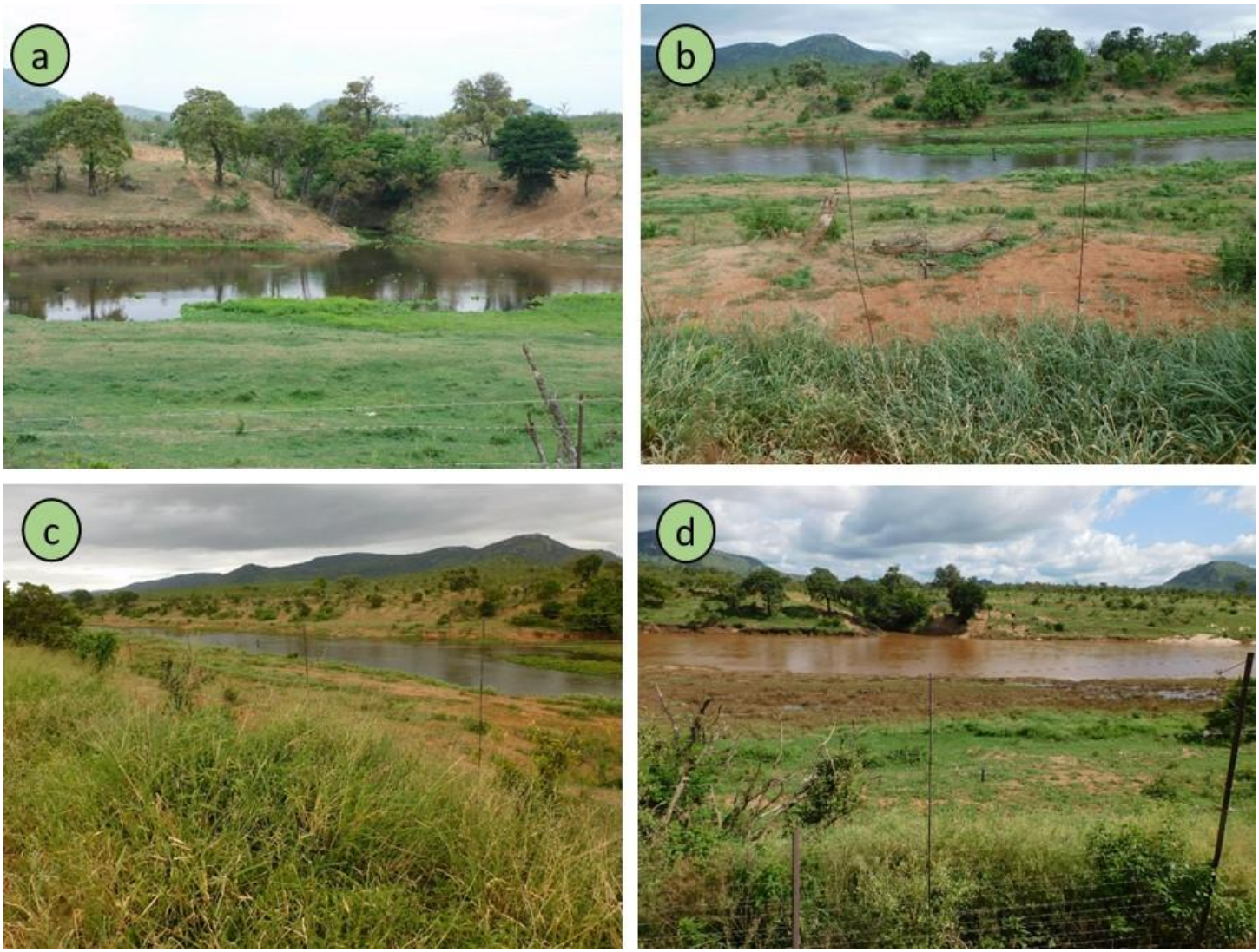


Figure 24:

24a. A view from the project area to the northern bank of the Crocodile River.
24b. A view through the current fence into the Kruger Park.
24c. An upstream view of the bordering Crocodile River.
24d. The receding flood waters of the Crocodile River after the January 2021 floods.

The Crocodile River forms the southern boundary of the Kruger Park. The macro-channel bank of the farm therefore also forms the northern boundary of the KMAE project area. Although there are some tall riparian trees on the opposite bank, most of the southern bank is without any woody vegetation. The soil on the upper riverbank has a reddish colour.

1b. Small stream on the eastern boundary

A small stream which enters the project area from the south-eastern boundary, originates on a sugarcane farm south of the railway and flows mostly through sugar cane fields.

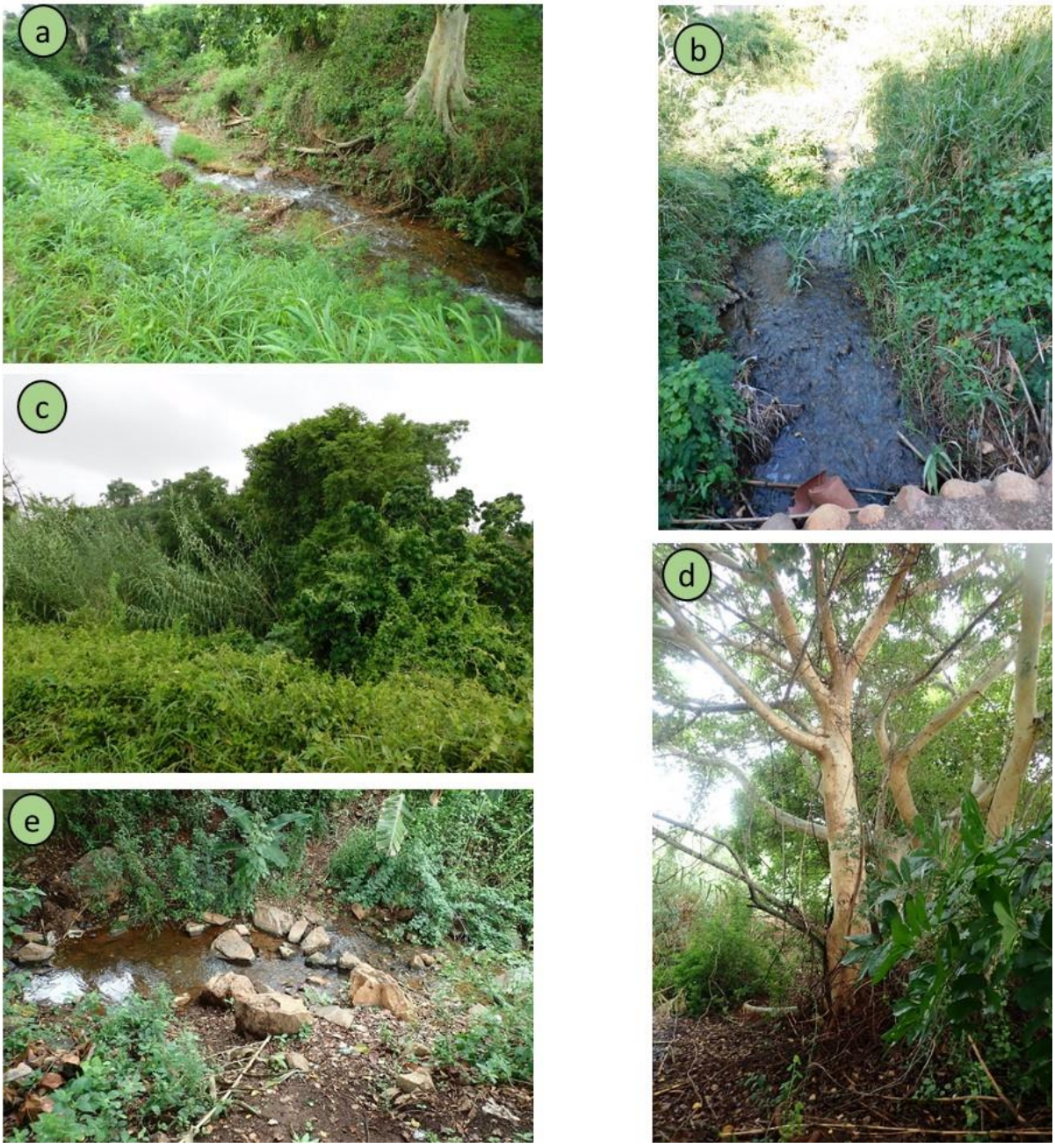


Figure 25:

25a: The small river reach close to the confluence with the Crocodile River.
25b: The stream is small, mostly not more than 2m wide and 30 cm deep.
25c: Dense riparian zone with an abundance of alien Spanish reed and other invasive plants.
25d and 25e: Despite the small size of the stream, large riparian trees are present on the edges.

The small stream is a drainage line running through the project area, and it is flanked by its riparian zone which is the interface between the terrestrial- and aquatic ecosystems. Despite the small size of the stream, large riparian trees are present on the edges and the dense riparian zone is riddled with alien and invasive plants.

Although the stream has been placed with Untransformed habitats, there are a number of aspects that classifies this habitat less natural, such as alien invading plants, removal of riparian vegetation and inflow of fertilizers.

Transformed vegetation/habitat

2. Agriculture – Fallow lands

Figure 26 a - d: Most of the project area is transformed by agriculture; fallow lands cover 90.0% of the project area.

3. Infrastructure – housing

There are some houses and derelict buildings on the farm.

Figure 27:

27a-b: Housing of the Irrigation Board and farm accommodation.
27c: There are some dirt tracks and roads on the farm.
27d: An old house will be evaluated for its historic importance.
27e: The old farm house will remain as accommodation for the farm manager.

4.2 Ecological survey transects in the KMAE project area.

A major component of this study is the characterisation of habitat types and associated fauna (obtained from regional distribution records) of the available landscape/environment. This information is used as a basis for predicting the potential impacts of the proposed project, and other human-induced activities, on the composition of threatened fauna in the study area. Representative survey sites were selected in all prominent vegetation types of the study area. Extensive transects (400-800m) were then surveyed for prevailing habitat and all associated fauna. GPS readings provide fixed locations of these transects for future monitoring (Table 8; Figure 28).

Table 8: Description of transects or point counts conducted for habitat, micro-habitat, influences and impacts, birds, mammal signs and herpetofauna (November 2020 to April 2021).

Habitat	Coordinates		Length (m)	Total (m)
	Start	End		
Untransformed vegetation/habitat				
1. Untransformed Riverine – Crocodile River				
Transect 1	25°30'2.57"S 31°28'9.89"E	25°29'55.96"S 31°28'33.09"E	682	
2. Untransformed Riverine – Unnamed stream				
Transect 2	25°29'55.60"S 31°28'39.55"E	25°30'5.50"S 31°28'39.18"E	305	
Transformed vegetation/habitat				
Transect 3	25°30'5.98"S 31°28'38.69"E	25°30'6.16"S 31°28'9.80"E	830	
Transect 4	25°30'3.25"S 31°28'9.70"E	25°30'7.82"S 31°28'27.58"E	253	
Transect 5	25°30'8.07"S 31°28'20.79"E	25°29'59.88"S 31°28'20.29"E	772	
Transect 6	25°30'4.07"S 31°28'28.60"E	25°29'55.45"S 31°28'37.87"E	488	
			Total	3330

GPS coordinates, acquired in the field (Table 8), were added to Google Earth to illustrate and demarcate the study area and survey transects. Six transects were completed to assess resident biota and their associated habitats. Specific habitat features were identified to provide an indication of available habitat for different animals favouring a specific biotope (specifically medium-sized fauna across all vertebrate groups).

In addition to the 6 terrestrial transects, two riparian transects were surveyed through the unnamed drainage line. The site information is summarized in Figures 31 to 32.

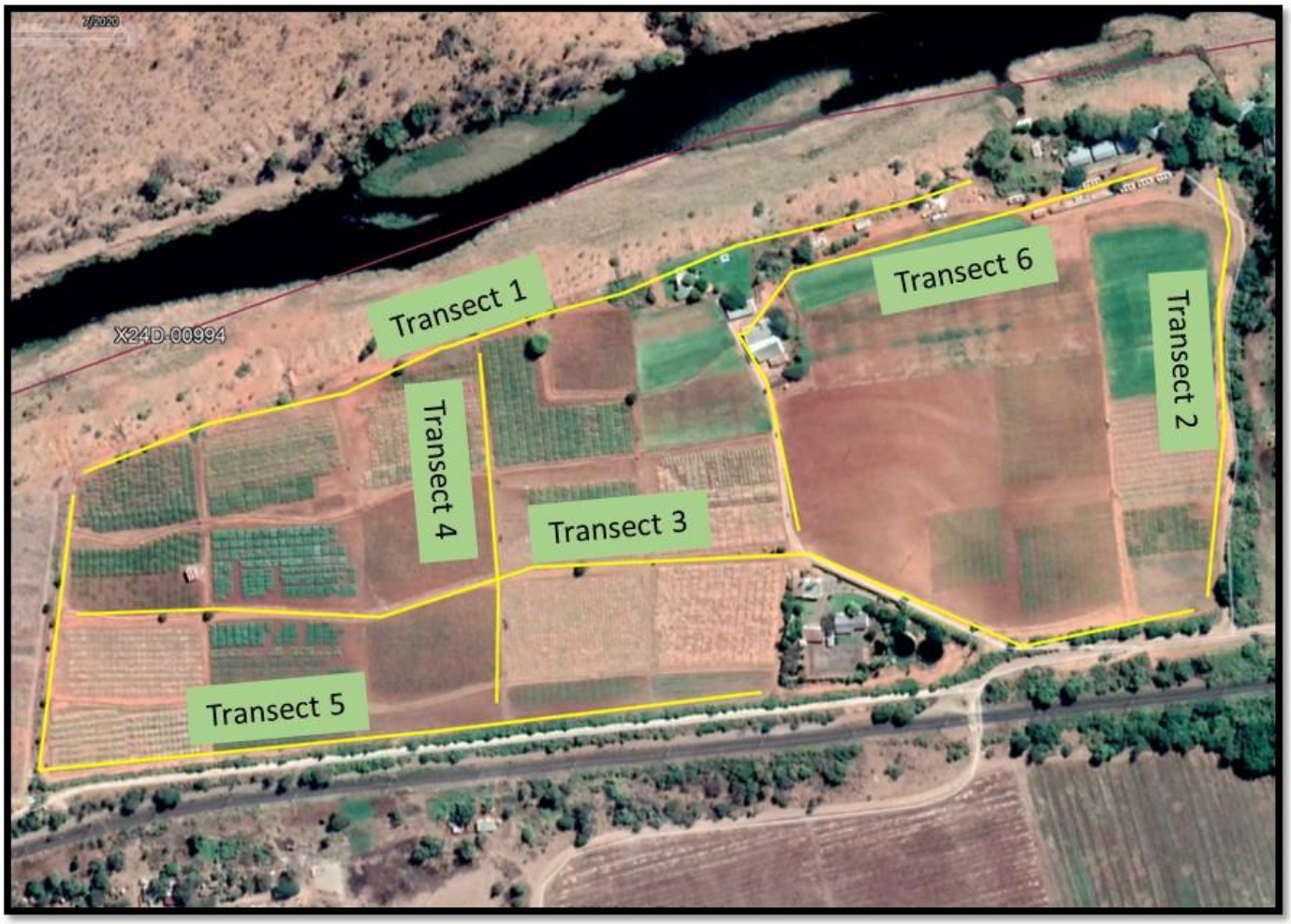


Figure 28: A Google Earth image, indicating the survey transects undertaken on the farm.

Figure 29: The transformed fallow lands have very little viable habitat available for any fauna.

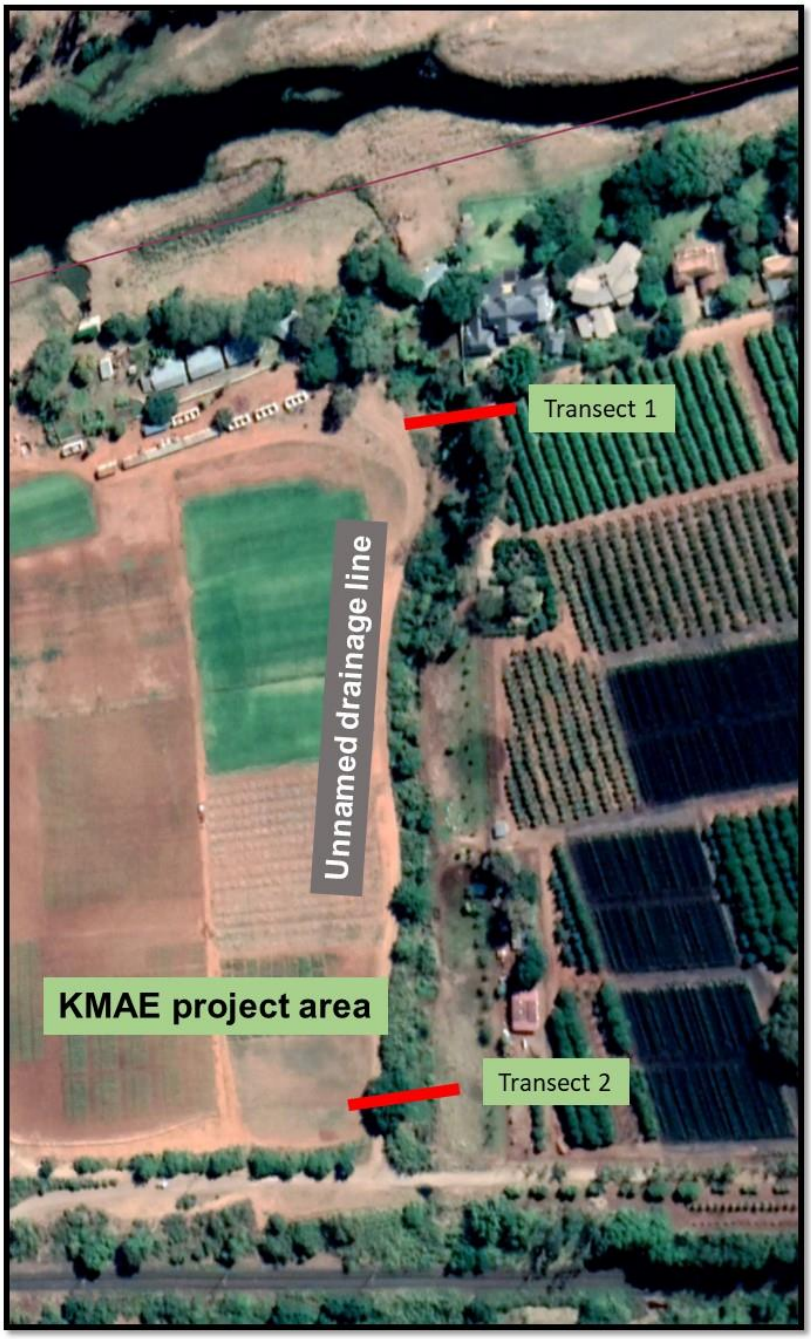


Figure 30: A Google Earth image, indicating the survey transects undertaken through the drainage line.

4.3 Biodiversity assessments

The fieldwork component of this study was conducted in the period November 2020 to April 2021. The survey methods described herein make use of a habitat surrogate technique, where habitat type and availability are used as a baseline assessment, with species' presence used to verify habitat integrity. The specialist report includes detailed species lists obtained from an extensive background review and the field monitoring results, with emphasis on the following:

- Probability of occurrence of species with high conservation value and assessment of the availability of their habitat on the property, as well as potential risks or threats to these species.
- Detailed overview on the current biodiversity status of the area in terms of terrestrial and wetland biota.
- Status of habitat, habitat preference and probability of occurrence.

During the biodiversity assessments of the KMAE environment, different vegetation and land cover units were identified. By definition, ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. Vegetation types provide a good representation of terrestrial biodiversity because most animals, birds, insects and other organisms are associated with specific vegetation types (Table 9).

In order to establish a baseline of faunal occurrence, an assessment was made of the ecosystem template. The ecosystem template is a function of the geomorphology (abiotic) and the vegetation (biotic) structure of the area. By using species occurrence data from the current surveys (November 2020 to April 2021) and expected occurrence records of known species distributions and preferred habitat type, the baseline integrity of the study is established.

Ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. The single biggest cause of biodiversity loss in South Africa is the loss and degradation of natural habitat. Vegetation types provide a good representation of terrestrial biodiversity, as they often reflect specific habitat types and associated animals, birds, insects and other organisms. The vegetation/land cover types were thus classified on the basis of structural and functional characteristics with the following objectives in mind:

- To assess the status of vegetation/land cover types impacted by development: due to either historical and/or present farming practices, residential occupation and/or mining practices;
- To assess the status of faunal assemblages in the study area, with emphasis on Species of Special Concern.

The next step is to establish the likelihood of Species of Special Concern, occurring in the vicinity (include degree of confidence). For this report, the category "Species of Special Concern" is considered to include all threatened taxa listed by South African Red Data lists (Species of Conservation Concern), Threatened or Protected Species (NEMBA) and all South African endemic taxa.

Conservation-important plant species listed for the quarter-degree grid 2531CB in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database were used to produce a list of the most likely occurring species, which were searched for during fieldwork. Due to their limited distribution and range in South Africa, endemic species are also included as species of special interest. Traditionally, an endemic species will have a global distribution restricted to >90% of the atlas region.

Species of special concern are those that have particular ecological, economic or cultural importance and include: those that are rare, endemic or threatened; species with unusual distributions; and medicinal and other indigenous species that are exploited commercially or for traditional use. A ‘Species of Special Concern’ is any species or subspecies of biota, native to the province that has entered a long-term state of decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. These are species that are threatened, or, if not, their population number is a special concern of the following ecological foundations:

- Occur in small, isolated populations or in fragmented habitat, and are threatened by further isolation and population reduction;
- Show marked population declines. Population estimates are unavailable for the vast majority of taxa. Species that show a marked population decline, yet are still abundant, do not meet the Special Concern definition, whereas a marked population decline in uncommon or rare species is an inclusion criterion;
- Depend on a habitat that has shown substantial historical or recent declines in size. This criterion infers the population viability of a species based on trends in the habitat types upon which it specialises;
- Occur only in or adjacent to an area where habitat is being converted to land uses incompatible with the animal's survival;
- Have few records, or which historically occurred here but for which there are no recent records; and
- Occur largely on public lands, but where current management practices are inconsistent with the species persistence.

Threatened faunal species represent a decline in biological diversity because of their numbers decrease and their genetic variability is severely diminished. Rare species, as well as those of special concern carry challenges different to most other large and common species; characteristics of these species are:

- extremely small or localised range
- requiring a large territory
- having low reproductive success
- needing specialised breeding areas
- needing specialised feeding areas
- habitat specificity
- life-histories not captured completely in the area (migrants)

4.4 Biota assemblages of the KMAE project areas

4.4.1 Vegetation communities

The vegetation communities of the KMAE study area are classified as the Granite Lowveld.

Only one untransformed vegetation community (two sub-sets) (Figure 23) and one viable transformed habitat were identified within the study area on the basis of distinctive vegetation structure (grassland, wetland, thicket, etc), floristic composition (dominant and diagnostic species) and position in the landscape (mid-slopes, terrace, crest, etc). The detail of the species found in the riverine community and different morphological levels are listed in Table 9.

Plant surveys

A total of 39 indigenous plant species were recorded during fieldwork (Table 9); as well as 11 exotic species, some declared alien invaders.

Table 9: Vegetation assemblages and relevant plant species in the identified landscapes of the project footprint. Vegetation types: 1= Crocodile River; 2= Unnamed drainage line; 3= Fallow land (Shaded cells indicate presence of the species).

Plant species	**1**	**2**	**3**
Trees			
Apple-leaf (*Philenoptera violacea*)	■		■
Brown ivory *(Berchemia discolor)*		■	
Buffalo-thorn (*Ziziphus mucronata*)	■		■
Common false-thorn *(Albizia harveyi)*	■		
Common spike thorn (*Gymnosporia buxifolia*)	■		■
Common wild currant (*Searsia pyroides*)		■	■
Fever tree *(Vachellia xanthophloea)*		■	
Flame climbing bushwillow (*Combretum microphyllum*)	■	■	
Flame thorn (*Acacia ataxacantha*)		■	
Knob thorn (*Vachellia nigrescens*)		■	
Jackal berry (*Diospyros mespiliformis*)	■		■
Knob thorn (*Vachellia nigrescens*)	■		
Leadwood (*Combretum imberbe*)		■	■
Magic guarri (*Euclea divinorum*)			■
Mallow raisin (*Grewia villosa*)	■		■
Mitzeeri (*Bridelia micrantha*)			■
Natal guarri (*Euclea natalensis*)	■	■	■
Natal mahogany (*Trichelia emetica*)	■	■	■
Pigeonwood (*Trema orientalis*)		■	
Potato bush (*Phyllanthus reticulatus*)	■	■	
Red ivory (*Berchemia zeyheri*)		■	
Russet bushwillow (*Combretum hereroense*)		■	
Sandpaper -bush (*Ehrethia amoena)*	■		■
Sausage tree (*Kigelia africana*)		■	
Sickle bush (*Dichrostachys cinerea*)	■		
Sycamore fig (*Ficus sycamorus*)		■	
Umbrella thorn (*Vachellia tortilis*)	■		
Velvet raisin *(Grewia flava)*	■		
White-berry bush (*Flueggea virosa*)	■		
Woolly caper-bush (*Capparis tomentosa*)	■		
Forbs			
Mountain aloe (*Aloe marlothii*)			■
Grass and sedges			
Bushveld signal grass (*Urochloa mossambicensis*)			■
Common carrot-seed grass (*Tragus berteronianus*)			■
Common crowfoot (*Dactyloctenium aegyptium*)			■
Feathered chloris (*Chloris virgata*)			■
Guinea grass (*Panicum maximum*)	■		
Natal red top (*Melenis repens*)			■

Alien invading plants			
Bougainvillea (*Bougainvillea glabra)*			
*Bugweed (*Solanum mauritianum*)			
*Castor oil bush (*Ricinis communis*)			
*Christmas berry (*Lantana camara*)			
*Demoina shrub (*Parthenium hysterophorus*)			
*Flamboyant tree (*Delonix regia*)			
*Large cocklebur *(Xanthium strumarium)*			
*Mango (*Mangifera indica*)			
*Pigweed (*Amaranthus hybridus*)			
*Spanish reed (Arundo donax)			
*Triffid weed (*Chromolaena odorata*)			

Due to the total transformation of the project area from savannah woodland to fallow land, it will be futile to list threatened plant species that could occur on the transformed land. During the surveys on the project site, very little natural vegetation occurred on the entire site because all natural vegetation was completely removed when the farm was established.

However, it will be important to provide a list of indigenous vegetation to establish in the gardens of the residential development. There are a number of plant nurseries in the area that sell indigenous plants. See Table 10 for a list of indigenous plants adapted to the area.

Table 10: A list of indigenous trees and shrubs which are adapted to the area and should be planted in the residential gardens.

Common coral tree (*Erythrina lysistemon*)
Common num-num (*Carissa bispinosa*)
Common wild fig (*Ficus burkei*)
Flame climbing bushwillow *(Combretum microphyllum)*
Hedge euphorbia *(Euphorbia tirucalli)*
Jackal berry (*Diospyros mespiliformis*)
Jacket plum (*Pappea capensis*)
Kudu lily (*Pachypodium saundersii*)
Large-leaved false-thorn (*Albizia versicolor*)
Natal mahogany (*Trichelia emetica*)
Pigeonwood (Trema orientalis)
Potato bush (*Phyllanthus reticulatus*)
Pride-of-De Kaap (*Bauhinia galpinii*)
Puzzle bush (*Ehretia rigida*)
Quinine tree (*Rauvolfia caffra*)
Rhino-coffee (*Kraussia floribunda*)
River bushwillow (*Combretum erythrophyllum*)
Sagewood (*Buddleja salviifolia*)
Sausage tree (*Kigelia africana*)
Southern Chinese hats (*Karomia speciosa*)
Sycamore fig (*Ficus sycamorus*)
Tree wistaria (*Bolusanthus speciosus*)
Weeping boer-bean (*Schotia brachypetala*)
Weeping lavender tree (Heteropyxis natalensis)
Wild pear *(Dombeya rotundifolia)*

4.4.2 Riverine Ecology

4.4.2.1 The extent of the riparian habitat

KMAE drainage system and associated riparian zone

The unnamed drainage line which runs on the eastern boundary of the property, will be incorporated into the development. It will form a natural feature with most of the natural riparian vegetation intact and protected by a 10 m buffer. Near the confluence with the Crocodile River an existing bridge crossing will be upgraded to provide access to the stand in the north-eastern corner, and this bridge will be constructed in such a way that is also will dam the water in the drainage line.

During the riparian study of the unnamed drainage line, the riverine environment was surveyed by completing two transects in the project area. Figure 30 consists of a map which was compiled using a Google Earth image which indicates these two surveys transects in the waterway.

The riparian zone is relatively narrow (5 to 8 metres wide) and the stream width between 1.5 and 2.0 metres. The drainage line changes from a rather shallow U-shaped channel (Figure 31) to a 7m deep V-shaped channel (Figure 32) closer to the confluence with the Crocodile River.

The vegetation in the riverine area consists of larger trees in the marginal areas, especially Natal mahogany and sycamore figs, while the non-marginal areas are covered by semi-wetland and terrestrial species. Reeds, both indigenous (thatching reed) and alien (Spanish reed) are found along the lower portions of the riparian zone. Numerous species of alien plants have invaded the drainage line.

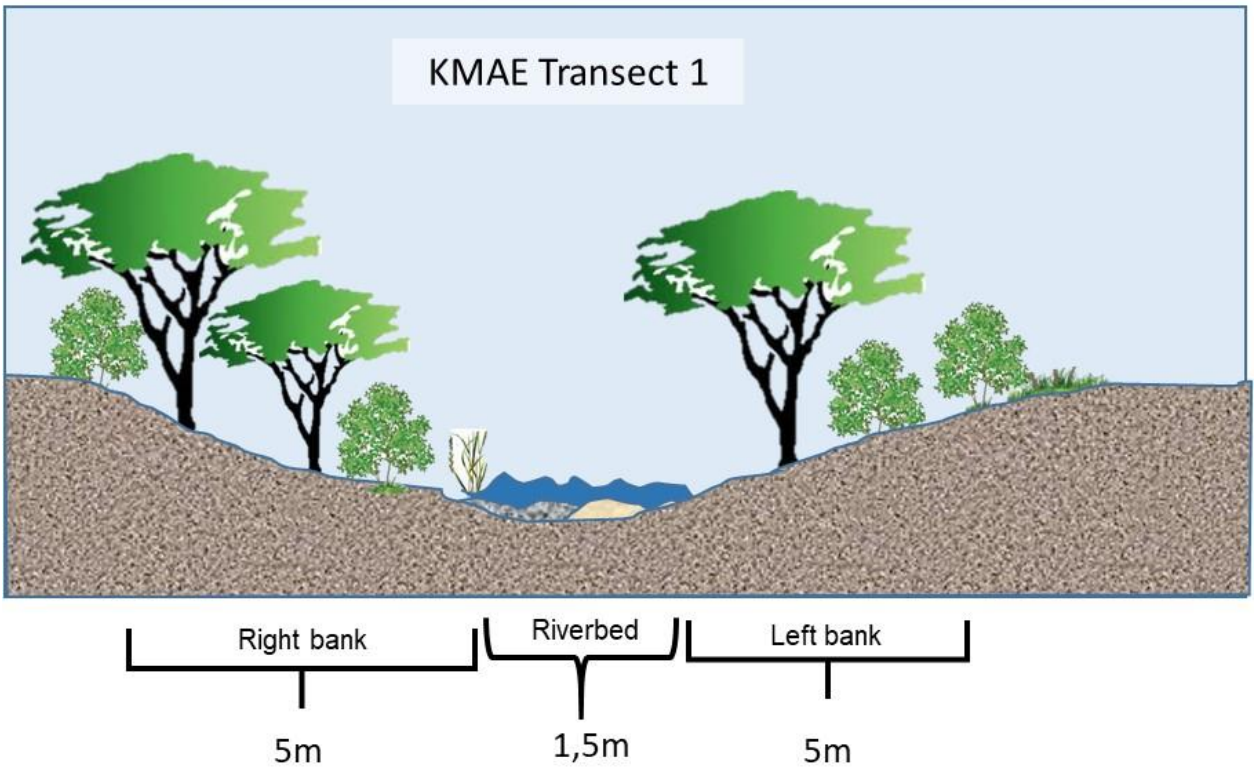
Of the all the tree species on the stream banks, two riparian indicator species, sycamore fig and leadwood were observed, as well as eight alien plant species. Two trees, the leadwood and apple-leaf, are listed as protected species.

The stream itself is a small system (1.5 to 2.0 m wide) with a rock cobble bed in steeper areas. Pools are rare.

Table 11: Riparian indicator plant species observed in the riparian zone along the stream reach during the survey.

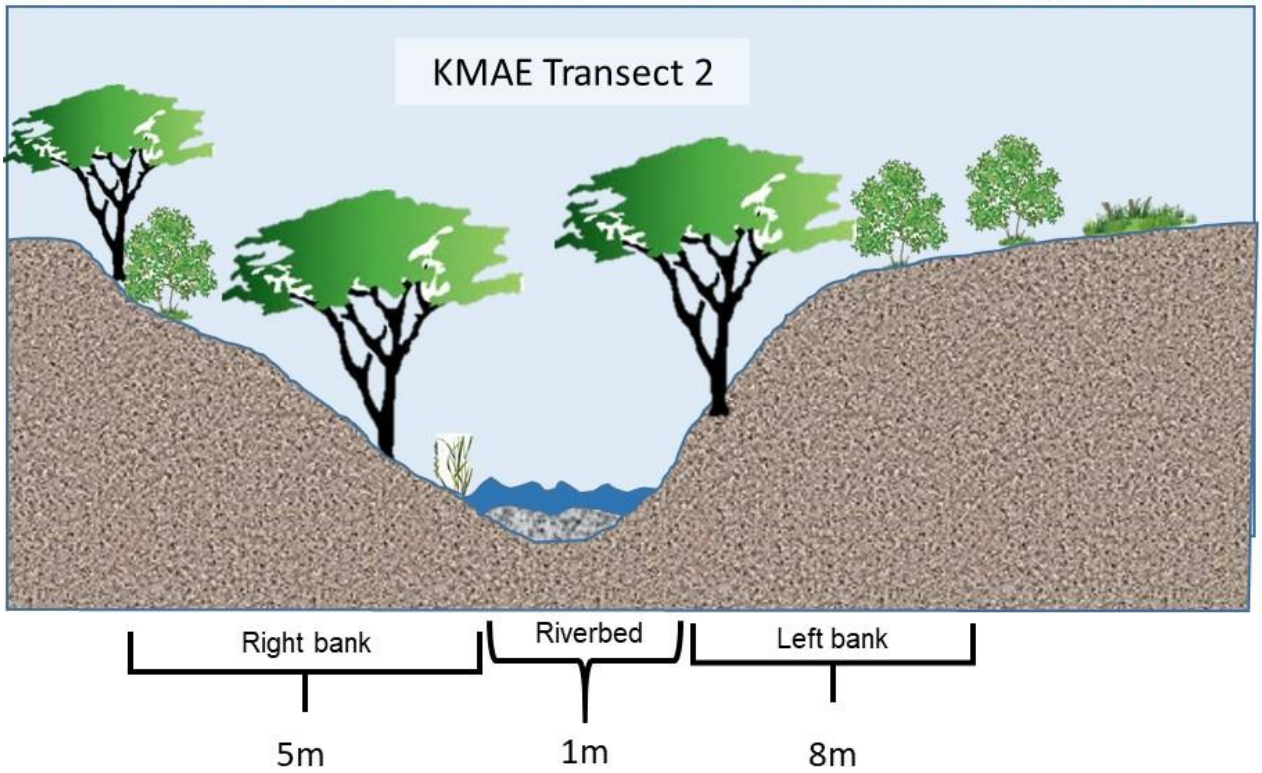
FAMILY	*TAXON*	HABITAT
MORACEAE	Sycamore fig (*Ficus sycamorus)*	Frequently along river banks, forming a distinctive part of the riverine thicket; also in mixed woodland
COMBRETACEAE	Leadwood *(Combretum imberbe)*	Medium to low altitudes, in mixed woodland, often along rivers or dry watercourses, particularly on alluvial soils.

During the site visit to the KMAE project area, two survey sites were earmarked for assessment. At each of these survey sites, a transect was surveyed: from the edge of the riparian area (left and right bank), and through the streambed to the other side. The site information is summarized in Figures 31 and 32.



Riparian width		Riverbed		Transect	#T1
Left bank	5m	Width	1.5m	Transect length	12m
Right bank	5m				
Riparian vegetation - Left bank		Riverbed cover		Riparian vegetation - Right bank	
Natal mahogany (*Trichelia emetica*)		Cobble and sand		Sycamore fig (*Ficus sycamorus*)	
Potato bush (*Phyllanthus reticulatus*)				Pigeonwood (*Trema orientalis*)	
Brown ivory *(Berchemia discolor)*				Flame thorn (*Acacia ataxacantha*)	
Flame climbing bushwillow (*Combretum microphyllum*)				*Castor oil bush (*Ricinis communis*)	
Terrestrial					
Common spike thorn (*Gymnosporia buxifolia*)				Sickle bush (*Dichrostachys cinerea*)	
Flame thorn (*Acacia ataxacantha*)				White-berry bush (*Flueggea virosa*)	
				Russet bushwillow (*Combretum hereroense*)	

Figure 31: Transect 1: Unnamed drainage line - Properties of the upstream section.



Riparian width		Riverbed		Transect	#T2
Left bank	8m	Width	1m	Transect length	15m
Right bank	5m				
Riparian vegetation - Left bank		Riverbed cover		Riparian vegetation - Right bank	
Sycamore fig (*Ficus sycamorus*)		Cobble and rock		Sycamore fig (*Ficus sycamorus*)	
Flame climbing bushwillow (*Combretum microphyllum*)				*Christmas berry (*Lantana camara*)	
*Spanish reed (Arundo donax)				Flame climbing bushwillow (*Combretum microphyllum*)	
*Castor oil bush (*Ricinis communis*)				Mitzeeri (*Bridelia micrantha*)	
Terrestrial					
Common spike thorn (*Gymnosporia buxifolia*)				*Triffid weed (*Chromolaena odorata*)	
Flame thorn (*Acacia ataxacantha*)				Flame thorn (*Acacia ataxacantha*)	
				Russet bushwillow (*Combretum hereroense*)	

Figure 32: Transect 2: Unnamed drainage line - Properties of the downstream section.

4.4.2.2 Aquatic habitat assessment

Aquatic surveys and biomonitoring are essential components of the system ecology and aim to measure present biological conditions and trends in the aquatic ecosystem. It attempts to relate the observed variation to changes in available habitat, as dictated by physical system drivers of the system such as water quality, geomorphology, and hydrology (Kleynhans & Louw, 2008).

During the survey, aquatic habitats surveyed at Transect 1 consisted of moderate deep water (30cm) over mud and rock. Abundant root wad habitat is created by sycamore fig roots, and there is some overhanging vegetation habitat.

Figure 33: The lower survey site (at Transect 2) consists of a narrow cobble and rock channel with shallow water flowing in the channel.

Aquatic habitats surveyed at Transect 2 consisted of a narrow cobble and rock channel flanked by forbs, reeds and large riparian trees, with shallow water flowing in the narrow channel. In areas of steeper slopes, small cobble riffles are washed open and, in some areas, small pools of deeper water are formed.

Figure 34: The lower survey site (at Transect 2) consists of a narrow cobble and rock channel with shallow water flowing in the channel.

During the monitoring survey in December 2020 the following parameters were measured - IHAS (Integrated Habitat Assessment System) and HQI (Habitat Quality Index) with the results summarised in Table 12.

Table 12: **The habitat parameters as measured at the survey sites in the unnamed drainage line.**

SITE	IHAS%	CATEGORY	HQI%	CATEGORY
TRANSECT 1 SITE	61	Fair	68	Fair
TRANSECT 2 SITE	65	Fair	71	Fair

The IHAS and HQI scores were mostly moderate due to the lack of deep-water habitats and good overhang, thus classified as a “Fair” category at both transect sites (Table 16).

4.4.2.3 Surveys of Aquatic Invertebrates and Fish

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporating the habitat aspects, a proper basis for biological diversity can be obtained.

Aquatic invertebrate assessment

The macro-invertebrates were sampled according to the SASS5 method at the two sites, and Table 13 lists the macro-invertebrates sampled at the sites and reflects the SASS5 scores for the December 2020 survey.

Table 13: SASS5 scores of the different habitat types at the Transect 1 sampling site (a complete table of this summarized version can be viewed in Appendix 3).

TAXON	Stones	Vegetation	GSM	Total
Atyidae (Shrimp) 8		A		A
Baetidae 2 spp 6	A	A		B
Caenidae 6			A	A
Coenagrionidae 4		A		A
Veliidae 5		A	1	A
Hydropsychidae 1= 4	A			A
Dytiscidae 5		1		1
Hydrophilidae 5		1		1
Chironomidae 2			A	A
Simuliidae 5	1			1
Tabanidae 5	1			1
Thiaridae 3			B	B
SASS Score	20	43	16	58
No of families	4	6	4	12
ASPT	5.0	7.1	4.0	4.8

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

According to Table 16, the macro-invertebrate scores, resulted in “Fair” SASS scores and a moderate number of families. The Fair score can be attributed to lack of good riffles and some moderate overhang.

Table 14: SASS5 scores of the different habitat types at the Transect 2 sampling site (a complete table of this summarized version can be viewed in Appendix 3).

TAXON	Stones	Vegetation	GSM	Total
Potamonautidae 3	A			A
Atyidae (Shrimp) 8		A		A
Baetidae 2 spp 6	B	A		B
Calopterydidae 10		1		1
Chlorocyphidae 10		1		1
Coenagrionidae 4		A		A
Veliidae 5		A	1	A
Hydropsychidae 1= 4	A			A
Philopotamidae 10	1			1
Dytiscidae 5		1		1
Helodidae 12		1		1
Hydrophilidae 5		1		1
Chironomidae 2			A	A
Simuliidae 5	A			A
Tabanidae 5	1			1
Thiaridae 3	A		B	B
SASS Score	36	65	10	97
No of families	7	9	3	16
ASPT	5.1	7.2	3.3	6.0

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

According to Table 14, the presence of shallow, well aerated riffles, as well as some overhanging vegetation were also reflected in the macro-invertebrate scores, resulting in "Good" SASS scores and a relative high number of families.

Table 15: A summary of the IHAS, HQI and SASS scores in the KMAE project area.

SURVEY SITE	Habitat scores		SASS5 Scores		
	IHAS %	HQI %	SASS score	Number of families	ASPT
TRANSECT 1 SITE	61	68	58	12	4.8
TRANSECT 2 SITE	65	71	97	16	6.0

Judging from Table 15, the habitat scores at both the sites are moderate and are thus categorized as "Fair" (Table 16). On the other hand, the SASS scores represent a "Good" integrity and relative high number of families, which can be attributed to shallow, well aerated riffles, as well as some overhanging vegetation.

Table 16: Categories used to classify Habitat, SASS and ASPT values:

HABITAT	SASS4	ASPT	CONDITION
>100	>140	>7	Excellent
80-100	100-140	5-7	Good
60-80	60-100	3-5	Fair
40-60	30-60	2-3	Poor
<40	<30	<2	Very poor

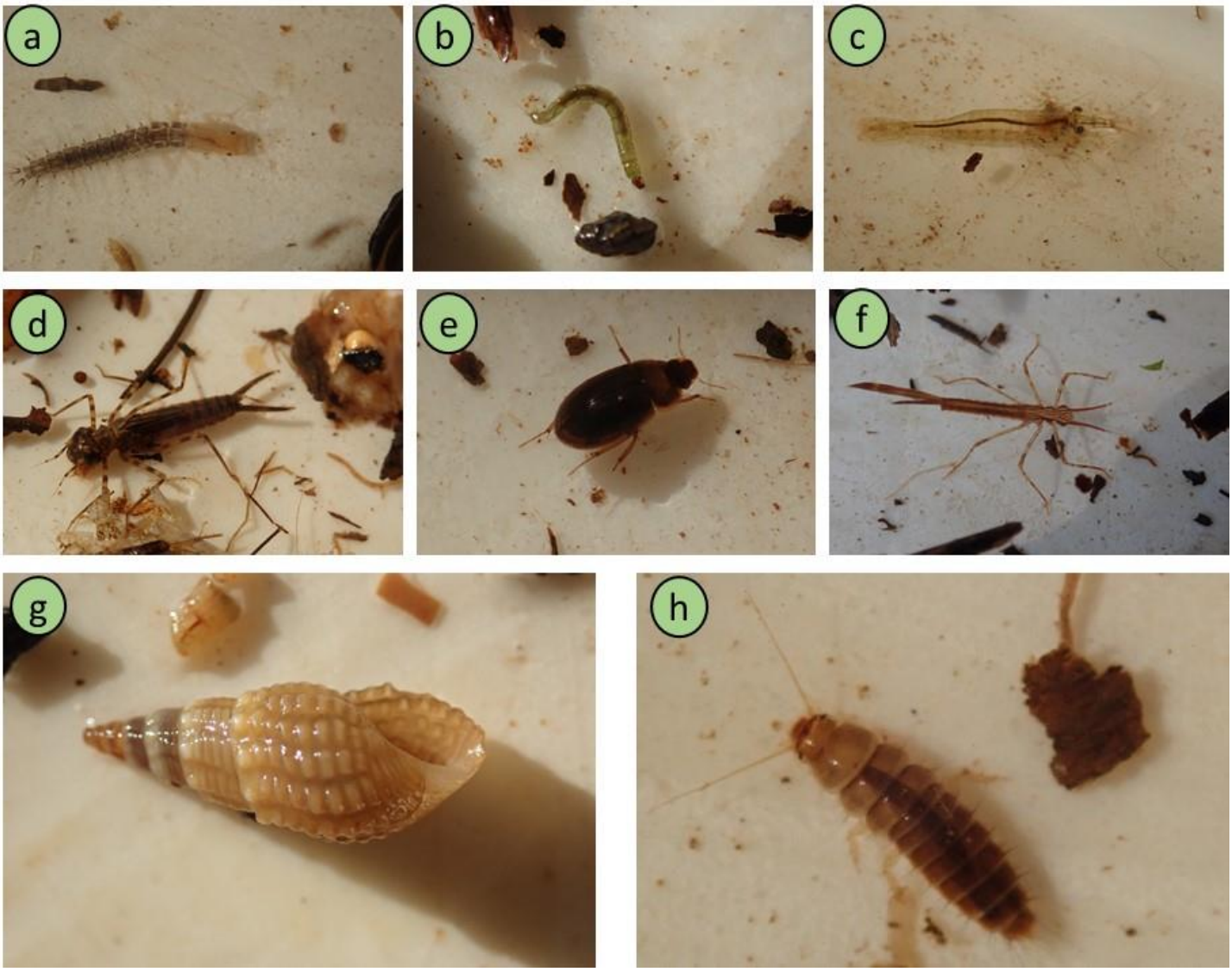


Figure 35: Some of the aquatic invertebrate taxa observed during the SASS5 process.

a. Philopotamidae
b. Chironomidae
c. Atyidae
d. Chlorocyphidae
e. Hydrophilidae
f. Calopterygidae
g .Thiaridae
h. Helodidae

Fish communities - Fish Response Assessment Index (FRAI)

The purpose of the Fish Response Assessment Index (FRAI) is to provide a habitat-based cause-and-effect interpretation underpinning the deviation of the fish assemblage from the reference condition.

The application of the FRAI is based on the following:

- The FRAI is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or rivers.
- These intolerance and preference attributes are categorised into metric groups with constituent metrics that relates to the environmental requirements and preferences of individual species.
- Assessment of the response of the species metrics to changing environmental conditions occur either through direct measurement (surveys) or are inferred from changing environmental conditions (habitat). Evaluation of the derived response of species metrics to habitat changes are based on knowledge of species ecological requirements. Usually, the FRAI is based on a combination of fish sample data and fish habitat data.
- Changes in environmental conditions are related to fish stress and form the basis of ecological response interpretation.

Determine reference fish assemblage: species and frequency of occurrence (FROC)

The fish reference Frequency of Occurrence (FROC) database (Kleynhans, Louw, & Moolman, 2007), which provides consistent reference frequency of occurrence for more than 700 fish sites in South Africa, was used to establish the baseline data for this report.

Fish are considered to be one of the important indicators of river health and their responses to modified environmental conditions are measured in terms of the Fish Response Assessment Index (FRAI) (Kleynhans 1999; Kleynhans *et al*. 2005). This index is based on a combination of fish species habitat preferences as well as intolerance to habitat changes, and the present frequency of occurrence of species compared to the reference frequency of occurrence (Kleynhans, Louw, & Moolman, 2007).

The list of species is based on species that are expected to be present or to have been present under close to reference habitat conditions. Species that are derived to have been present under relatively recent reference habitat conditions are also identified. The resulting species reference list is a combination of both of the above approaches.

The rating of the FROC refers to the reference fish frequency of occurrence (FROC) in a particular ecologically defined reach of a river. Ratings are scored from 1 to 5. This means that FROC ratings are derived based on conditions at the particular site as well as the available habitat in the reach for species expected under reference conditions.

Basic habitat conditions that were considered in terms of the FROC of species are based on intolerance and a preference rating as defined in the FRAI (Kleynhans *et al.* 2005). The presence and abundance of habitat features such as velocity-depth classes, cover types (including substrate) and the characteristics of the natural flow regime (especially the degree of pereniality) in the river reach under reference conditions formed the basis for the expert judgement of the FROC (Kleynhans, Louw, & Moolman, 2007).

There is no FROC Data available for the unnamed drainage line on the KMAE project area (project reach). On the other hand, fish data for the Crocodile River, X24D-00994 is available and will be used as an indication of the species with the potential to migrate up the small tributary and inhabit the habitat types available (FROC & PESEIS data bases - DWS).

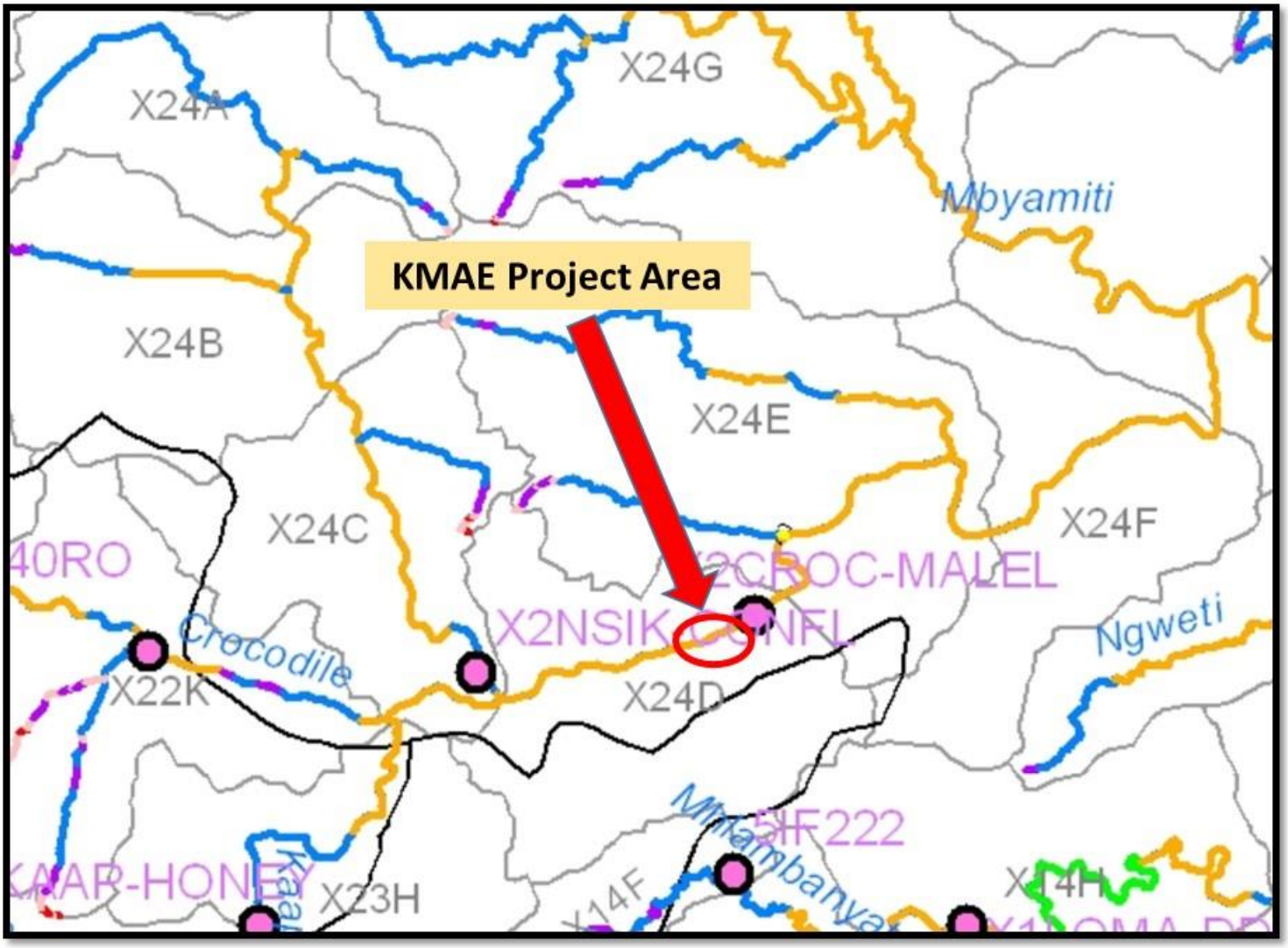


Figure 36: KMAE stream is situated in the X24D catchment as recorded in the DWS FROC & PESEIS data bases.

Table 17: The PESEIS fish list (and their potential to migrate) up the KMAE stream. Migration potential is listed as follows:

5. Migration critical for survival of species (large scale migrations undertaken for reproduction, avoidance, feeding and dispersal).
4. Migration critical for survival of species (large scale migrations undertaken for reproduction, avoidance, feeding and dispersal. Migrate into floodplains & seasonal rivers confirmed).
3. Migration moderately important for survival of species (uncertain).
2. Migration not important for survival of species (migration mostly undertaken for dispersal).
1. Migration not important for survival of species (migration mostly undertaken for dispersal).

Fish Species	Migration potential	Potential to migrate up the KMAE unnamed tributary (Likely/Unlikely)
Migration critical (4-5):		
Longfin eel *(Anguilla mossambica)*	5	Likely
Giant mottled eel (*Anguilla marmorata)*	5	Unlikely
Largescale yellowfish *(Labeobarbus marequensis)*	5	Likely
Hamilton's barb (*Enteromius afrohamiltoni)*	5	Likely
Broadstriped barb *(Enteromius annectens)*	5	Likely
Orangefin barb *(Enteromius eutaenia)*	4	Likely
Straightfin barb *(Enteromius paludinosus)*	4	Likely
Three-spot barb *(Enteromius trimaculatus)*	4	Likely
Beira barb *(Enteromius radiatus)*	4	Likely
East-coast barb (*Enteromius toppini*)	4	Likely
Longbeard barb *(Enteromius unitaeniatus)*	4	Likely
Bowstripe barb *(Enteromius viviparus)*	4	Likely
Southern barred minnow *(Opsaridium peringueyi)*	4	Unlikely
Red-eye labeo *(Labeo cylindricus)*	4	Likely
Leaden labeo *(Labeo molybdinus)*	4	Likely
Purple labeo *(Labeo congoro)*	4	Unlikely
Silver labeo *(Labeo ruddi)*	4	Likely
Rednose labeo *(Labeo rosae)*	4	Likely
Tigerfish *(Hydrocynus vittatus)*	4	Unlikely
Imberi *(Brycinus imberi)*	4	Likely
Silver robber *(Micralestes acutidens)*	4	Likely
River sardine *(Mesobola brevinialis)*	4	Likely
Migration moderately important (3):		
Bulldog *(Marcusenius macrolepidotus)*	3	Likely
Churchill *(Petrocephalus wesselsi)*	3	Likely
Migration not important (1-2):		
Sharptooth catfish *(Clarias gariepinus)*	2	Likely
Silver catfish *(Schilbe intermedius)*	2	Unlikely
Brown squeaker *(Synodontis zambezensis)*	2	Unlikely
Sawfin suckermouth (*Chiloglanis paratus)*	2	Unlikely
Shortspine suckermouth (*Chiloglanis pretoriae)*	2	Unlikely

Lowveld suckermouth (*Chiloglanis swierstrai)*	2	Unlikely
Mozambique tilapia *(Oreochromis mossambicus)*	2	Likely
Redbreast tilapia *(Tilapia rendalli)*	2	Unlikely
Banded tilapia *(Tilapia sparrmanii)*	2	Unlikely
Orange-fringed largemouth *(Chetia brevis)*	1	Unlikely
Southern mouthbrooder *(Pseudocrenilabrus philander)*	1	Unlikely
Tank goby (*Glossogobius giuris)*	1	Unlikely

Determine present state for drivers

The purpose is to provide information on the fish response and associated habitat condition and *vice versa* (i.e. fish responses that are possible, given certain habitat conditions). This assessment considers the whole river section to be studied. If information on the drivers is available, these should be used.

In the project area, the KMAE unnamed tributary seems to be a semi-perennial stream as it also receives water from irrigation return-flows in the upstream catchment.

Sampling site selection

During the survey, aquatic habitat types which were surveyed at Transect 1 and 2. The sites are described in Section 4.4.2.1.

Due to the terrain and flows in the river only the electro-shocking method was applied.

Table 18: Habitat types sampled and the sampling effort made per survey site.

HABITAT TYPES SAMPLED AND EFFORT

SAMPLING EFFORT	SLOW DEEP	SLOW SHALLOW	FAST DEEP	FAST SHALLOW
Electro shocker (min)		10 minutes		20 minutes
Small seine (mesh size, length, depth, efforts)				
Large seine (mesh size, length, depth, efforts)				
Cast net (dimensions, efforts)				
Gill nets (mesh size, length, time)				

Table 19: Fish sampled during the survey.

SPECIES SAMPLED	SLOW DEEP	SLOW SHALLOW	FAST DEEP	FAST SHALLOW
Largescale yellowfish *(Labeobarbus marequensis)*		1		2
Orangefin barb *(Enteromius eutaenia)*				8
Sharptooth catfish (*Clarias gariepinus*)		1		3
Red-eye labeo *(Labeo cylindricus)*				4
Leaden labeo *(Labeo molybdinus)*				5
Three-spot barb *(Enteromius trimaculatus)*		1		6

Execute the FRAI model

The FRAI model makes use of the fish intolerance and preference database that was compiled in 2001 (Kleynhans 2003). This information was included into the FRAI. The approach followed included the ranking, weighting and rating of metric groups. A large component of the FRAI is based on an automated calculation of rankings, weights and ratings. Table 20 indicates the weights of the different metric groups for fish at the KMAE stream site.

Table 20: The weight allocated to the different metric groups in the model.

Weight of metric groups	
Metric group	**Weight (%)**
Velocity-depth	**100,00**
Cover	**85,71**
Flow modification	**97,14**
Physico-chemical	**48,57**
Migration	**88,57**
Impact of introduced	**20,00**

The Velocity-depth metric carries the most weight due to improved water supply situation, while Flow modification indicates the effects of the catchment impacts.

Table 21: The FRAI results at the study sites during the current surveys with the expected and observed fish species and the resultant ecological class.

AUTOMATED	
FRAI (%)	**52.3**
EC: FRAI	**D**
ADJUSTED	
FRAI (%)	**55.6**
EC: FRAI	**D**

Abbreviations: reference species (introduced species excluded)	**Scientific names: reference species (introduced species excluded)**	**Reference frequency of occurrence**	**EC: observed & habitat derived frequency of occurrence**
BEUT	BARBUS EUTAENIA BOULENGER, 1904	3,00	1,00
BMAR	LABEOBARBUS MAREQUENSIS SMITH, 1841	2,00	1,00
BFRI	BARBUS AFROHAMILTONI CRASS, 1960	2,00	1,00
BANN	BARBUS ANNECTENS GILCHRIST & THOMPSON, 1917	2,00	1,00
BPAU	BARBUS PALUDINOSUS PETERS, 1852	3,00	1,00
BTRI	BARBUS TRIMACULATUS PETERS, 1852	3,00	2,00
BRAD	BARBUS RADIATUS PETERS, 1853	2,00	1,00
BTOP	BARBUS TOPPINI BOULENGER, 1916	2,00	1,00
BUNI	BARBUS UNITAENIATUS GÜNTHER, 1866	2,00	1,00
BVIV	BARBUS VIVIPARUS WEBER, 1897	3,00	2,00
LCYL	LABEO CYLINDRICUS PETERS, 1852	2,00	1,00
LMOL	LABEO MOLYBDINUS DU PLESSIS, 1963	2,00	1,00
MACU	MICRALESTES ACUTIDENS (PETERS, 1852)	2,00	1,00
MBRE	MESOBOLA BREVIANALIS (BOULENGER, 1908)	2,00	1,00
MMAC	MARCUSENIUS MACROLEPIDOTUS (PETERS, 1852)	2,00	1,00

PCAT	PETROCEPHALUS WESSELSI KRAMER & VAN DER BANK, 2000	2,00	1,00
CGAR	CLARIAS GARIEPINUS (BURCHELL, 1822)	4,00	4,00
OMOS	OREOCHROMIS MOSSAMBICUS (PETERS, 1852)	3,00	2,00
BEUT	BARBUS EUTAENIA BOULENGER, 1904	3,00	1,00

The relative FRAI score of 52.3% at this reach in the KMAE places this reach within the limits of an ecological state category Class D (40 to 59%), in other words “Largely modified” as described in Table 22.

Table 22: Ratings for the fish integrity classes

	FRAI ASSESSMENT CLASSES	
Class rating	Description of generally expected conditions for integrity classes	Relative FRAI score (% of expected)
A	Unmodified, or approximate natural conditions closely.	90 to 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification.	80 to 89
C	Moderately modified. A lower-than-expected species richness and presence of most intolerant species. Some impairment of health may be evident at lower limits of this class.	60 to 79
D	Largely modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderate intolerant species. Impairment of health may become more evident at the lower limit of this class.	40 to 59
E	Seriously modified. A strikingly lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 to 39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species. Only tolerant species may be present with a loss of species at the lower limit of the class. Impairment of health generally very evident.	0 to 19

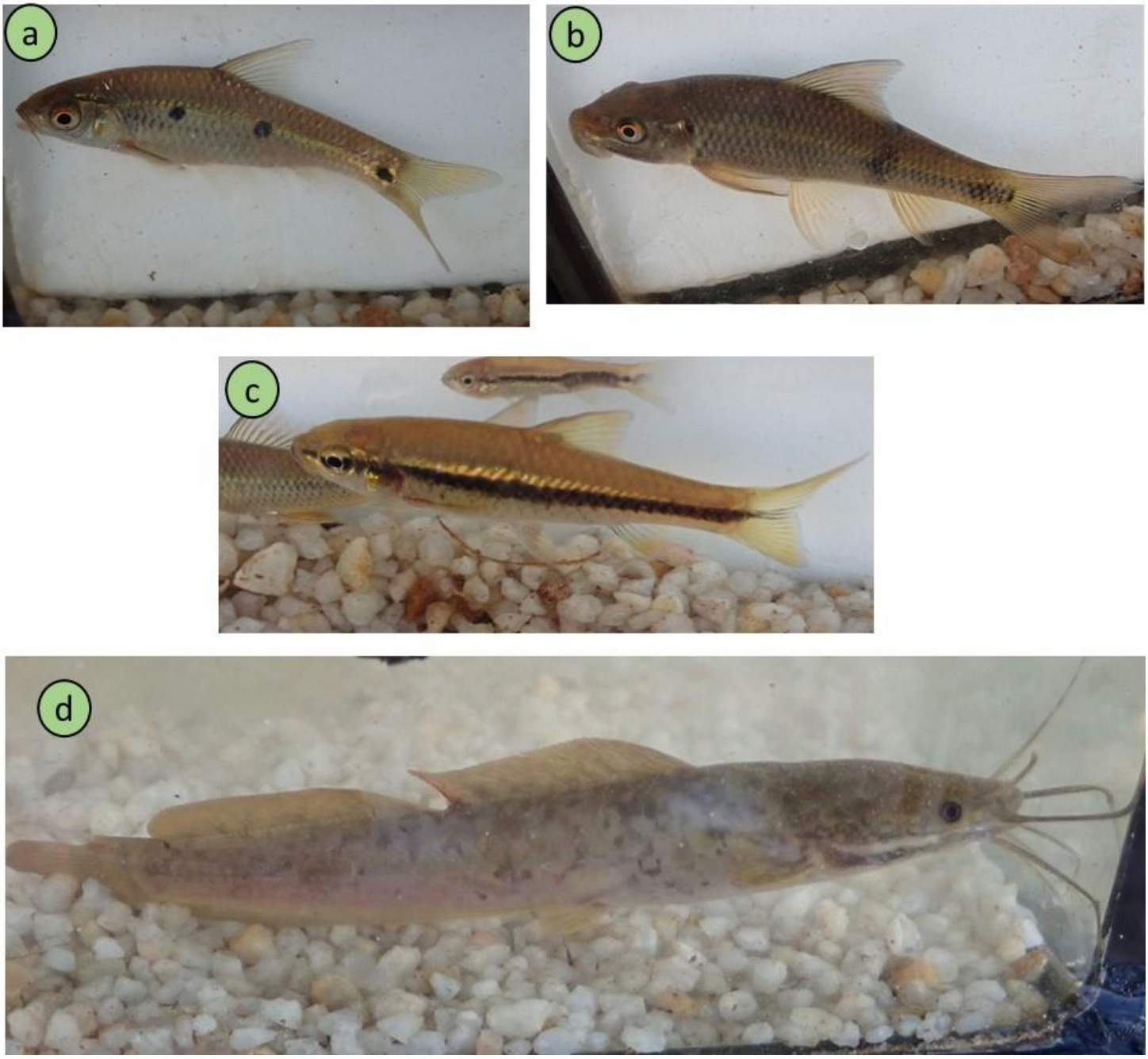


Figure 37: Some of the fish species collected during the FRAI process.

a. Three-spot barb *(Enteromius trimaculatus)*
b. Red-eye labeo *(Labeo cylindricus)*
c. Orangefin barb *(Enteromius eutaenia)*
d. Sharptooth catfish (*Clarias gariepinus*)

4.4.3 Terrestrial ecology

Customarily this section of the report incorporates lists of habitat types and all species of fauna and flora with emphasis on threatened status and distribution. This data would then be analysed in order to establish the impact that the implementation of the proposed project will have on the surrounding ecology.

In the case of the KMAE project area, **no natural terrestrial habitat is present in the project area.** Surveys relating to the biodiversity presented a few species that now utilise the transformed habitat, but this relation is far from natural. Also, the fact that a large portion of the area will remain for agriculture, compounds this issue. It was therefore decided not to include lists of species which occurred there historically.

It is true that the report must address the possibility of the impacts of the development on the adjacent ecosystem of the Crocodile River and the Kruger Park biodiversity. Lists of observed faunal species compiled by the author (the period 2004 to 2021) along this reach of the river are available in the Appendix 5 and the Red Data species will be highlighted and listed in the section below.

4.4.3.1 Frogs

According to the 2004 Frog Atlas (Minter, *et al* 2004), the project area is situated in the Bushveld District. The Bushveld District has a relatively high species richness (>30 species per grid cell), decreasing westwards, but is moderate in endemic species (7-10 species) (Minter *et al*, 2004). The associated frog distribution maps, confirms 29 frog species are expected to be present in the region. During surveys of the frog species, 2 of the 29 expected species were encountered in the KMAE project area:

- African common toad (*Sclerophrys gutturalis*)
- Painted reed frog (*Hyperolius marmoratus taeniatus*)

A total of 19 observed frog species were listed for a property 160 metres downstream of the KMAE project area. No threatened species are on the list.

4.4.3.2 Reptiles

Current knowledge of reptiles within the study area is derived from the Reptile Atlas Project (Bates, *et al.* 2014). According to the distribution of reptiles in South Africa, 61 species have distribution ranges extending into the region. During the surveys of reptile species 3 of the 61 were encountered in the KMAE project area:

- Common dwarf gecko *(Lygodactylus capensis capensis)*
- Striped skink (*Trachylepis striata*)
- Water monitor *(Varanus niloticus niloticus)*

A total of 25 observed reptile species were listed for a property 160 metres downstream of the KMAE project area, which include two threatened reptile species:

- Southern African python (*Python natalensis*). NEMBA TOPS (2015): Protected,
- Nile crocodile (*Crocodylus niloticus*) - Regional: Vulnerable (2014). NEMBA TOPS (2015): Protected, suggested Vulnerable; SARCA (2014): Vulnerable.

The Nile crocodiles were observed inside the KNP boundary.

4.4.3.3 Birds

During the period November 2020 to April 2021 the KMAE project site was surveyed for bird species. A total of 332 bird species were observed in this region during the Bird Atlas project (Harrison *et al.* 1997). During the surveys of bird species, 49 of the 332 species were encountered in the KMAE project area:

1. Egyptian goose (*Alopochen aegyptiaca*)
2. Natal spurfowl (*Francolinus natalensis*)
3. Helmeted Guineafowl (Numida meleagris)
4. African Wattled plover (*Vanellus senegallus*)
5. Blacksmith plover (*Vanellus armatus*)
6. Black-headed heron (Ardea melanocephala)
7. African Harrier-Hawk (*Polyboroides typus)*
8. Laughing dove (*Spilopelia senegalensis*)
9. Red-eyed Dove (*Streptopelia semitorquata*)
10. Purple-crested Turaco (*Tauraco porphyreolophus*)
11. Burchell's Coucal (*Centropus burchellii*)
12. Diederik Cuckoo (*Chrysococcyx caprius*)
13. Speckled mousebird (*Colius striatus*)
14. Red-faced Mousebird (*Urocolius indicus*)
15. Brown-hooded Kingfisher (*Halcyon albiventris*)
16. Woodland Kingfisher (*Halcyon senegalensis*)
17. White-fronted bee-eater (*Merops bullockoides*)
18. European Bee-eater (*Merops apiaster*)
19. Lilac-breasted Roller (*Coracias caudatus*)
20. Lesser Striped Swallow (*Cecropis abyssinica*)
21. African Palm-Swift (*Cypsiurus parvus*)
22. Barn Swallow (*Hirundo rustica*)
23. Fork-tailed Drongo (*Dicrurus adsimilis*)
24. Black-headed Oriole (*Oriolus larvatus*)
25. Arrow-marked Babbler (*Turdoides jardineii*)
26. Dark-capped Bulbul (*Pycnonotus tricolor*)
27. Sombre Greenbul (*Andropadus importunus*)
28. Kurrichane Thrush (*Turdus libonyana*)
29. White-browed robin-chat (*Cossypha heuglini*)
30. White-browed Scrub Robin (*Erythropygia leucophrys*)
31. Green-backed Camaroptera (*Camaroptera brachyura*)
32. Long-billed Crombec (*Sylvietta rufescens*)
33. Rattling Cisticola (*Cisticola chiniana*)
34. Red-faced Cisticola (*Cisticola erythrops*)
35. Tawny-flanked prinia (*Prinia subflava*)
36. African Paradise Flycatcher (*Terpsiphone viridis*)
37. Yellow-throated Longclaw (*Macronyx croceus*)
38. African Pipit (*Anthus cinnamomeus*)
39. Orange-breasted Bushshrike (*Chlorophoneus sulfureopectus*)
40. Brown-crowned Tchagra (*Tchagra australis*)
41. Cape Starling (*Lamprotornis nitens*)
42. Common Myna (Acridotheres tristis)
43. Cape white-eye (*Zosterops capensis*)
44. Spectacled Weaver (*Ploceus ocularis*)
45. Village weaver (*Ploceus cucullatus*)
46. Pin-tailed Whydah (*Vidua macroura*)
47. White-winged Widowbird (*Euplectes albonotatus*)

48. Blue Waxbill (*Uraeginthus angolensis*)
49. Yellow-fronted Canary (*Crithagra mozambicus*)

A total of 249 observed bird species were listed for a property 160 metres downstream of the KMAE project area, which include 19 threatened bird species (many of these birds were observed in the adjacent KNP environment):

1. Yellow-billed stork (*Mycteria ibis*) - SA Red Data (Taylor 2015): Endangered. IUCN 2016 Status: Least concern.
2. Black stork (*Ciconia nigra*) - SA Red Data (Taylor 2015): Vulnerable, TOPS (2007): Vulnerable. IUCN 2016 Status: Least concern. Mpumalanga: Vulnerable.
3. Saddle-billed stork (*Ephippiorhynchus senegalensis*) - SA Red Data (Taylor 2015): Endangered. NEMBA (TOPS): Endangered. IUCN 2014 Status: Least concern.
4. Marabou Stork *(Leptoptilos crumeniferus)* - SA Red Data (Taylor 2015): Near threatened. IUCN 2014 Status: Least concern.
5. African Finfoot *(Podica senegalensis)* - SA Red Data (Taylor 2015): Vulnerable. Mpumalanga: Vulnerable. IUCN 2015: Least concern.
6. White-backed Night-Heron *(Gorsachius leuconotus)* - SA Red Data (Taylor 2015): Vulnerable. IUCN 2015 Least concern.
7. African White-backed Vulture *(Gyps africanus)* - IUCN 2015: Critically Endangered; SA Red Data (Taylor 2015): Critically Endangered. NEMBA TOPS (2015 - Endangered
8. Hooded Vulture *(Necrosyrtes monachus)* - IUCN (2015): Critically Endangered; NEMBA TOPS (2015): Endangered species; SA Red Data (Taylor 2015): Critically Endangered.
9. White-headed Vulture *(Trigonoceps occipitalis)* - IUCN 2015: Critically Endangered; Endangered species; SA Red Data (Taylor 2015): Critically Endangered.
10. Lappet-faced Vulture *(Torgos tracheliotus)* - IUCN 2010 Endangered; NEMBA TOPS (2015): Endangered species; SA Red Data (Taylor 2015): Endangered.
11. Tawny Eagle *(Aquila rapax)* - SA Red Data (Taylor 2015): Endangered; NEMBA TOPS (2015): Endangered species; IUCN 2015 Status: Least concern.
12. Martial Eagle *(Polemaetus bellicosus)* - IUCN 2015 Status: Near-threatened; SA Red Data (Taylor 2015): Endangered; NEMBA TOPS (2015): Endangered species.
13. African Crowned Eagle *(Stephanoaetus coronatus)* - IUCN 2015 Status: Near-threatened. SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species. Mpumalanga: Vulnerable.
14. Bateleur *(Terathopius ecaudatus)* - IUCN 2015 NT: Near-threatened. SA Red Data (Taylor 2015): Endangered. NEMBA TOPS (2015): Endangered species.
15. Lanner Falcon *(Falco biarmicus)* - SA Red Data (Taylor 2015): Vulnerable. IUCN 2017 Status: Least concern.
16. Southern Ground-Hornbill *(Bucorvus leadbeateri)* - IUCN (2014) VU Vulnerable. SA Red Data (Taylor 2015): Endangered; NEMBA TOPS (2015): Endangered species.
17. Half-collared Kingfisher *(Alcedo semitorquata)* - SA Red Data (Taylor 2015): Near-threatened. Mpumalanga: Near-threatened. IUCN 2015 Status: Least concern.
18. European Roller (*Coracias garrulus*) - SA Red Data (Taylor 2015): Near-threatened; IUCN 2018 Least concern.
19. Greater Painted snipe (*Rostratula benghalensis*) - SA Red Data (Taylor 2015): Near-threatened.

4.4.3.4 Mammals

According to the distribution of mammals in South Africa, 100 species have distribution ranges extending into the region. During the surveys for mammal species 3 of the 100 were encountered in the KMAE project area:

- African savannah hare (Lepus victoriae)
- Common Molerat (Cryptomys hottentotus)
- Vervet monkey (Cercopithecus aethiops)

A total of 35 observed mammal species were listed for a property 160 metres downstream of the KMAE project area, which include 11 threatened species (most of these mammals were observed in the adjacent KNP environment):

1. Spotted hyaena *(Crocuta crocuta*) - NEMBA (TOPS 2015): Protected species. SA Red Data (Child 2016) Near-threatened.
2. Cheetah (*Acinonyx jubatus*) - IUCN 2015: Vulnerable; NEMBA (TOPS 2015): Vulnerable species. SA Red Data (Child 2016) Vulnerable.
3. Leopard (*Panthera pardus*) - IUCN (2016): Vulnerable. SA Red Data (Child 2016) Vulnerable. NEMBA (TOPS 2015): Protected species.
4. Lion (*Panthera leo*) - IUCN (2012): VU Vulnerable. NEMBA (TOPS 2015): Vulnerable species. SA Red Data (Child 2016) Vulnerable.
5. Wild dog (*Lycaon pictus*) - IUCN 2012: EN Endangered; NEMBA (TOPS 2015): Endangered species. SA Red Data (Child 2016) Endangered.
6. Cape clawless otter (*Aonyx capensis*) - IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Near-threatened; NEMBA (TOPS 2007): Protected species.
7. Honey badger (*Mellivora capensis*) - NEMBA (TOPS) 2007: Protected species. IUCN (2014) Least concern. SA Red Data (Child 2016): Least concern.
8. African elephant (*Loxodonta africana*) - IUCN (2010): Vulnerable. NEMBA (TOPS 2015): Protected species; SA Red Data (Child 2016): Least concern.
9. South central black rhinoceros (*Diceros bicornis minor*) - IUCN (2016): Endangered; SA Red Data (Child 2016): Endangered; NEMBA (TOPS 2015): Vulnerable species.
10. Southern white rhinoceros (*Ceratotherium simum*) - IUCN (2014): NT Near-threatened. SA Red Data (Child 2016): Near-threatened; NEMBA (TOPS 2015): Protected species.

5. Impact Assessment

5.1 Screening Report

The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity. It also provides site specific EIA process and review information and allows for the generation of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended.

Following is an abstract from the original Screening Tool application:

Cadastral details of the proposed site

Table 23: Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	MALELANE ESTATE	140	0	25°29'49.6S	31°29'15.7E	Farm
2	STRATHMORE	214	0	25°32'16.24S	31°26'6.53E	Farm
3		585	0	25°29'57.13S	31°29'29.34E	Farm Portion
4	STRATHMORE	214	112	25°30'12.29S	31°27'54E	Farm Portion
5	MALELANE ESTATE	140	13	25°30'0.94S	31°28'27.87E	Farm Portion

Table 24: Property details: Nearby developments and Environmental Management Frameworks (EMF) areas.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area	No nearby wind or solar developments found.
Environmental Management Frameworks relevant to the application	No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections include a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmental sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected.

Table 25: A summary of any development incentives, restrictions, exclusions or prohibitions.

Application classification	Agriculture - Forestry – Fisheries | Crop Production | Fisheries - Crop Production
Relevant development incentives, restrictions, exclusions or prohibitions	No intersection with any development zones found.

Proposed Development Area Environmental Sensitivity

The following summary of the development footprint environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Table 26: The development footprint environmental sensitivities (Figure 38).

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		**X**		
Animal species		**X**		
Aquatic Biodiversity Theme				**X**
Archaeological and Cultural Heritage Theme		**X**		
Civil Aviation Theme			**X**	
Plant Species Theme			**X**	
Defence Theme				**X**
Terrestrial Biodiversity Theme	**X**			

The following section with maps represents the results of the screening for environmental sensitivity of the proposed site for selected environmental themes associated with the project classification.

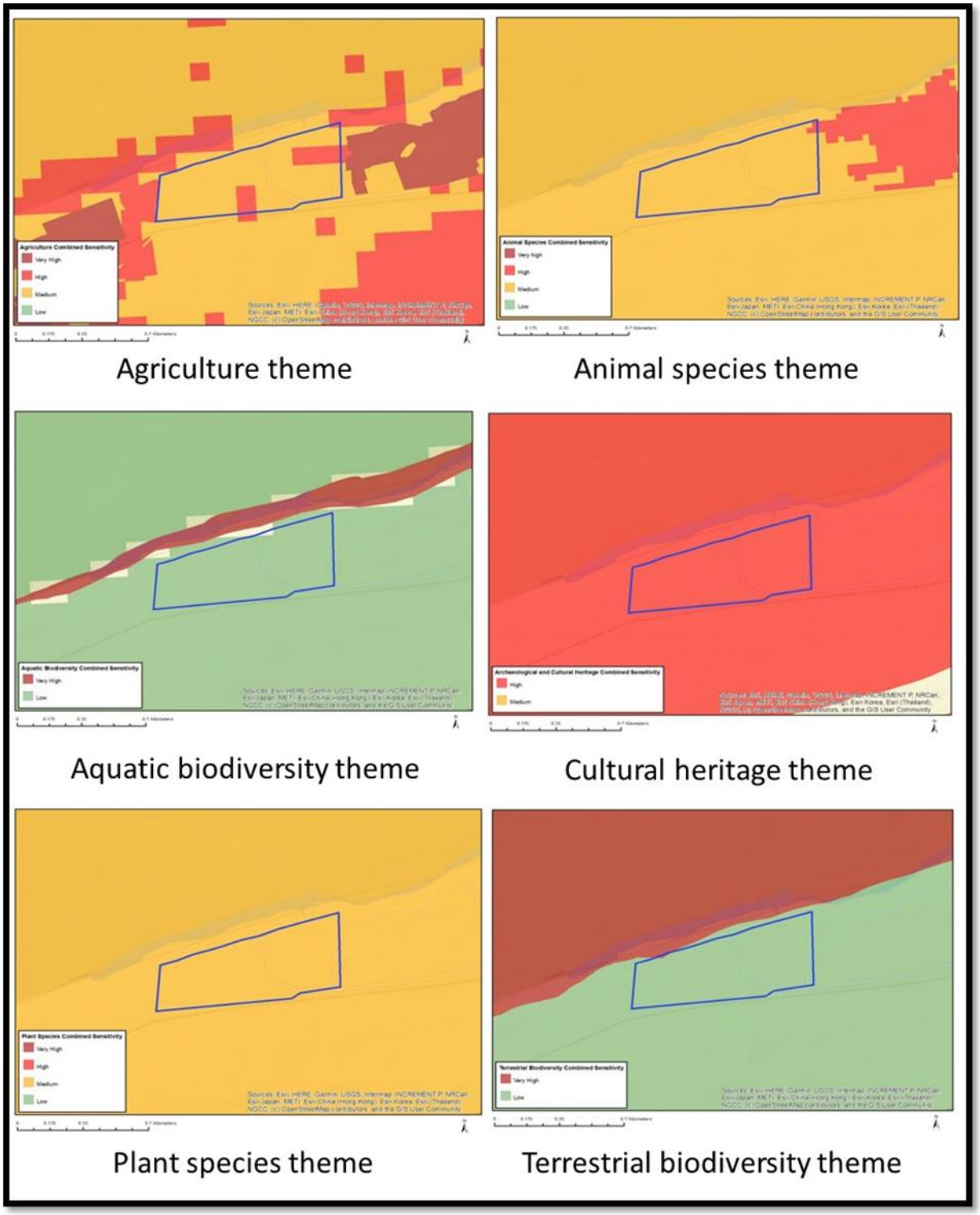


Figure 38: Maps of relative theme sensitivity for important selected themes (Table 26).

Table 27: Sensitivity features of the project area.

Theme	Sensitivity	Feature
Agriculture Theme	High	Land capability; 09. Moderate-High/10. Moderate-High
Animal species theme	Medium	Mammalia - *Lycaon pictus* Mammalia- *Acinonyx jubatus* Reptilia- *Kinixys natalensis* Insecta- *Lepidochrysops swanepoeli* Insecta- *Orachrysops violescens*
Aquatic biodiversity	Low	
Archaeological and Cultural Heritage Theme	High	Within 500 m of an important river Within 1 km of a protected area
Plant Species Theme	Medium	*Caesalpinia rostrata*
Terrestrial Biodiversity Theme	Low	Low sensitivity

5.2 Sensitivity mapping

Sensitivity assessments identify those sections of the study area that have a high conservation value or that may be sensitive to disturbance. Sensitivities could be determined based on:

- areas containing untransformed natural vegetation and associated faunal habitat;
- irreplaceability of the vegetation type and associated faunal habitat;
- ecological importance of vegetation and faunal habitat;
- high diversity or complexity of faunal habitat;
- observations of the abundance and diversity of floral and faunal species present at the time of the assessment;
- occurrence of Species of Conservation Concern (SCC);
- systems vital to sustaining ecological functions;
- presence or absence of CBAs and ESAs;
- degree of disturbance encountered as a result of historical activities.

In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have a low sensitivity.

An ecological sensitivity map of the project area was produced by integrating the information collected on-site with the available ecological- and biodiversity information available in the literature and various relevant reports. This includes delineating the different vegetation and habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties. Additionally, values and potential presence of vegetation and fauna species diversity, as well as species of conservation concern, were evaluated.

Five, broad-scale botanical biodiversity ‘sensitivity’ categories were identified and were developed for practical mapping purposes. They are intended as a summary of the perceived botanical biodiversity value and sensitivity, of mapped broad-scale vegetation and land-cover type units. Based on the assessment, the sensitivity of the project footprint can be divided into five categories of sensitivity: Very high, High, Moderate, Low and Negligible. These categories are listed as biodiversity sensitivity categories in Table 28.

Table 28: Important parameters relating to faunal diversity and landscape sensitivity listed in the different vegetation and land cover types in order to establish the biodiversity sensitivity and value of the project area.

Vegetation/ Land cover type unit	**Status and sensitivity of vegetation type**	**CBA Category**	**Biota:** Species of special concern (**SSC**)	**Biodiversity value and sensitivity**	**Overall ecological value and sensitivity**
Crocodile River	Granite Lowveld - Vulnerable	ESA: Protected area buffer	**SSC:** 2 reptiles; 19 birds; 10 mammals	Very high	**High**
Small stream on the eastern boundary	Granite Lowveld - Vulnerable	ESA Protected Area Buffer	**SSC:** 1 reptiles 2 birds; 2 mammals	Moderate	**Moderate**
Agriculture – Fallow lands	Granite Lowveld - Vulnerable	ESA: Protected area buffer	**SSC:** None	Negligible	**Negligible**
Infrastructure – housing	Granite Lowveld - Vulnerable	ESA Protected Area Buffer	**SSC:** None	Negligible	**Negligible**

The Crocodile River and its riparian zone are situated entirely in the confines of the Kruger National Park. Due to its protected status and very high biodiversity value, which includes a number of Species of Conservation concern, this biotope has a "**High**" overall ecological value and sensitivity status. Edge effects of the developments on the southern bank of the river are the reason why it does not reach the status of "Very High" (Table 28).

The small KMAE drainage line is part of a landscape changed completely by agricultural activities. These drainage lines fulfil an important function in maintaining the narrow riparian zones which acts as migration corridors and to buffer these riparian habitats. The drainage line also provides connectivity with the important Crocodile River system. The project area is situated in a Protected Area Buffer of the Kruger National Park.

Even though most of the project area consists of cultivated area and old lands (Figure 23), the drainage line and its associated riparian characteristics of this vegetation unit has a **Moderate** sensitivity and value in terms of biodiversity conservation.

The remaining cover types, fallow lands and infrastructure have no value in terms of biodiversity or sensitivity and therefore their status is categorised as **Negligible** (Table 28).

5.3 Land-use planning and Decision-making

5.3.1 The use of CBA maps in Environmental Impact Assessments

Ideally, all land-users and people who make decisions about land and the use of natural resources should be aware of spatial biodiversity priorities and should know how to take these into consideration in their planning and decision-making processes. This is so that they can proactively identify the ecological opportunities and constraints within a landscape and use these to locate different land-uses appropriately (Cadman *et al.*, 2010).

Systematic biodiversity planning provides a powerful set of tools (maps and land-use guidelines) that facilitate this in a wide range of sectors, at both the policy-making and operational decision-making levels. The Mpumalanga Biodiversity Sector Plan represents the biodiversity sector's input into a wide range of planning and decision-making processes, frameworks and assessments in multiple land-use sectors (MBSP Handbook, Lötter *et al.* 2014).

Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems

The Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Tourism & Parks Agency, Mbombela (Nelspruit). provides maps of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the entire province, which is referred to as the CBA Map in the MBSP.

Critical Biodiversity Area (CBA) maps and their associated land-use guidelines are used to determine the biodiversity context of a proposed land-use site, ahead of making the first site visit. Although the CBA maps supply crucial guidelines for the assessment, additional background information is required to develop a broader understanding of the study area. A number of resources and tools are therefore used to establish how important the proposed development site is for meeting biodiversity targets. Specifically, the Land-Use Decision Support Tool (LUDS) and the Mpumalanga Biodiversity Sector Plan (MBSP) are extensively used to compile reports (BGIS, 2015). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level.

The conservation status of the SVl3 Granite Lowveld is "Vulnerable" with a target of 19%. It has been greatly transformed (20%), **mainly by cultivation and by settlement** development. (Mucina & Rutherford 2006).

The KMAE project area resides within the planning domain of the Mpumalanga Biodiversity Sector Plan, developed by the Mpumalanga Tourism and Parks Agency (MTPA). The potential impact of the development on Critical Biodiversity Areas should be considered in detail as these areas have been identified through systematic conservation planning exercises and represent biodiversity priority areas which should be maintained in a natural to near natural state in order to safeguard biodiversity patterns and ecological processes.

This report made use of the Mpumalanga Biodiversity Sector Plan (MBSP), which was founded on an extensive biodiversity database compiled over the years by the province's conservation biologists. These detailed records, together with the latest mapping and remote sensing data on vegetation, land use and water resources, have been combined and subjected to sophisticated analyses. For the finer components of a conservation plan, the MBSP maps were consulted and the detail added to the sensitivity assessment of the study area.

The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives. Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.

If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Its primary objective is to serve as a guide for biodiversity planning but should not replace specialist ecological assessments. To maintain an area in a 'natural' state, a variety of biodiversity-compatible land uses and resource uses should be followed.

The MBSP maps the distribution of the province's known biodiversity into seven categories. These are ranked according to ecological- and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The categories are:

- Protected areas - already protected and managed for conservation;
- Irreplaceable areas - no other options available to meet targets—protection crucial;
- Highly significant areas - protection needed, very limited choice for meeting targets;
- Important and necessary areas - protection needed, greater choice in meeting targets;
- Ecological corridors – mixed natural and transformed areas, identified for long term connectivity and biological movement;
- Areas of Least Concern – natural areas with most choices, including for development; and
- Areas with No Natural Habitat Remaining – transformed areas that make no contribution to meeting targets.

It must first be established how important the site is for meeting biodiversity targets. To do this, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives, e.g. is it in a CBA or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the MTPA requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

Table 29: The key results of the LUDS Report as extracted for the KMAE project area from national datasets available from BGIS.

National Data Set	Aspect	Present
National terrestrial information: Portions 8, 13 & 14 of the Farm Malelane Estate 140- JU in the Malalane area, Mpumalanga		
South African District	Ehlanzeni	
South African municipal boundaries	Municipality name: Nkomazi	MP324
Quarter-degree grid square		2531CB
Terrestrial CBAs		
Bioregion	**National vegetation map**	**Status**
Savanna Biome (Lowveld)	SVl3 Granite Lowveld	Vulnerable but moderately protected in South Africa.
Ecological Support Areas	Protected area buffer	Kruger National Park
Aquatic Critical Biodiversity Areas		
Water Management Area (WMA)	Inkomati WMA	
Sub Water Management Area	Crocodile Catchment	
NFEPA River	Crocodile River	3_P_L
		Lowveld Group 3_Channelled valley-bottom wetland
	Fish support area	Tigerfish
Ecoregion 1	Lowveld Ecoregion	3.07

5.3.2 Critical Biodiversity Areas

Overlaying the BGIS Critical Biodiversity Areas map onto the KMAE project area, resulted in the compilation of Figures 37 to 39 and Table 29. With reference to these maps and LUDS Report (Table 29) the project area falls into the following sensitive areas:

- Terrestrial:
  - Ecological Support Area: Protected area buffer
  - Vulnerable Ecosystem Status: Granite Lowveld – Vulnerable
- Aquatic:
  - NFEPA River: Crocodile River

With these landscape properties, it is paramount to approach the construction- and operation phases of the entire project with caution.

Ecological Support Areas: Those areas that play a significant role in supporting ecological functioning of Critical Biodiversity Areas and/or delivering ecosystem services, as determined in a systematic biodiversity plan.

A CBA map of the study area was compiled by using the Biodiversity Geographic Information System (BGIS) maps as illustrated in Figure 39. Every attempt should be made during all phases of the project development not to have an impact on these areas. While determining the area and distribution of a core habitat is important, it is equally important that appropriate management measures be defined to ensure the core habitat continues to function effectively.

The goal is to maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation: Design project layouts and select locations that minimise

loss and fragmentation of remaining natural habitat and maintain spatial components of ecological processes, especially in ecological corridors, buffers around wetlands, CBAs and ESAs. Activities that are proposed for CBAs must be consistent with the desired management objectives for these features and should not result in fragmentation.

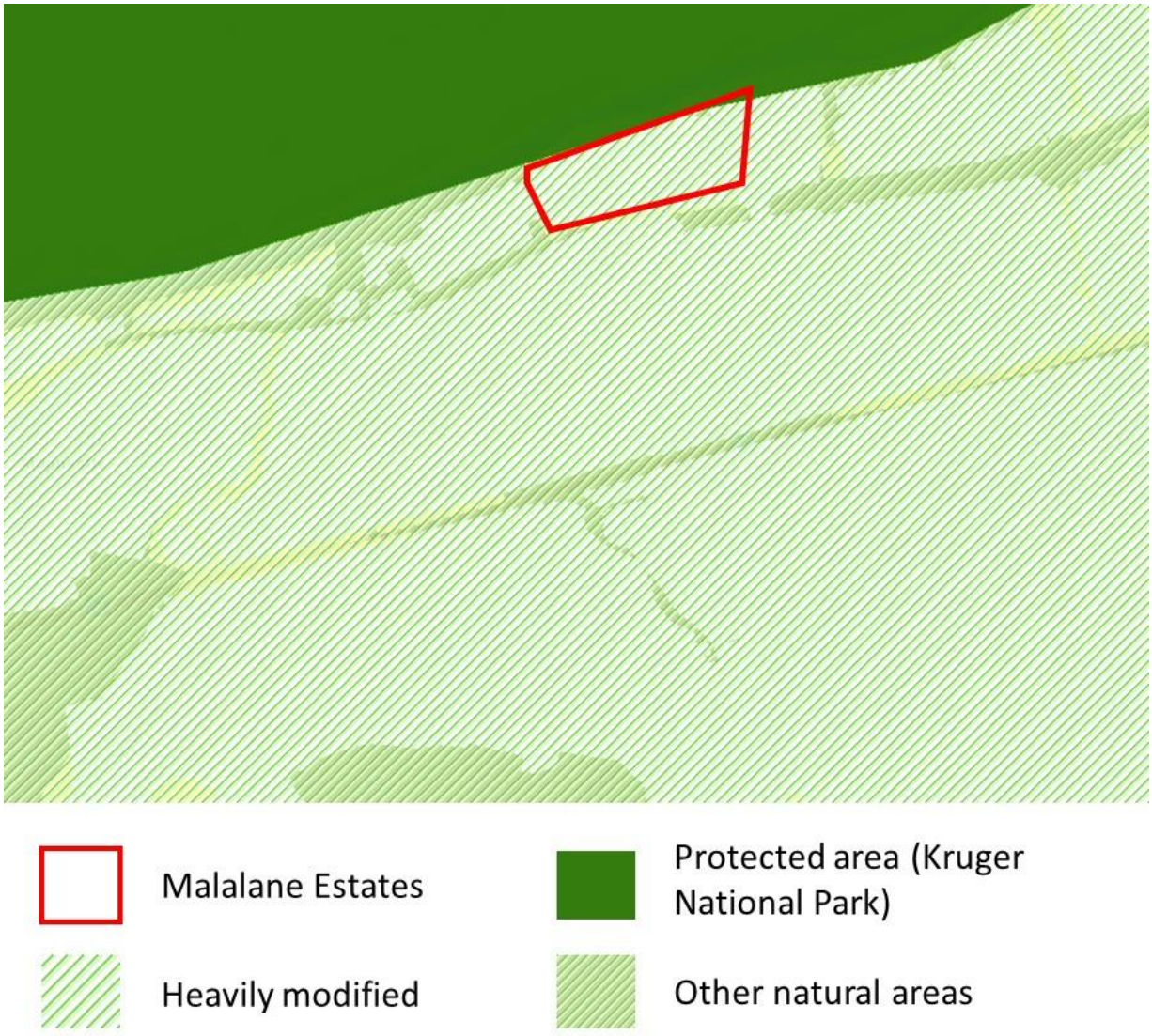


Figure 39: The Critical Biodiversity areas for the KMAE project area as illustrated by the LUDS programme (BGIS, 2015) for Mpumalanga.

Figure 23 illustrates the Present Ecological State of the project area as illustrated by the LUDS programme (BGIS, 2015) for Mpumalanga. It indicates the current and historically cultivated areas including the position of the proposed development.

Figure 40: The Terrestrial Critical Biodiversity areas for the KMAE project area, illustrating the ESA Protected Area Buffer around the Kruger National Park, as per the LUDS programme (BGIS, 2015) for Mpumalanga.

Figures 40 and 41 illustrate the Critical Biodiversity areas for the KMAE project area as compiled from the LUDS programme (BGIS, 2015) for Mpumalanga and it shows most of the area has been transformed by agriculture (“Heavily Modified”). But even so, the entire farm is situated in a Protected Area Buffer which is part of the delineated buffer (distance of 10 km) around National Parks, in this case the Kruger National Park.

As the KMAE project area is located in an Ecological Support Area (ESA Protected Area Buffer), the Desired Management Objectives are to minimise habitat and species loss through judicious planning and maintain basic ecosystem functionality and ecological condition within the surrounding landscape (sub-catchment).

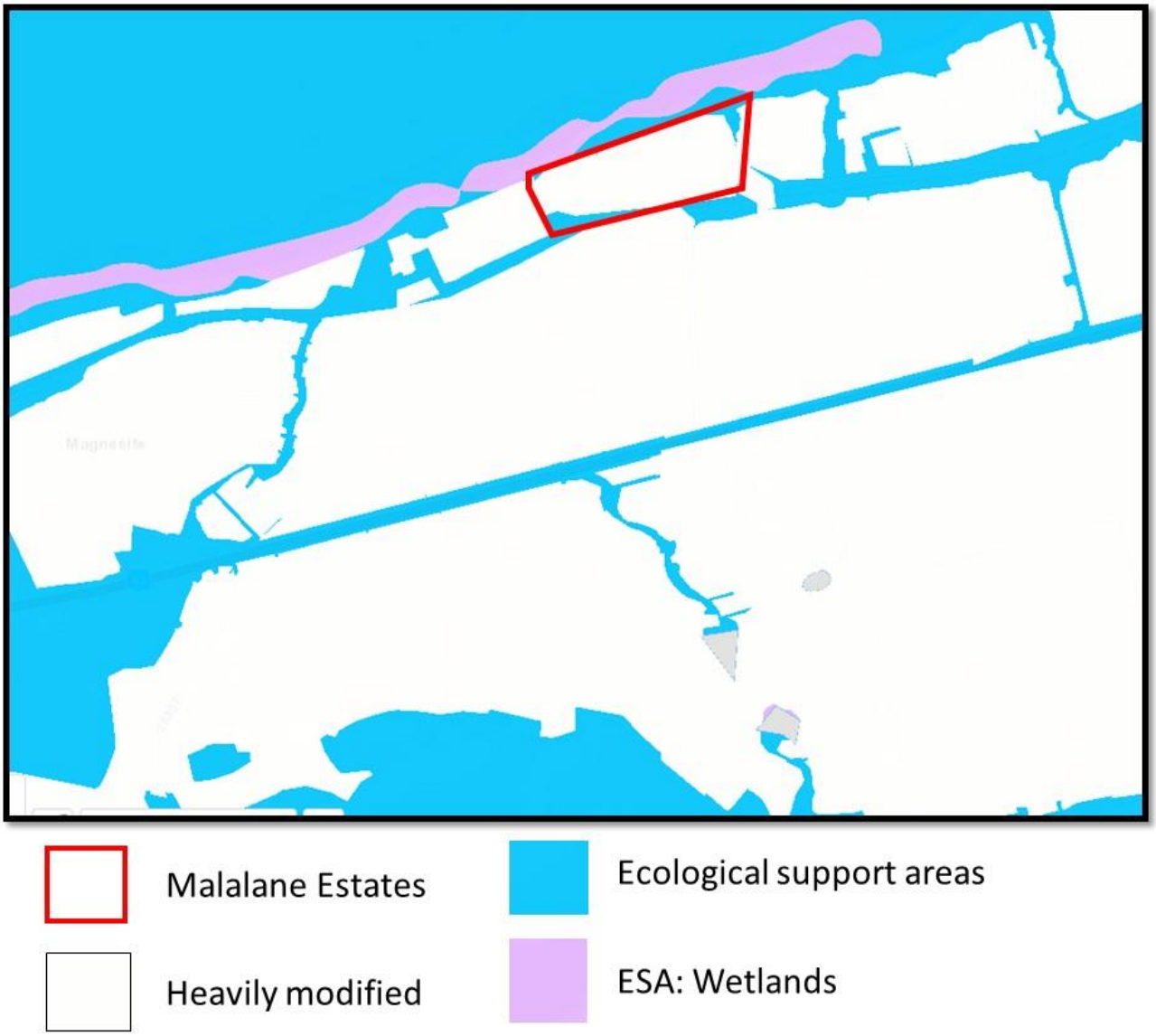


Figure 41: A map obtained from the 2014 Mpumalanga Biodiversity Sector Plan to indicate the Freshwater CBAs and ESAs in the project area, (red rectangle) (Mpumalanga Biodiversity Sector Plan, 2014).

Freshwater Ecosystem Priority Areas (FEPAs) are identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries. The Crocodile River which flows past the project area is a FEPA river (Figure 41).

5.3.3 Corridors for Connectivity

The guidelines for land-use practices or activities that impact on water quantity in freshwater CBAs includes: Generic buffers should be established around streams within these catchments. These buffers can be refined based on a site visit and applying the DWS's wetland delineation tool.

Due to their positioning adjacent to water bodies, buffer zones associated with streams and rivers will typically incorporate riparian habitat. Riparian habitat, as defined by the NWA, includes the physical structure and associated vegetation of the areas associated with a watercourse (Macfarlane et al, 2015). However, the riparian zone is not the only habitat type that is present in the buffer as the zone may also incorporate stream banks and terrestrial habitat, depending on the width of the aquatic impact buffer zone applied. Therefore, the riparian zone must be delineated before the buffer zone is established.

5.3.4 Riparian delineation

During the process of riparian delineation, five transects were surveyed. A transect runs from the outer edge of one riparian zone (left bank), through the drainage line to the outer edge of the other riparian zone (right bank). The results of the surveys are illustrated in Figures 31 and 32 in the previous section.

Riparian delineation and habitat evaluation was undertaken according to the DWAF Guidelines (2005) and DWAF updated manual (2008) (see Methods Section 2.1 Vegetation). Figures 43 and 44 illustrate the KMAE project area with the Crocodile River and the small unnamed stream riparian zones delineated. The delineation shapefiles are available as Appendices 6 to 11.

5.3.5 Buffer zones

Landscape connectivity may be achieved through several main types of habitat configurations that function as linkages for species, communities or ecological processes. Linkages are used as pathways by animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements and range expansion. Linkages also contribute to other ecological functions in the landscape and in particular, have an important role to play in providing habitat for plants and animals in human-dominated environments (Bennett, 2003).

The riparian zone along this reach of the Crocodile River and its tributaries classifies the river system as a CBA (refer to Section 5.3.1), and according to the Mpumalanga Biodiversity Sector Plan (2014), a buffer should be implemented around the delineated riparian area, measured from the top of bank. Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another.

Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity. These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Determining the required buffer width is largely an exercise of assessing the situation and linking it to an acceptable level of risk. Determining appropriate management measures for

aquatic impact buffer zones is largely dependent on the threats associated with the proposed activity adjacent to the water resource. These threats include:

- Increases in sedimentation and turbidity;
- Increased nutrient inputs;
- Increased inputs of toxic organic and heavy metal contaminants; and
- Pathogen inputs.

Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality. One of the important control measures listed above, is the buffer zone protecting the adjacent KMAE drainage systems. Buffer zones will serve as a mitigating measure for impacts created by the construction- and operational phases of the proposed KMAE development.

The implementation of a buffer zone to emphasise the importance of the riparian zone and adjacent dry land will certainly augment the importance of the ecology in the project area. The area included in the buffer zone, as well as the core areas in the riverine zone, should have explicit and very strict biodiversity conservation management measures and the operating teams should be well aware of this.

Site-based assessment: Desktop threat ratings are used as a starting point for buffer zone determination. While desktop threat ratings provide an indication of the level of threat posed by different land uses/activities, there is likely to be some level of variability between activities occurring within a sub-sector. It is therefore important that these threat ratings be reviewed based on specialist input and that a justification for any changes is documented in the Buffer Zone Tools.

Determine the Risk Posed by Proposed Activities on Water Resources

Once both threats posed by potential land uses/activities and the inherent sensitivity of receiving water resources have been assessed, this information is used to evaluate the risks posed by such activities on the water resource under consideration (Tables 31 and 33). Risk scores are calculated by multiplying threat and sensitivity scores to obtain a risk score for each impact type evaluated as illustrated in Table 30.

Table 30: Risk classes used in this assessment.

Risk Class	Risk Score	Description
Very low	<0.3	The proposed development/activity poses a very low risk to the water resource under investigation for the threat type assessed.
Low	0.3-0.5	The proposed development/activity poses a low risk to the water resource under investigation for the threat type assessed.
Moderate	0.51-0.7	The proposed development/activity poses a moderate risk to the water resource under investigation for the threat type assessed.
High	0.71-0.9	The proposed development/activity poses a high risk to the water resource under investigation for the threat type assessed.
Very high	>0.91	The proposed development/activity poses a very high risk to the water resource under investigation for the threat type assessed.

The sensitivity of water resources to lateral impacts is another factor affecting the level of risk posed by a development. A more risk-averse approach is therefore required when proposed developments take place adjacent to water resources that are sensitive to lateral impacts, as opposed to the same development taking place adjacent to a water resource which is inherently less sensitive to the impacts under consideration.

There are two stream systems to be delineated on the KMAE project area. The Crocodile River and a small unnamed drainage area that drains a catchment area from the south (mostly developed as sugar cane fields). This little stream seems perennial due to constant flows, but the water supply is most probably kept perennial due to irrigation return flows.

The Crocodile River section adjacent to the proposed development, is mostly devoid of woody vegetation. Due to this, no recognisable riparian zone could be delineated. In the case where no clear riparian zone is present, buffers should be delineated from the edge of the macro channel bank (Figure 1).

The active channel is the portion of a river that is inundated at sufficiently regular intervals to maintain channel form (i.e. the presence of distinct bed and banks) and to keep the channel free of established terrestrial vegetation. Active channels are typically filled to capacity during bankfull discharge (i.e. during the annual flood).

The riparian zone or riparian area of a river is the portion of land directly adjacent to the active channel (i.e. on the banks of the river), which is influenced by river-induced or river-related processes. These areas are commonly characterised by alluvial soils and by vegetation that is distinct from that of adjacent land areas in terms of its composition and physical structure. The riparian zone of a river is typically located between the outside edge of the active channel and the outside edge of the macro-channel.

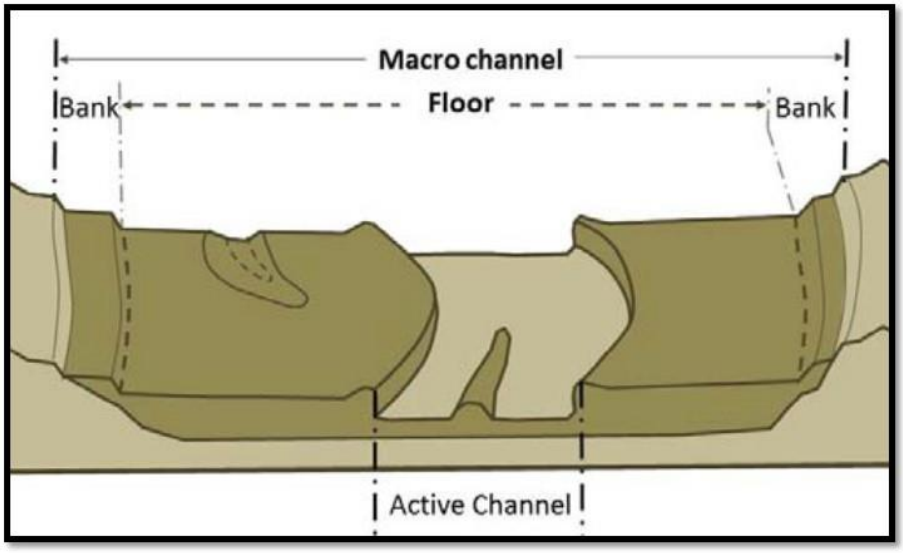


Figure 42: Guidance for a Buffer Zone Delineation: Buffer delineated from edge of macro channel floor (Macfarlane and Bredin, 2017).

The small unnamed tributary to the east of the project area, is a narrow stream (1-2m wide) confined to a steep V-shaped valley (3 - 7m deep). A few scattered large trees are present on the embankment, some of them terrestrial species, indicating that the stream was not always perennial. True riparian trees is limited to:

- Natal mahogany – 2 trees
- Sycamore figs – 6 trees
- Pigeonwood – 1 tree

All indications are there that this system never had an extensive riparian zone. Currently the stream channel is completely overgrown with the alien invasive Spanish reed. Should all the invasive vegetation be removed, the riverine environment will consist of the narrow stream bed and a few scattered riparian trees. Therefore, it was decided to implement the aquatic buffer from the edge of the active channel.

The aspects utilised to establish the KMAE project area riparian buffer zones for the Crocodile River and the small unnamed tributary, are listed in Tables 31 and 33.

Crocodile River buffer

Table 31: Site-based tool: Determination of buffer zone requirements for the Crocodile River.

Site-based tool: Determination of buffer zone requirements for the Crocodile River.	
Name of Assessor	Dr AR Deacon
Project details	KMAE project area
Date of Assessment	12/12/2020
Level of Assessment	Site-based
Approach used to delineate the riparian zone & active channel?	Site-based delineation
River type	Lowland river
Present Ecological State	“D” Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
Ecological importance & sensitivity	High: Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They typically play an important role in providing ecological services at the local scale.
Management Objective	Maintain status.
Sector	Residential: Provides for land and buildings for a variety of housing types, ranging from areas that are almost entirely residential to those areas having a mix of other compatible land uses, where the predominant land use is residential.
Sub-sector	Resort: Accommodation in the form of lodges, bush camps, cultural villages and bed and breakfast establishments within a rural setting.
MAP Class	801 – 1000mm
Rainfall intensity	Zone 4
Stream order	5th order
Channel width	>20m
Perenniality	Perennial system (>9 months)

Average slope of rivers catchment	3%
Inherent runoff potential of the soil in the river's catchment	Low (A & A/B)
Longitudinal river zonation	Lowland river
Inherent erosion potential (K-factor) of catchment soils	0.25-0.50
Retention time	Generally free flowing
Inherent level of nutrients in the landscape	Moderate base status
Inherent buffering capacity	Neutral pH
Natural salinity levels	Non-saline (<200mS/m)
River depth to width ratio	>0.25
Mean annual temperature	Zone 5 (19.5 - 24.2^0 C)
Level of domestic, livestock and contact recreational use	Moderately low
Buffer attributes	
Slope of the buffer	Gentle (2.1 - 10%)
Vegetation characteristics (Construction phase)	Very poor: Vegetation either very short (<2cm) offering little resistance to flow or sparse and providing poor interception (e.g. degraded grasslands with very poor basal cover).
Vegetation characteristics (Operational phase)	Good: Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands).
Soil permeability	Moderately low: Deep moderately fine textured soils (e.g. loam & sandy clay loam) OR shallow (<30cm) moderately drained soil.
Micro-topography of the buffer zone	Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception.
Additional mitigation measures to consider	
3. Increase in sediment inputs & turbidity	Manage storm water and prevent any sediment to enter the drainage line
Final aquatic impact buffer requirement	
Construction Phase	**20m**
Operational Phase	**23m**

Identify Additional Mitigation Measures Where Appropriate and Refine the Aquatic Impact Buffer Width Accordingly.

Where appropriate, identify additional mitigation measures and refine aquatic impact buffer width accordingly (Tables 32 and 34). Although buffer zones are advocated as standard mitigation measure to address a range of threats, they are only one of a suite of mitigation measures that can be used to reduce potential impacts. Pollution prevention, on-site mitigation (such as water treatment/water reuse and reclamation) and effective storm water management controls are regarded as critical for effective mitigation instead of simply relying on buffer zones as a last form of defence. An opportunity is therefore provided for the assessor to identify suitable supplementary mitigation measures that will reduce the threats posed by the development/activities and in so doing, reduce associated buffer zone requirements.

Table 32: Revised aquatic impact buffer requirements (including additional mitigation measures) – Crocodile River:

Threat posed by the proposed land use activity	**Specialist threat rating**	**Specialist justification for refined threat ratings**
Increase in sediment input and turbidity	Low	Manage storm water and prevent any sediment to enter the drainage line
Increased nutrient input	Low	Make use of Best Practice Guidelines and Specifications (re agricultural fertilisers).

Storm water management is a critical element of urban planning. Without appropriate planning and management, storm water can have significant impact on water resources. However, carefully designed and managed buffer zones can contribute to a highly effective storm water management system.

Final aquatic impact buffer requirements (including practical management considerations) for the Crocodile River:

- Construction Phase: 20 m
- Operational Phase: 23 m
- Final aquatic impact buffer requirement: 23 m

The final buffer zone requirements are not only dictated by requirements for minimising impacts of pollutants on the water resource. No development is typically permitted within the water resource boundary. Therefore, final buffer zone requirements are effectively determined by the maximum distance of the water resource boundary (including riparian habitat), or the aquatic impact buffer zone required to protect the water resource.

Unnamed tributary to the Crocodile River

Table 33: Site-based tool: Determination of buffer zone requirements for the small unnamed tributary to the Crocodile River.

Site-based tool: Determination of buffer zone requirements for river systems.	
Name of Assessor	Dr AR Deacon
Project details	KMAE project area
Date of Assessment	12/12/2020
Level of Assessment	Site-based
Approach used to delineate the riparian zone & active channel?	Site-based delineation
River type	Lowland river
Present Ecological State	"E" Seriously modified.
Ecological importance & sensitivity	Low: Features are not ecologically important and sensitive at any scale. The biodiversity of these areas is typically ubiquitous with low sensitivity to anthropogenic disturbances and play an insignificant role in providing ecological services.
Management Objective	Maintain status.
Sector	Residential
Sub-sector	Residential low impact
MAP Class	801 – 1000mm
Rainfall intensity	Zone 4
Stream order	4th order
Channel width	<1m
Perenniality	Seasonal system (3-9 months)
Average slope of rivers catchment	3%
Inherent runoff potential of the soil in the river's catchment	Low (A & A/B)
Longitudinal river zonation	Lowland river
Inherent erosion potential (K-factor) of catchment soils	0.25-0.50
Retention time	Generally slow moving
Inherent level of nutrients in the landscape	Moderate base status
Inherent buffering capacity	Neutral pH
Natural salinity levels	Non-saline (<200mS/m)
River depth to width ratio	0.25 – 0.75
Mean annual temperature	Zone 5 (19.5 - 24.2^{0} C)
Level of domestic, livestock and contact recreational use	Moderately low
Buffer attributes	
Slope of the buffer	Gentle (2.1 - 10%)
Vegetation characteristics (Construction phase)	Very poor: Vegetation either very short (<2cm) offering little resistance to flow or sparse and providing poor interception (e.g. degraded grasslands with very poor basal cover).
Vegetation characteristics (Operational phase)	Poor: Vegetation either short (<5cm) (e.g. maintained lawns) or robust but widely spaced plants with poor interception (e.g. trees or shrubs with poorly vegetated understory).

Soil permeability	Moderately low: Deep moderately fine textured soils (e.g. loam & sandy clay loam) OR shallow (<30cm) moderately drained soil.
Micro-topography of the buffer zone	Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception.
Additional mitigation measures to consider	
3. Increase in sediment inputs & turbidity	Prevent any sediment to enter the drainage line
Final aquatic impact buffer requirement	
Construction Phase	**10m**
Operational Phase	**10m**

Identify Additional Mitigation Measures Where Appropriate and Refine the Aquatic Impact Buffer Width Accordingly.

An opportunity is provided for the assessor to identify suitable supplementary mitigation measures that will reduce the threats posed by the development/activities and in so doing, reduce associated buffer zone requirements.

Table 34: Revised aquatic impact buffer requirements (including additional mitigation measures) - Unnamed tributary:

Threat posed by the proposed land use activity	**Specialist threat rating**	**Specialist justification for refined threat ratings**
Increase in sediment input and turbidity	Very Low	Mitigation and management measures are to be specified in order to ensure that areas susceptible to potential erosion are protected both during the construction and operational phase of the development.
Increased nutrient input	Very Low	Make use of Best Practice Guidelines and Specifications (re agricultural fertilisers and sewerage systems). Refrain from releasing grey water into the stream.

Final aquatic impact buffer requirements (including practical management considerations) for the small stream:

- Construction Phase: 10 m
- Operational Phase: 10 m
- Final aquatic impact buffer requirement: 10 m

Figure 43: The 10m riverine buffer zones of the unnamed tributary to the east of the proposed development

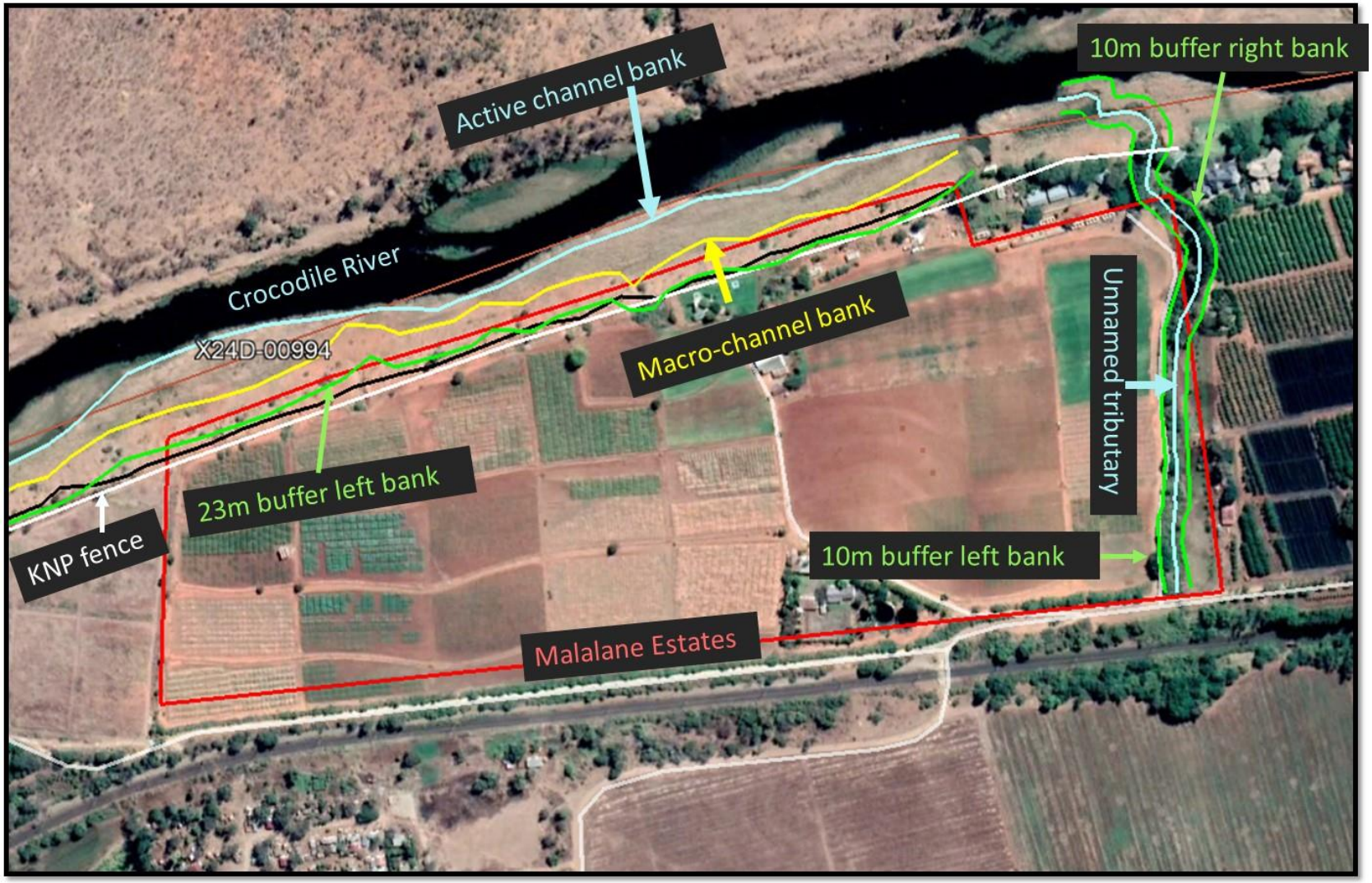


Figure 44: The KMAE project area lay-out, illustrating the stream morphology and riverine buffer zones of the Crocodile River and the unnamed tributary to the east of the proposed development.

5.3.6 Land-use guidelines

The following section outlines land-use activity descriptions and it includes a summary of the circumstances under which any of these land-use activities can be regarded as biodiversity compatible and outlines additional biodiversity-related management practices and controls.

Maintaining biodiversity patterns and ecological processes and the ecosystem services derived from these, requires integrated management over large areas of land. Although a system of well-managed, strategically located protected areas is the most secure long-term strategy for conserving biodiversity, it is generally acknowledged that protected areas alone will never be adequate to conserve a representative sample of biodiversity and maintain ecosystem functioning – it is both impractical and undesirable to secure all biodiversity priority sites through formal protection, protected areas can be expensive to establish and manage and carry high opportunity costs. It is also difficult to conserve ecological processes in isolated protected areas alone.

There remains a need to safeguard biodiversity beyond the boundaries of protected areas to maintain the integrity of ecosystems across broader landscapes and for all who live and work in these landscapes to play a part in managing them sustainably. This is the essence of the 'landscape approach' to conservation, in which protected areas are embedded in a matrix of land-uses that strives for biodiversity compatibility and in which biodiversity management objectives are integrated into the plans, decisions and practices of a wide range of land users. These land-use guidelines are designed to help achieve this.

In broad terms, the biodiversity priority areas need to be maintained in a healthy and functioning condition, whilst those that are less important for biodiversity can be used for a variety of other land-use types (Lötter et al, 2014).

Table 35: The different categories on the CBA maps have specific management objectives, according to their biodiversity priority (MBSP Handbook 2014).

Map Category	**Definition**	**Desired management objectives**
Critical Biodiversity Areas (CBAs)	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
Ecological Support Areas (ESAs)	Areas that are not essential from meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.
ESA: Protected Area Buffer	A buffer distance of either 10 km for National Parks; 5 km for all other PAs; and 1 km for Protected Environments.	Maintain or improve ecological and tourism functionality of a PA, ensuring none of the PA objectives are compromised by activities or land-use changes in the buffer zone.
Other Natural Areas (ONAs)	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some

	biodiversity, they are still an important part of the natural ecosystem.	authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

5.3.7 Desired Management Objective

The following section outlines land-use activity descriptions and it includes a summary of the circumstances under which any of these land-use activities can be regarded as biodiversity compatible and outlines additional biodiversity-related management practices and controls.

Tables 36 summarises the final permissible land-uses that are proposed for the identified landforms on the KMAE project area. The demarcated map is found in Figures 39 to 41. The area is listed and rated as follows:

Critical Biodiversity Areas (CBAs): ESA Protected Area Buffer (KNP)

ESA: Protected Area Buffers are areas around protected areas where changes in land-use may affect the ecological functioning or tourism potential of the adjacent protected area. The purpose of buffer zones is to reduce the impacts of undesirable land-uses on the environment, and to provide opportunities for tourism.

Modification of the natural habitat within the buffer zones may have negative impacts on the zonation and management plan of the adjacent protected area. Only low-impact, biodiversity-sensitive land-uses are appropriate.

Table 36: Permissible land-uses that are set for the identified landforms on the KMAE project area.

Permissible land-uses that are unlikely to compromise the biodiversity objective.	Land-uses that may compromise the biodiversity objective and that are only permissible under certain conditions.	Land-uses that will compromise the biodiversity objective and are not permissible.
Livestock & Game Ranching	Arable Lands	Residential
Conservation / Stewardship	Agricultural Infrastructure	Urban Influence
Open Space	Forestry	Low Impact & General Industry
Low Impact Tourism	Municipal Commonage	High Impact Industry
Eco-estates	High Impact Tourism	Quarrying / Opencast Mining
	Rural Residential	
	Roads & Rail	
	Water Works, Sewerage Works, Catchment Transfers	
	Prospecting / Underground Mining	
	Transport Services	
	Linear Structures: Pipelines, Canals, Power lines	
	Other Utilities	

CBAs and listed activities in terms of the EIA Regulations.

Depending on specific activities, CBAs (and ESAs) trigger the need for basic assessments in terms of the EIA regulations, and should inform the development of Terms of Reference for the biodiversity specialists appointed in the EIA process.

The specific activities requiring an environmental authorisation are listed in three notices, reflected in Government Notice R 544, R 545 and R546, as follows:

Listing Notice 1: This states that a Basic Assessment (BA) is required for those activities with known impacts that can be avoided or reduced.
Listing Notice 2: This refers to activities with unknown impacts that require specialist studies to be worked out. Such activities require a comprehensive scoping/environmental impact assessment.
Listing Notice 3: This applies to activities in sensitive geographic areas, requiring a basic assessment and environmental authorisation before commencement of any land-use activity.
In Mpumalanga, these sensitive geographic areas are CBAs and ESAs as defined in the MBSP.

The activities covered by all three of these listing notices conflict with the desired management objective for CBAs.

Protected area buffers

When assessing the impacts of proposed land uses in protected area buffers, consideration needs to be given to both direct (e.g. plantation forestry blocking view-sheds and reducing water flows into a Protected Area) and indirect impacts (e.g. light and noise pollution).

Land-use change applications within the buffer zone may be referred to the protected area manager or ecologist for evaluation. The fact that the land use change only involves the development of the front portion of the demarcated project area, and the change is in line with the permissible land-uses as listed in Table 36 under “Permissible land-uses that are unlikely to compromise the biodiversity objective”, which is Low Impact Tourism and Eco-estates.

A viewshed analysis of the potential visual impact of the proposed land-use on adjacent protected areas should be undertaken where necessary. In the case of this project, a viewshed analysis was done and will be added to the final EIA report.

5.4 Assessment of impacts

The potential impacts of the project on the biodiversity of the study area are assessed under the following broad categories, namely:

Activity 1. Construction of the lifestyle units.
- 1.1 Storm water and erosion/siltation
- 1.2 Pollution
  - 1.2.1 Sewerage
  - 1.2.2 Hazardous substances associated with construction activities
  - 1.2.3 Solid waste

Activity 2. Construction of a dam in an unnamed drainage line.
- 2.1 Inundation of the stream
- 2.2 Migration barrier

Activity 3. Establishment of the orchards
- 3.1 Storm water and erosion/siltation

Activity 4. Human wildlife conflict – fences, elephants and orchards; scavenging; lighting, etc.

Activity 5. Alien invasive vegetation.

The impact assessment of all the perceived impacts provided below, describes each broad impact, determines the significance of the impact and lists summarised mitigation- and monitoring measures for each impact.

Activity 1: Construction of the lifestyle units.

Impact 1.1: Stormwater and erosion/siltation

Applicable Phase: Construction- and Operational phase.

Applicable activity: Surface flows from residential areas will be released as stormwater into the receiving environment, which may cause erosion and siltation

Nature of impact: A development, such as the KMAE development implies that areas of natural vegetation are replaced with housing units, roads, and other forms of impervious surfaces in the residential areas. The effect of this is that water runs from the new hard ground surfaces and enters streams or watercourses in greater volumes and over a shorter period of time. However, the KMAE development can be considered as a very low density development which directly implies that runoff will not increase impermeable areas significantly.

Mitigation of Impact 1.1:

Mitigation Description: Modern stormwater management practices are aimed at considering stormwater as part of the water cycle, a strategy which is increasingly being known as Water Sensitive Urban Design (WSUD) with the stormwater management component being known as Sustainable Drainage Systems (SuDS). A number SuDS options are available and for this development Source and Local controls will be implemented for both the agriculture and the residential areas (ConSolv, 2020).

Source Controls include the following and are normally specified by the estate architect as part of the Architectural Guidelines for the development:

- Rainwater Harvesting refers to the temporary storage and reuse of rooftop and/or surface runoff.

- Soakaways are usually excavated pits that are packed with coarse aggregate and other porous media and are used to detain and infiltrate stormwater runoff from a single source.
- Permeable pavements consist of load bearing, durable and pervious surfaces such as concrete block pavers (CBPs) on top of a granular or stone base that can temporarily store stormwater runoff.

Local Controls include the following and

- Filter strips are vegetated areas of land that are used to manage shallow overland stormwater runoff through filtration;
- Swales are shallow grass-lined channels with flat and sloped sides that are used to convey stormwater from one place to another. They typically remain dry between rainfall events;
- Infiltration trenches are excavated trenches which are lined with a geotextile and backfilled with rock or other relatively large granular material. They are typically designed to receive stormwater runoff from adjoining residential properties;
- Rio-retention areas are landscaped depressions used to manage stormwater runoff through several natural processes such as filtration, adsorption, biological uptake and sedimentation.

Certainly not all of these examples of controls will be installed at each unit, but a mix of most appropriate controls should be considered to prevent any further damage to the receiving environment (the KNP in this case).

It is proposed that soakaways be used within the residential sites to lessen the impact of runoff from the roofs combined with permeable paving, both source control measures. Another source control which could be considered is rainwater harvesting (ConSolv, 2020). It is further proposed that swales be constructed adjacent to all the access roads as the primary local control. See the detail of a standard vegetated swale in Figure 45 below:

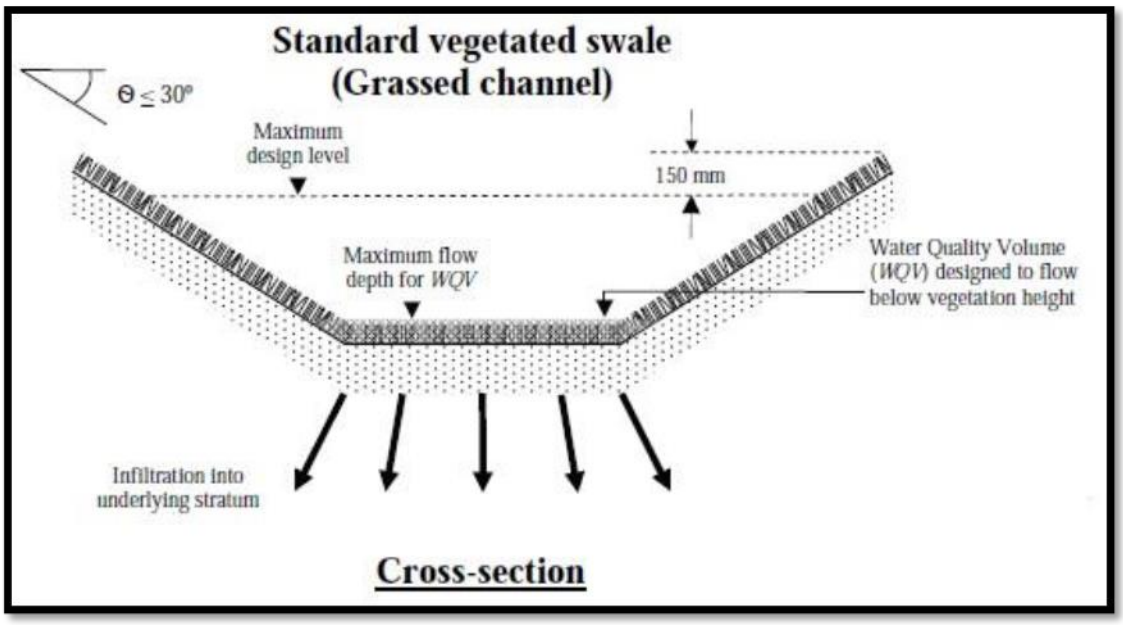


Figure 45: Detail of a standard vegetated swale.

Should water be channelled in any event from the property, it is suggested that the water should be slowed down before it reaches the KNP fence/boundary with a slowdown system such as infiltration trenches.

It is envisaged that the current open, erosion prone fallow lands will rapidly be transformed into lush gardens of local indigenous vegetation as soon as construction is completed. Some indigenous trees have already been planted as part of the initial rehabilitation. These gardens will each act as slowdown systems for stormwater generated by paved surfaces and roofs on the unit.

Table 37: Impact Rating of Activity 1.1: Stormwater flows resulting in erosion and siltation.

ISSUE:	Stormwater flows - erosion and siltation.
Project Phase	**Construction and Operational**
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very low (3)
Probability	Improbable
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Medium

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 1.2 Pollution

1.2.1 Sewerage

Applicable Phase: Operational phase.

Applicable activity: Wastewater treatment.

Nature of impact: Poorly maintained septic tanks can result in nutrient-rich runoff being discharged. These waste waters create unfavourable conditions for natural vegetation and encourage growth of weeds. When nutrients such as nitrogen and phosphorus are discharged from septic systems into the groundwater, they represent a potentially important nonpoint source of pollution to the Crocodile River.

This could also negatively affect the unnamed watercourse on the eastern boundary due to inter alia inadequately treated effluent, a risk associated with the passive biological treatment process of septic tanks.

Mitigation of Impact 1.2.1:

Mitigation Description: In order to improve the level of wastewater treatment at the Waste Water Treatment Works (WWTW) and minimise the 'amount of disease organisms, nutrients, and chemicals that enter ground and surface waters, the system must be in proper working order, follow simple maintenance procedures, and conserve water.

A waterborne sewerage system will thus be installed with a Maskam Fusion WWTW package which will be situated centrally, at this stage on proposed Portion 20. The outflow from this system will conform to General Standards and will be used for irrigation of the Macadamia orchards. One pump station (situated on proposed portion 19) will feed the WWTW.

All the sewerage from the reticulated sites within the development will be treated at the treatment plant. The Waste Water Treatment Plant will be constructed next to the water treatment plant and the treated water will be used for irrigation. The treated effluent will comply with the general standards required by the Department of Water and Sanitation and will be of such quality that the treated water can be used for irrigation purposes.

The project area drains towards the north-east, and the lowest point is next to the Crocodile River. It is proposed that the sewer lines be placed outside the riparian buffer. No reticulation lines will be constructed within the 1:100-year flood line and one sewer pump station will be required to pump sewer to the proposed sewer treatment plant. The total Annual Average Dry Weather Sewerage Flow is estimated at 21.66 kl/day. It is recommended that some spare capacity in the sewerage treatment plant be provided to cater for storm water ingress.

Table 38: Impact Rating of Activity 1.2.1: Sewerage - Wastewater treatment.

ISSUE:	Sewerage - Wastewater treatment.
Project Phase	**Operational**
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Medium

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

1.2.2 Hazardous substances associated with construction activities

Applicable Phase: Construction phase.

Applicable activity: Alterations to water quality due to pollution from hazardous chemicals released through effluents, storm water runoff or accidental spillages from the project area into the receiving aquatic environment.

Nature of impact: Oil, fuel, lime-containing (high pH) construction materials (concrete, cement and grouts), and chemicals such as hydrocarbons, PCB's, carbonaceous sediments, flushed-out pesticides, house-hold detergents.

A range of hazardous chemicals, some of which are lethal to in-stream biota (fish and invertebrates) could contaminate the watercourses during various stages of this project if due precautions are not taken. Hazardous chemicals can leak or be accidentally spilled by construction vehicles during construction and might contaminate the soil, ground water and receiving wetlands. It is essential to prevent pollution of the waters of the Kruger National Park and the resulting poisoning of fish, birds and other animals.

Mitigation of Impact 1.2.2:

Mitigation Description: The buffers for the water courses as assessed with the DWS buffer tool must be implemented between the development and surrounding environment. These buffers around the riparian zones and wetlands were calculated as follows:

- Crocodile River: 23m wide
- Small stream on the eastern boundary (valley bottom wetland): 10m wide

These buffers will protect the riverine area from the following potential sources of pollution:

- Construction camps, storage areas, soil stockpile areas and laydown areas must be located outside the riparian or wetland buffer zones.
- Prohibit the dumping of waste material within the riparian or wetland buffer zones. Spoil material must be appropriately disposed of at a registered waste disposal facility.
- Portable toilets must be located outside the riparian or wetland buffer zones.

The following issues relating to potential pollution of the watercourses and wetlands should be addressed by the management:

- Fuel storage and engine fuel - leakage and spillage.
- Hazardous substances storage and handling of these substances.
- Servicing and/or repairs of construction equipment on site.
- Mixing of cement within the construction footprint.
- An emergency protocol and accidental spill response equipment.
- Stockpiling of construction materials.
- Approved insecticides.
- Ablution facilities.

Table 39: Impact Rating of Activity 1.2.2: Hazardous substances.

ISSUE:	Hazardous substances.
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very low (3)
Probability	Improbable
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Medium

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

1.2.3 Solid waste

Applicable Phase: Construction and Operational phases.

Applicable activity: Solid waste disposal and management.

Nature of impact: Improper solid waste disposal and management causes all types of pollution: air, soil, and water. Uncontrolled burning of solid waste and improper incineration contributes significantly to urban air pollution.

Health and safety issues also arise from improper solid waste management. Insect and rodent vectors are attracted to the waste and can spread diseases. The availability of household trash can alter the composition of wildlife communities by providing food for animal populations that thrive on trash (such as rats, baboons and monkeys) to the detriment of those that do not, e.g. small mammals and birds.

Mitigation of Impact 1.2.3:

Mitigation Description: Refuse removal will be provided by the KMAE Management. Waste will be collected weekly by the Nkomazi Municipality.

It is proposed that solid waste be taken daily in municipal refuse bags to a holding facility at the entrance gate to the development. A surfaced area with screening walls will be constructed at the entrance gate to accommodate a number of “skips”. The holding facility must be constructed with brick and concrete. The facility will include a concrete floor, washing and drainage facilities.

Table 40: Impact Rating of Activity 1.2.3: Solid waste.

ISSUE:	Solid waste.
Project Phase	Construction and Operational phases
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very low (3)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Medium

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Activity 2. Construction of a dam in an unnamed drainage line.

2.1 Inundation of the stream

Applicable Phase: Construction phase.

Applicable activity: Drowning of a section of the riparian zone.

Nature of impact: This impact refers to the permanent loss of untransformed habitat, especially the interruption of the riparian corridor.

Mitigation of Impact 2.1:

Mitigation Description: Very little mitigation will be available during the flooding of the riparian zone. Establish a 10m buffer zone around the full-water mark and replant some of the key riparian tree species from the basin onto the dam margin border.

Currently there are some intact riparian zones upstream and downstream of the proposed dam basin along the stream banks of the drainage line. The riparian zone of the designated drainage line should be protected and excluded from any further development in order to maintain the integrity of the remaining riparian corridor. In order to protect this remaining riparian zone, a 10m buffer had been established with the DWS Buffer Tool.

In order to re-establish the link between the riparian corridors upstream and downstream of the dam basin, a riparian buffer should also be established along the new marginal zone around the dam.

Table 41: Impact Rating of Activity 2.1: Drowning of the riparian zone.

ISSUE:	Drowning of the riparian zone
Project Phase	Construction phase
Nature	Negative
Extent	Site (1)
Intensity	Moderate (2)
Duration	Long term (3)
Consequence	Medium (6)
Probability	Definite
Degree to which impact cannot be reversed	Moderate
Degree to which Impact may cause irreplaceable loss of resources	Moderate
Confidence level	High
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Medium (-ve)**
Degree of Mitigation	Medium

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.

2.2 Migration barrier

Applicable Phase: Operational phase.

Applicable activity: Dams prevent the free passage of aquatic animals and fish and thus disrupt riverine migration routes.

Nature of impact: The disruption of migratory routes affects the lifecycle of migratory aquatic species as dam barriers and prevent brood stock from reaching their spawning grounds during the breeding season, resulting in a failure of recruitment and eventual extinction of the stock above the dam.

Mitigation of Impact 2.2

Mitigation Description: The catchment area is small and 90% transformed (sugar cane fields). Only approximately 650m of transformed and artificially created river is available for utilisation (negligible).

Potentially, as fish may be attracted to migrate upstream and after spending energy to cross the barrier (potential fishway), there is no to limited suitable habitat available upstream. The proposed dam may furthermore create suitable habitat (pool) for colonization of high abundance of predatory sharptooth catfish (and potential other unwanted species such as alien largemouth bass). These species will prey on and potentially eradicate all small and juvenile fish species that may enter the dam.

An assessment as to the necessity for providing a fishway at the said barrier (bridge-dam) was completed by Dr Pieter Kotze (Kotze, 2021). Based on the results of this assessment, it was concluded that a fishway will add little, if any ecological benefit at the proposed dam site and therefore no fishway is required for installation at the proposed dam. This recommendation is based on ecological considerations.

Table 42: Impact Rating of Activity 2.2: Dams prevent the free passage of aquatic animals and fish, and thus disrupt riverine migration routes.

ISSUE:	The disruption of migratory routes
Project Phase	**Operational**
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Long term (3)
Consequence	Low (5)
Probability	Improbable
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.

Activity 3. Establishment of the orchards

3.1 Storm water and erosion/siltation

Applicable Phase: Construction- and Operational phases.

Applicable activity: Erosion and siltation due to channelled and thus concentrated stormwater deriving from the orchards.

Nature of impact: Whether the stormwater arrives via non-point sources or via storm-water systems, it inevitably discharges directly to the receiving waters without any prior treatment. Even moderate runoff volumes and velocities give rise to a wide variety of water quality problems that are linked to flooding and wash-off. The typical categories of problems that arise are sedimentation, erosion (channel widening and streambed alteration) and habitat changes, as well as loss of aquatic- or riparian habitats.

Referring to Figure 46 (as well as Figure 15), it is clear, that historical land uses resulted in concentrated stormwater channelling between croplands and where this channelled water was released on the other side of the KNP fence, visible erosion took place, leaving the scars of erosion dongas on the floodplain.

Figure 46: The scars of erosion dongas left by historical stormwater channelling between croplands.

It is also clear by the colour of the soil below the property on the KNP side of the fence (Figure 46), that sheet erosion through the years transported a great deal of soil from the agricultural lands into the Park.

Both the loss of good agricultural soil and the deposition of washed-out alluvial sediment into the KNP must be considered a significant adverse impact. Perhaps the change of vegetation cover from 2006 to 2020 may even be a result of the silt deposition in the Park?

Mitigation of Impact 3.1:

Mitigation Description: Proper storm water management is essential to ensure protection of life and property from flood hazards and that the natural environment is protected. Storm water drainage systems will be designed to accommodate a 1:2-year flood frequency.

The objectives of storm water management can be summarised as follow:

- to provide a storm water drainage system for the protection of the property from damage by runoff from frequent storms;
- to prevent loss of life and reduce damage of the property from severe storms;
- to prevent land and watercourse erosion;
- to protect water resources from pollution;
- to preserve natural watercourses and their eco-systems;
- to achieve the foregoing objectives at optimal total cost.

The storm water channels and structures will be designed for a 1:2-year storm recurrence, except at the piped crossings where a 1:5 year storm recurrence is catered for. The infrastructure will be located within the road servitudes.

The introduction of efficient stormwater drainage systems to deal with the erosion and siltation problem implies that the runoff must be conveyed as efficiently as possible to the natural watercourses. This has the effect of decreasing the time runoff takes to reach the natural watercourses. The result is a reduction of overland flow, meandering watercourses and the like, through a system which drains runoff to the watercourses as quickly as possible. The flood problem is therefore transferred downstream.

It is suggested that Best Practice Guidelines and Specifications relating to stormwater management should be used to implement measures to slow down flows channelled through the orchards, right from where the orchards start at the southern boundary.

Figure 47 illustrates the layout of the proposed stormwater servitudes in the project area. It is clear that this system will mainly serve the agricultural stormwater emanating from the orchards. It therefore comes down to the fact that each residential unit must be able to manage the stormwater on its own property.

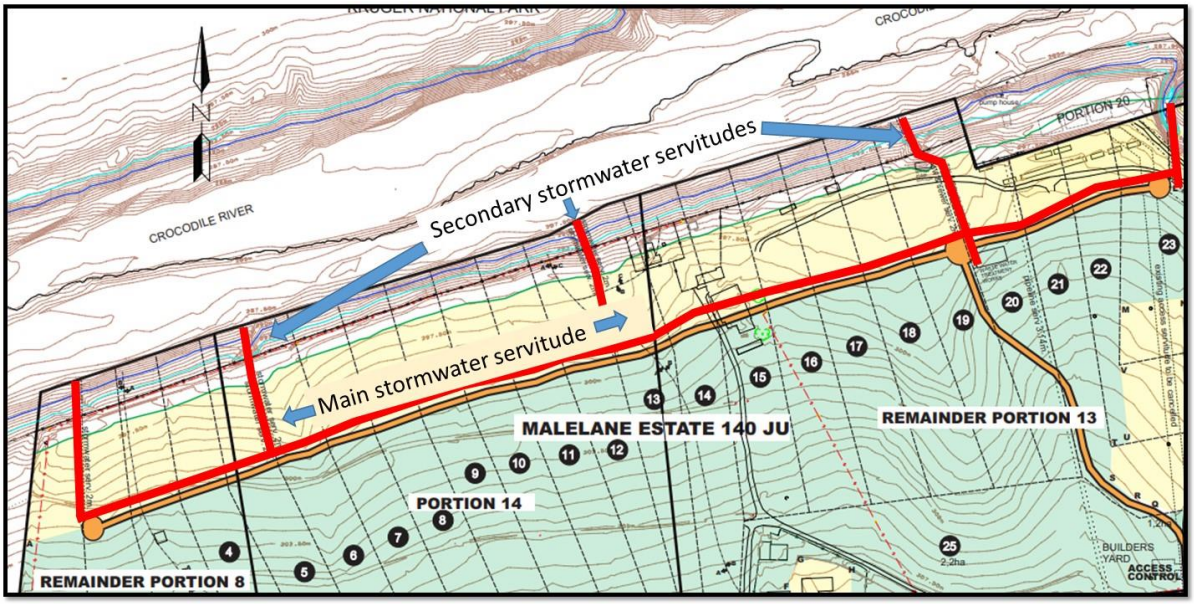


Figure 47: The layout of the planned stormwater servitudes.

The main stormwater servitude runs parallel along the east to west road servitude, and five secondary stormwater servitudes run from the main stormwater servitude directly to the northern boundary of the project area. The most eastern line will release its volume of stormwater into the unnamed drainage line, a natural drainage system for rain water.

This layout predicts that the main stormwater line will collect most of the stormwater draining from the orchards, and then relayed via the secondary stormwater lines to be released at the KNP boundary.

It is clear that if all the stormwater is released equally through the secondary stormwater lines, the impact of erosion will not be alleviated. The dongas will remain or even deteriorate due to the concentrated stormwater flows during high rainfall events. To mitigate for this impact, the following are suggested:

- The main stormwater channel should be a few centimetre deeper than the secondary stormwater channels, in order for most of the initial inflows to be diverted to the natural stream outlet and no erosion is expected to occur here;
- It may be appropriate to release the stormwater below the dam wall in order to protect the structure from higher than usual flood peaks;
- When the main stormwater channel fills up, more water will be released into the secondary stormwater channels and the water diverted towards the northern boundary of the project area and KNP fence;
- In order to prevent high volumes of stormwater being released straight into the downstream environment, it is suggested that the stormwater channels first let the water flow into a system of drains and rock-filled sumps to slow down the flows and dissipate the released water to prevent further erosion and siltation on the KNP side of the fence.

Table 43: Impact Rating of Activity 3.1: Stormwater flows resulting in erosion and siltation.

ISSUE:	Stormwater flows - erosion and siltation.
Project Phase	**Construction and Operational**
Nature	Negative
Extent	Local (2)
Intensity	Moderate (2)
Duration	Long term (3)
Consequence	High (7)
Probability	Possible
Degree to which impact cannot be reversed	Moderate
Degree to which Impact may cause irreplaceable loss of resources	Moderate
Confidence level	Moderate
Significance Pre- Mitigation	**High (-ve)**
Significance Post Mitigation	**Medium (-ve)**
Degree of Mitigation	Medium

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.

Impact 4: Human wildlife conflict.

Applicable Phase: Construction and operational phases.

Applicable activity: Human-animal conflict.

Nature of impact: Human-animal conflict is often caused by learned behaviour. The eradication of the problem animal is often the result.

Situations might arise where certain animals and their behaviour become problematic to the management of a place bordering a wilderness area or so close to a Big Five location (Kruger Park).

Human-animal conflict is often caused by learned behaviour. It is therefore important to design the facilities in a way that prevents this undesirable learnt behaviour. The most common problem animals in this regard are; elephants, hyenas, baboons, vervet monkeys and badgers.
Although there is a strong barrier between KMAE and the park, animals are opportunists and will sometimes find a way to get past the barrier. Smaller species such as baboons, vervet monkeys and badgers can easily climb through or over the fence.

Mitigation of Impact 4:

It will be expected from the KMAE management to implement the necessary preventative measures to avoid the development of problem animals. A Problem Animal Policy for the owners may include the following strategy:

Potential food sources

- It is important to avoid the animals associating humans with easy food, therefore food should never be left visible, unattended and/ or accessible.
- Educate and sensitise contractors, owners, guests and visitors on the issues related to problem animals.
- Fences around waste storage facilities must be functional.
- It must be made clear to owners and their guests that the feeding of any animals, even birds, is unacceptable.
- Fruit trees, such as oranges, should not be planted. Plant indigenous trees.

Interfering with biota:

- No person shall disturb or destroy any fauna or flora.
- Disturb any animal inside the project area.
- Remove, cut or damage a plant inside the project area.
- Feed any animal inside the project area.
- No snake (poisonous or non-poisonous) may under any circumstances be killed unless a human life is at stake.
- No trapping, snaring, hunting, fishing or killing of any animal may occur inside the project area.
- Baiting of wildlife to enhance viewing is not permitted.

General

- Strict lighting controls will be enforced to limit light pollution. No floodlights and open lighting will be allowed for night lighting. The number and wattage of outdoor lights will be limited, and shields used to direct lighting downwards.
- No fires may be lit except in designated areas.
- No loud noise or disturbance will be permitted.

Table 44: Impact Rating of Activity 4: Human-animal conflict.

ISSUE:	**Interactions with wildlife**
Project Phase	**Construction and operational**
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Medium-term (2)
Consequence	Very Low (4)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	Low (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Low
Preferred Alternative	

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 5. The introduction and spread of alien vegetation.

Applicable Phase: Construction and operational phases.

Applicable activity: Invasive, non-native plants often establish in vacant niches, such as cleared or eroded areas and subsequently compete with indigenous plant species for space and thus further transform the natural habitat.

Nature of impact: One of the main threats to the biodiversity is considered to be the introduction and spread of alien vegetation.

Mitigation of Impact 5:

Mitigation Description: The control methods of alien invasive plants can be broadly classified into three categories: mechanical, chemical or biological.

- mechanical control methods involve the physical destruction or total removal of plants (e.g. felling, strip-barking; ring-barking, hand-pulling and mowing);
- chemical control of invasive alien plants includes the foliar spraying of herbicides to kill targeted plants and
- biological control or bio-control methods involves the release of natural enemies that will reduce plant health and reduce population vigour to a level comparable to that of the natural vegetation.

It is often necessary to use a combination of at least two of these methods to control or remove invasive alien plants. With repeated follow-up, mechanical and chemical control methods tend to be short-term activities suitable for smaller plant invasions that can result in the complete removal of the target species. After the implementation of the methods, it is

important to evaluate the effectiveness of the methods and to monitor the cleared areas on a regular basis to identify emergent seedlings and to remove those immediately.

A list of indigenous plants should be available to owners so that no alien invading plants are planted in gardens and become escapees to the KNP. There should be strict controls regarding this aspect.

Table 45: Impact Rating of Activity 5: The introduction and spread of alien vegetation.

ISSUE:	Alien invasive vegetation.
Project Phase	**Operational**
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very low (3)
Probability	Probable
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	High
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

LOW: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact Assessment Summary

Table 46: A summary of the impact assessment post mitigation.

Impact No	Issue and aspect	Phases	Significance without mitigation	Significance with mitigation
1.1	Stormwater flows resulting in erosion and siltation.	Construction / Operational	**Medium (-ve)**	**Low (-ve)**
1.2.1	Sewerage - Wastewater treatment.	Operational	**Medium (-ve)**	**Low (-ve)**
1.2.2	Hazardous substances.	Construction	**Medium (-ve)**	**Low (-ve)**
1.2.3	Solid waste disposal and management.	Construction / Operational	**Medium (-ve)**	**Low (-ve)**
2.1	Flooding of the riparian zone.	Construction	**Medium (-ve)**	**Medium (-ve)**
2.2	Migration barrier.	Construction / Operational	**Low (-ve)**	**Low (-ve)**
3.1	Storm water and erosion/siltation – orchards.	Construction / Operational	**High (-ve**	**Medium (-ve)**
4	Human wildlife conflict.	Construction / Operational	**Low (-ve)**	**Low (-ve)**
5	The introduction and spread of alien vegetation.	Construction / Operational	**Medium (-ve)**	**Low (-ve)**

5.5 Conditions for inclusion in the environmental authorisation

These conditions are based on the identification of mitigation measures and solutions that minimise impacts on biodiversity and conflicts in land-uses by making use of CBA maps in the Environmental Impact Assessment (see Table 46). The steps used in this section correspond with the steps which are obtained from the Mpumalanga Biodiversity Sector Plan (2014). Step 2.3 listed in the Land-use planning and Decision-making table (Table 36), lists compromises and solutions that minimise impacts on biodiversity and conflicts in land-use, which are supported by the following five steps:

Step 2.3.1 Retain **natural habitat and connectivity** in CBAs and ESAs: The avoidance of environmentally sensitive areas identified during the Sensitivity Mapping exercise is regarded as the single most effective possible mitigation measure for mitigating impacts on the ecology of the project area.

- The riparian corridor will be inundated by the small dam water and the riparian link will thus be affected. The increased moisture from the higher water levels in the dam will enhance plant growth and probably create a secondary riparian zone which will link up with the original upstream and downstream riparian corridors.
- The project team should protect this riparian corridor by incorporating a rehabilitated buffer around the periphery of the dam high level mark.
- By establishing a 10m buffer around the dam high level mark, the new perimeter could be rehabilitated with vegetation removed and replanted from the dam basin.
- This measure of mitigation is consistent with the desired management objectives for riparian corridors and could prevent fragmentation.

Step 2.3.2: Apply the mitigation hierarchy: The mitigation hierarchy for dealing with negative impacts on biodiversity, consists of four activities (Figure 11):

- **Avoid and prevent:** Consider options in land-use location, siting, scale, layout, technology and phasing to avoid impacts on biodiversity, ecosystem services and people. This is the best option but not always possible.
- Identify the best practicable environmental options by avoiding loss of biodiversity and disturbance to ecosystems, especially in CBAs.
- Four options for small dam locations were proposed, but all four were in the same river reach and none of them having a lower predicted impact on the system. The preferred dam will act as an access bridge over the stream.
- **Minimise:** Consider alternatives in land-use location, siting, scale, layout, technology and phasing to minimise impacts on biodiversity, ecosystem services and people.
- Minimise unavoidable impacts: Manage and mitigate impacts where possible, such as clearing of vegetation, erosion of soil, siltation of the river and control alien vegetation.
- **Rehabilitate:** If impacts have been unavoidable, take measures to return impacted areas to a condition like the pre-impact or natural state — although this is important and necessary, rehabilitation can never replicate the diversity and complexity of an un-impacted natural site.
- Replanting the new riparian zone will form part of this process.
- Owners will replant the fallow soil with indigenous vegetation which will successfully mimic a riparian zone absent for decades.
- **Offset:** As a last resort, compensate for remaining unavoidable negative impacts on biodiversity. When every other effort has been made to minimise or rehabilitate impacts to a degree of ‘no net losses of biodiversity against biodiversity targets, offsets can compensate for unavoidable negative impacts.
- Unfortunately, due to the level of development on the farming property, there is no untransformed land left to set aside as an offset area.

- The “rehabilitation” or re-establishment of a riparian zone in the gardens of the residential units will improve a rather sterile environment, as adjacent properties downstream of the KMAE have proven.

Step 2.3.3 Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship: Set aside land of high biodiversity importance for conservation through biodiversity stewardship options. Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation:

- Unfortunately, due to the level of development on the farming property, there is no untransformed land left to set aside land of high biodiversity importance for conservation. The remaining riverine and riparian corridors should be left intact and protected from further development. Should the riparian zone around the dam re-establish and the corridor regained, this zone should be managed and protected in order to link up with the downstream Crocodile River environment.
- The “rehabilitation” or re-establishment of a riparian zone in the gardens of the residential units will link up with existing riparian corridors quite successfully.

Step 2.3.4 Remedy degradation and fragmentation through rehabilitation: Design project layouts and select locations that minimise loss and fragmentation of remaining natural habitat and maintain spatial components of ecological processes, especially in ecological corridors, buffers around rivers and wetlands, CBAs and ESAs. Activities that are proposed for CBAs must be consistent with the desired management objectives for these features and should not result in fragmentation.

- The project should re-establish the riparian corridors along the Crocodile River embankment and establish a rehabilitated buffer of 10 m around the periphery of the dam/bridge high level mark. This measure of mitigation is consistent with the desired management objectives for riparian corridors and should not result in fragmentation.

Step 2.3.5 Promote long-term persistence of taxa of special concern

- Some bird species of special concern will utilise the riparian corridor once it is rehabilitated. Hooded Vulture, Martial Eagle and African Crowned Eagle have been observed in gardens of the adjacent properties.

Table 47: The use of CBA maps in Environmental Impact Assessment and the reference to relevant sections present in the report.

Land-use planning and Decision-making	**Reference**
Step 1: Prepare for the site visit: Purpose: To determine the biodiversity context of the proposed land-use sites (using CBA maps, land-use guidelines and underlying GIS layers)	
Step 1.1 Establish how important the site is for meeting biodiversity targets? (Is it in a CBA or ESA?)	Critical Biodiversity Areas (under 5.3)
○ Step 1.1.1 Proposed land use	Project description (under section 1.1)
○ Step 1.1.2 Environmental Impact Assessments (EIA) and Freshwater Ecosystem Priority Areas (FEPA)	Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems (under 5.3)
○ Step 1.1.3 Description of the biophysical environment	3.2 Physiography of the study area
○ Step 1.1.4 Present Ecological State of the New Project	3. Description of the study area
○ Step 1.1.5 Critical Biodiversity Areas	Critical Biodiversity Areas (under 5.3)
• Step 1.2 Assess if the proposed land-use is consistent with the desired management objectives for the site (Use the land-use guidelines)	5.3.6 Land-use guidelines
○ Step 1.2.1 Critical Biodiversity Area in the Project area	Figures 37 to 39 (under 5.3)
• Step 1.3 Find out if threatened or other red data-listed species or ecosystems are present ○ Vegetation ○ Fish ○ Frogs ○ Reptiles ○ Birds ○ Mammals	4.4 Biota assemblages of the KMAE project areas
Step 2: Conduct the site visit: Purpose: To Ground truth the CBA maps and conduct additional biodiversity assessments in the study area	4.3 Biodiversity assessments
Step 2.1 Compare mapped land cover with observed land cover at the site	Figure 23: The broad-scale vegetation units or ground cover of the KMAE Dam project area.
○ Step 2.1.1 Record observed features in site assessment report ▪ Ecological surveys - methods ▪ Aquatic habitat assessments ▪ Vegetation ▪ Aquatic biota ▪ Aquatic invertebrate assessment	2. Methodology 4.4 Biota assemblages of the KMAE project areas Appendix 5

▪ Fish communities ▪ Terrestrial fauna studies ▪ Amphibian surveys ▪ Reptile surveys ▪ Bird surveys ▪ Mammal surveys	
○ Step 2.1.2 Results of Ecological Surveys	4. Results
Vegetation	4.1 Vegetation units and land cover types within the study area
▪ Observed vegetation	4.4.1 Vegetation communities
▪ Riparian delineation	5.3.4 Riparian delineation
○ Fauna surveys	4.4 Biota assemblages
▪ Aquatic habitats and fauna	4.4.2 Riverine Ecology
▪ Aquatic habitat assessment	4.4.2.2 Aquatic habitat assessment
▪ Aquatic invertebrate assessment	4.4.2.3 Surveys of Aquatic Invertebrates and Fish
▪ Fish Response Assessment Index	4.4.2.3 Surveys of Aquatic Invertebrates and Fish
▪ Terrestrial fauna	4.4.3 Terrestrial ecology
○ Frogs	4.4.3.2 Frogs
○ Reptiles	4.4.3.3 Reptiles
○ Birds	4.4.3.4 Birds
○ Mammals	4.4.3.5 Mammals
○ Step 2.1.3 Further planning to proceed using ground-truthed land cover	5.3 Land-use planning and Decision-making
Step 2.2 Compare mapped CBA or ESA features with ground-truthed ones	Vegetation and land cover types identified for the ecological surveys (under 4.1) – Figure 23: The broad-scale vegetation units or ground cover of the KMAE project area.
Step 2.3 Identify compromises and solutions that minimise impacts on biodiversity and conflicts in land-use	5.4 Assessment of impacts
○ Step 2.3.1 Retain natural habitat and connectivity in CBAs and ESAs	5.5 Conditions for inclusion in the environmental authorisation.
○ Step 2.3.2 Apply the mitigation hierarchy	Step 2.3.2: Apply the mitigation hierarchy
○ Step 2.3.3 Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship	Step 2.3.3: Secure priority biodiversity in CBAs and ESAs through biodiversity

	stewardship
○ Step 2.3.4 Remedy degradation and fragmentation through rehabilitation	Step 2.3.4: Remedy degradation and fragmentation through rehabilitation
○ Step 2.3.5 Promote long-term persistence of taxa of special concern	Step 2.3.5: Promote long-term persistence of taxa of special concern
Step 3: Assess impact on biodiversity: Purpose: To make recommendations regarding the impacts of the proposed land-use development on biodiversity	5.4 Assessment of impacts
Step 3.1 When impacts are likely to be insignificant	5.4 Assessment of impacts
○ Step 3.2 When significant impacts are unavoidable	5.7.2 Reasoned opinion
○ Step 3.2.1 CBAs and ESAs	5.7.2 Reasoned opinion
○ Step 3.2.2 ONAs	5.7.2 Reasoned opinion
Step 4: Identify opportunities to conserve biodiversity: Purpose: Maximise conservation gains by proactive identification of opportunities to conserve biodiversity	5.3.2 Critical Biodiversity Areas
○ Step 4.1 Set aside land of high biodiversity importance for conservation through biodiversity stewardship options	5.3.2 Critical Biodiversity Areas
○ Step 4.2 Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation	5.3.2 Critical Biodiversity Areas
○ Step 4.3 Clear invasive alien vegetation and rehabilitate existing degraded habitats	5.4 Assessment of impacts
Step 5: Incorporate biodiversity priorities in EIA report: Purpose: Show explicitly how CBA maps and land-use guidelines have informed project location, design and implementation	5.3.2 Critical Biodiversity Areas
○ Step 5.1 Determine the least damaging location and design	5.3.2 Critical Biodiversity Areas
○ Step 5.1.1 Avoiding CBAs	5.3.2 Critical Biodiversity Areas
○ Step 5.1.2 Reducing pressure on natural habitat and ecological processes.	5.4 Assessment of impacts
○ Step 5.1.3 Concentrating disturbance footprints in heavily modified or degraded areas that are not earmarked for rehabilitation	5.4 Assessment of impacts
○ Step 5.1.4 Integrating *in situ* biodiversity-sensitive management into the overall design and operation of the proposed land-use development	5.4 Assessment of impacts

5.6 Monitoring requirements

Environmental performance monitoring should be designed to ensure that mitigation measures are implemented. The monitoring programme should clearly indicate the linkages between impacts, indicators to be measured, measurement methods and definition of thresholds that will signal the need for corrective actions.

The applicant must appoint an independent ECO that will have the responsibility of monitoring and reporting on compliance with the conditions of the Environmental Authorisation (EA), as well as monitoring and reporting on the implementation of the approved EMPr.

A monitoring programme for the biodiversity associated with the project, would ideally be to record the reaction of the biota to changes in the environment due to the impacts of the project.

Aspect 1: Dam buffer and riparian corridor: It is vital to monitor the effectiveness of the maintenance plan which optimises the riparian plant species development and riparian habitat restoration (ensure integrity of wildlife corridor is retained and links between habitat types are enhanced). The restoration of the dam buffer area should be monitored throughout the duration of construction activities to ensure that the effectiveness of the final buffer zone areas is maintained, and that management measures are implemented appropriately. Regular inspections during the operational phase should also be undertaken to ensure that functions are not undermined by inappropriate activities.

Aspect 2: Vegetation clearing or disturbing soil: Establish an effective record keeping system for each area where soil is disturbed for whatever purposes. The monitoring will evaluate whether the erosion and sedimentation control techniques that are employed throughout the site preparation activities are effective in minimising erosion of exposed areas and sedimentation of site surface water.

Aspect 3: Water quality: It is recommended that the SASS5 method be implemented as part of the Biomonitoring Programme, specifically for the reaction of the sensitive species to water quality above and below the dam. Monitoring surveys (per year) are suggested as follows:

- One wet season survey at the established sites.
- One dry season survey when the impacts of reduced surface water and water quality issues become evident.

Aspect 4: Exotic- and alien invasive plants: To anticipate and evaluate imminent or potential risks to the project area regarding exotic- and alien invasive plants, as well as pathways of invasion, a monitoring programme should be developed in order to create effective mechanisms to manage or mitigate these. Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. It is important to evaluate the effectiveness of control methods and to monitor the cleared areas on a regular basis to identify emergent seedlings and to remove those immediately.

5.7 Recommendations

5.7.1 Summary of mitigation measures

The potential impacts of the project on biodiversity of the study area are assessed under 5 broad activities and 10 specific impacts (Section 5.4). The following list provides a summary of the impact assessment, indicating the changes from pre-mitigation to post mitigation.

Activity 1: Construction of the lifestyle units.

Impact 1.1: Stormwater and erosion/siltation

Construction and Operational Phases – Medium significance improves to Low significance.

Mitigation: It is proposed that soakaways be used within the residential sites to lessen the impact of runoff from the roofs combined with permeable paving, both source control measures. Another source control method which could be considered is rainwater harvesting. It is further proposed that swales be constructed adjacent to all the access roads as the primary local control method.

Impact 1.2 Pollution

Impact 1.2.1 Sewerage - Wastewater treatment.

Operational phase – Medium significance improves to Low significance.

Mitigation: A waterborne sewerage system will be installed with a Maskam Fusion a Waste Water Treatment Works package (WWTW) situated centrally - on proposed portion 20). The outflow from this system will conform to General Standards and will be used for irrigation of the Macadamia orchards. One pump station (situated on proposed portion 19) will feed the WWTW.

Impact 1.2.2: Hazardous substances.

Construction Phase – Medium significance improves to Low significance.

Mitigation: The buffers for the water courses as assessed with the DWS buffer tool must be implemented between the development and surrounding environment. Issues relating to potential pollution of the watercourses and wetlands should be addressed by the management.

Impact 1.2.3: Solid waste.

Construction and Operational Phase – Medium significance improves to Low significance.

Mitigation: Refuse removal will be undertaken daily by the KMAE Management. Waste will be collected weekly by the Nkomazi Municipality.

Activity 2. Construction of a dam in an unnamed drainage line.

Impact 2.1 Inundation of the stream.

Construction Phase – Medium significance improves to Low significance.

Mitigation: Create a 10m buffer zone around the full-water mark and replant some of the key riparian tree species from the basin onto the dam margin border.

Impact 2.2: Migration barrier

Operational phase– High significance improves to Medium significance.

Mitigation: Based on the results of a necessity protocol assessment for a fishway, it was concluded that such a structure will add little, if any ecological benefit at the proposed dam site and therefore no fishway is required. This recommendation is based on ecological considerations.

Activity 3. Establishment of the orchards

Impact 3.1 Stormwater flows resulting in erosion and siltation.

Construction and Operational Phase – High significance improves to Medium significance.

Mitigation: The introduction of efficient stormwater drainage systems to deal with the erosion and siltation problem implies that the runoff must be channelled as efficiently as possible to the natural watercourses. This has the effect of decreasing the time runoff takes to reach the natural watercourses. The result is a reduction of overland flow, meandering watercourses and the like, through a system which drains runoff to the watercourses as quickly as possible.

Impact 4: Human wildlife conflict.

Construction and Operational Phase – Low significance remains Low significance.

Mitigation: It will be expected from the KMAE management to implement the necessary preventative measures to avoid the development of problem animals.

5.7.2 Reasoned opinion

According to the General Requirements in terms of Appendix 6 (not an appendix to this report) of the EIA Regulations, 2014, a “Reasoned opinion” should include the rational as to whether:

- the proposed activity, activities or portions thereof should be authorised;
- regarding the acceptability of the proposed activity or activities;
- and if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan.

The entire project area is situated in a Terrestrial CBA: Ecological Support Area - Protected Area Buffer (Figure 40), and the purpose of buffer zones is to reduce the impacts of undesirable land-uses on the environment, and to provide opportunities for tourism.

It is evident that a central concern regarding the development on the KMAE property is the deterioration of the ground cover on the farm and the resultant erosion and siltation of the receiving environment. Most of the problem can be attributed to the neglected stormwater management of the farm in the recent years. With the current planned development, there are two sources of potential erosion:

- a)the residential areas with housing units, roads, and other forms of impervious surfaces;
- b) and the current fallow land to be developed into macadamia orchards.

To prevent the continuation of donga formation and sediment deposition on the receiving Kruger Park landscape, a number of stormwater decelerating schemes are available to the engineers when developing the stormwater drainage system. A number of these schemes are discussed in the ConSolv Engineering Service Report (2020) and a combination of these methods can be implemented in both the residential and agricultural areas.

In the residential areas, soakaways could be used to lessen the impact of runoff from impervious surfaces, rainwater harvesting can receive some of the water and swales along all the access roads, can all serve as primary local control systems. All channelled water should be slowed down before it reaches the KNP fence/boundary with decelerating systems, such as infiltration trenches and vegetated swales. The planting of lush Lowveld gardens which will establish rapidly in the rich soils and controlled watering systems, will also be an effective control addition to slow down stormwater.

Different controls could be incorporated in the orchards, beginning from the southern boundary, all the way to the storm water channelling system along the main road. The stormwater decelerating methods could include filter strips, swales, infiltration trenches and rio-retention areas (see ConSolv Engineering Service Report, 2020). These systems will be able to slow down stormwater before it reaches the storm water channelling system which will intercept the surface flows before it reaches the residential areas.

However, it is important to firstly divert most of the initial flows towards the natural drainage line to the east of the property, thereafter the increased flow may overflow into the secondary storm water channels. More importantly now is to slow down the water towards the point of release in order to prevent concentrated flows discharged into the receiving environment.

In order for that to happen, it is suggested that the stormwater channels release the water into a system of drains and rock-filled sumps to slow down the flows and dissipate the released water over a wider surface area to prevent further erosion and siltation on the KNP side of the fence.

Pollution of the drainage systems (including the channelled stormwater) on the farm and the adjacent Crocodile River, is another concern in developing the estate. If there is a pollution risk, it will persist into the operational phase. There are three aspects of concern relating to potential pollution, namely the sewerage system, solid waste and hazardous substances associated with construction and afterwards stemming from household tasks.

The wastewater treatment of effluent will be a waterborne sewerage system. The system will be installed with a Maskam Fusion WWTW which will ensure that the outflow from the system will conform to general standards required by the Department of Water and Sanitation and be used for the irrigation of the macadamia orchards.

In order to protect the riverine area from potential sources of pollution, the following mitigation are proposed:

- Implementation and maintenance of aquatic buffer zones around the local waterways,
- and adhering to Best Practice Guidelines and Specifications relating to all construction activities (camps, storage, dumping, ablution, servicing, mixing and stockpiling).

Solid waste will initially be managed effectively by the construction teams, and during operation the management of the estate development will fulfil this function. Refuse removal will be undertaken by the KMAE management and the stored waste will be collected weekly by the Nkomazi Municipality.

Building the dam/bridge structure over the small stream has a twofold function: i) damming water in the stream will create a small dam which will act as a water feature for the development; ii) the structure will also serve as a bridge to allow vehicles to cross the stream.

Based on the results of a necessity protocol assessment for a fishway, it was concluded that such a structure will add little, if any ecological benefit at the proposed dam site and therefore no fishway is required for installation at the proposed dam. This recommendation is based on ecological considerations.

As indicated in Section 5.4, “Assessment of impacts” (Table 46), most of the impacts can be mitigated to a certain degree. However, filling the dam and inundating the riparian vegetation are impacts that cannot be mitigated satisfactory as a relatively large surface area is inundated and eliminated from the ecosystem footprint, therefore the significance of this action is still listed in a “Medium” category.

To protect the remaining riparian zone of the stream, a 10m buffer around the riparian zone has been established with the DWS Buffer Tool. In order to re-establish the link between the riparian corridors upstream and downstream of the dam basin, a 10m riparian buffer should also be established along the new marginal zone around the dam.

It is thus anticipated that, in order to mitigate for the impacts of the proposed dam on the environment, the listed adverse influences should be managed to such a degree that the overall ecology in the project area will still be functional.

It is expected that aspects such as “Human wildlife conflict” and “Alien plant control” can be managed without difficulty through channels created by the KMAE Management and if maintained it should successfully mitigate these potential impacts.

By implementing all the mitigation measures and managing the system as prescribed on an ongoing basis, all the impacts will be alleviated to a satisfactory level. Therefore, it is proposed that the construction and operation of the project should be authorised with the provision that the mitigation measures prescribed in this document are included in the EMPr.

5.7.3 Consultation process

The input from the following parties:

- Mr Barend Marx - information relating to the dam wall;
- Dr Pieter Kotze - information relating to the fish-way;
- Dr Mervyn Lotter regarding the Mpumalanga Threatened Species Database is appreciated.

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Appendices

Appendix 1: Declaration of interest

The specialist appointed in terms of the Regulations

10.4 The Specialist

Note: Duplicate this section where there is more than one specialist.

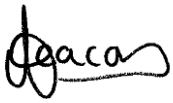
I …Dr Andrew Richard Deacon…, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

X	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or

	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation **18** of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).



Signature of the specialist
Name of company: Andrew Deacon Environmental Consultant
Date: 10 June 2021

Appendix 2: Curriculum Vitae

CURRICULUM VITAE - DR ANDREW RICHARD DEACON

Born in Klerksdorp, South Africa in 1951. Matriculated at the Goudveld High School in 1969. South African citizen. Married and with one child.

FORMAL EDUCATION
Ph.D., Zoology (RAU 1987) Thesis: "The nutritional ecology and physiology of *Tilapia rendalli* and *Oreochromis mossambicus* in a warm, sewage-enriched habitat".
M.Sc., Zoology (RAU 1983) Thesis: "The occurrence and feeding habits of *Anguilla*-species in selected rivers of the Transkei".
B.Sc., Hons. in Zoology (RAU 1980)
B.Sc., majors Zoology and Botany (PU for CHE 1974)

PROFESSIONAL EXPERIENCE

2012-ongoing Environmental consultant
1989-2012 Scientific Services, Kruger National Park, SANParks
2000-2012 Programme Manager: Small vertebrates
1989-2000 Senior Scientist: Freshwater Ecologist.
1988 Consulting - Technikon of RSA; Berghoek Nature Reserve; Klaserie Nature Reserve.
1985-1987 Lecturer (Part-time) - Witwatersrand Technikon. Biology for the Food Technologists.
1984-1986 Lecturer - Department of Zoology at RAU. Biology and Taxonomy.
1983 Lecturer - Goudstad College of Education. Zoology.
1979-1982 Research assistant - Department of Zoology at RAU.
1978 Research technician - Onderstepoort Veterinary Institute. Helminthology - Taxonomy and physiology of South African helminths.
1975 – 1977 Teacher - Biology and Science

National Biomonitoring Programme - Project leader for River Health Programme (1998 - 2010)
Olifants River Forum - Vice Chairman (1994)
Research Unit for Terrestrial and Aquatic Ecology (RAU) (1991-1996)
Water Research Commission Steering Committee (30 projects) (1990 - 2011)
Lowveld Pollution Incident Committee – collaborator (1991-1998)
Mpumalanga River Health Programme - Project leader (1999 - 2005)

CONSULTING PROJECTS (112 projects)

Specialist fields for environmental studies (surveys and monitoring):

Specialist studies for:
Environmental Impact Assessments – Specialist studies (10 studies)
Reserve Determination – Environmental Water Requirements (13 projects)

Aquatic ecosystem
Hydro-electrical projects (5 projects)
Fish, macro-invertebrates and riparian (37 project)
Fish-ways (3 projects)
Wetland delineation (3 projects)

Terrestrial ecosystems (Mammals, birds, reptiles, frogs, plants)
Fauna specialist studies (40 projects)
Faunal and ecosystems monitoring: (6 projects)
Biodiversity and Habitat integrity: (30 projects)
Vegetation studies (2 projects)

Lecturing & Training: Ecology (10 projects)

OTHER
Initiated the Olifants River Forum. Received the trophy for the ORF Top Project of the Year competition and awarded honorary life membership of the Olifants River Forum.
Completed the Environmental Impact Assessment short course at the University of Cape Town.
Submitted a proposal for the Limpopo floodplains to be declared as a Ramsar site.
Accredited for SASS4 Macro-invertebrate Biomonitoring Methods.
Completed: Wetland Introduction and Delineation – Centre for Environmental Management: University of the Free State
Scientific Advisor: Leadership for Conservation in Africa
10 scientific papers in refereed journals

Appendix 3: The complete SASS 5 form.

TAXON	Stones	Vegetation	GSM	Total
Porifera 5				
Coelenterata 3				
Turbellaria 3				
Oligochaeta 1				
Leeches 3				
Amphipoda 15				
Potamonautidae 3				
Atyidae (Shrimp) 8				
Palaemonidae 10				
Hydracarinae 8				
Notonemouridae 14				
Perlidae 12				
Baetidae 1 spp 4				
2 spp 6				
>2 spp 12				
Caenidae 6				
Ephemeridae 15				
Heptageniidae 10				
Leptophlebiidae 13				
Oligoneuridae 15				
Polymitarcyidae 10				
Prosopistomatidae 15				
Teloganodidae 12				
Tricorythidae 9				
Calopterydidae 10				
Chlorocyphidae 10				
Chlorolestidae 8				
Coenagrionidae 4				
Lestidae 8				
Platycnemidae 10				
Protoneuridae 8				
Zygoptera 6				
Aeshnidae 8				
Cordulidae 8				
Gomphidae 6				
Libellulidae 4				
Belostomatidae 3				
Corixidae 3				
Gerridae 5				
Hydrometridae 6				
Naucoridae 7				
Nepidae 3				
Notonectidae 3				
Pleidae 4				
Veliidae 5				
Corydalidae 8				
Sialidae 6				
Dipseudopsidae 10				
Ecnomidae 8				
Hydropsychidae 1= 4				
2spp = 6				
>2spp =12				
Philopotamidae 10				
Polycentropodidae 12				

Psychomyiidae/Xip. 8				
Barbarochthonidae 13				
Calamoceratidae 11				
Glossosomatidae 11				
Hydroptilidae 6				
Hydrosalpingidae 15				
Lepidostomatidae 10				
Leptoceridae 6				
Petrothrincidae 11				
Pisuliidae 10				
Sericostomatidae 13				
Dytiscidae 5				
Elmidae/Dryopidae 8				
Gyrinidae 5				
Haliplidae 5				
Helodidae 12				
Hydraenidae 8				
Hydrophilidae 5				
Limnichidae 8				
Psephenidae 10				
Athericidae 13				
Blepharoceridae 15				
Ceratopogonidae 5				
Chironomidae 2				
Culicidae 1				
Dixidae 13				
Emphididae 6				
Ephydridae 3				
Muscidae 1				
Psychodidae 1				
Simuliidae 5				
Syrphidae 1				
Tabanidae 5				
Tipulidae 5				
Ancylidae 6				
Bulininae 3				
Hydrobidae 3				
Lymnaeidae 3				
Physidae 3				
Planorbidae 3				
Thiaridae 3				
Viviparidae 5				
Corbiculidae 5				
Spaeridae 3				
Uniondae 6				
SASS Score				
No of families				
ASPT				

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Appendix 4: The Nature of the Red Listed categories

All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories (see Chart below).

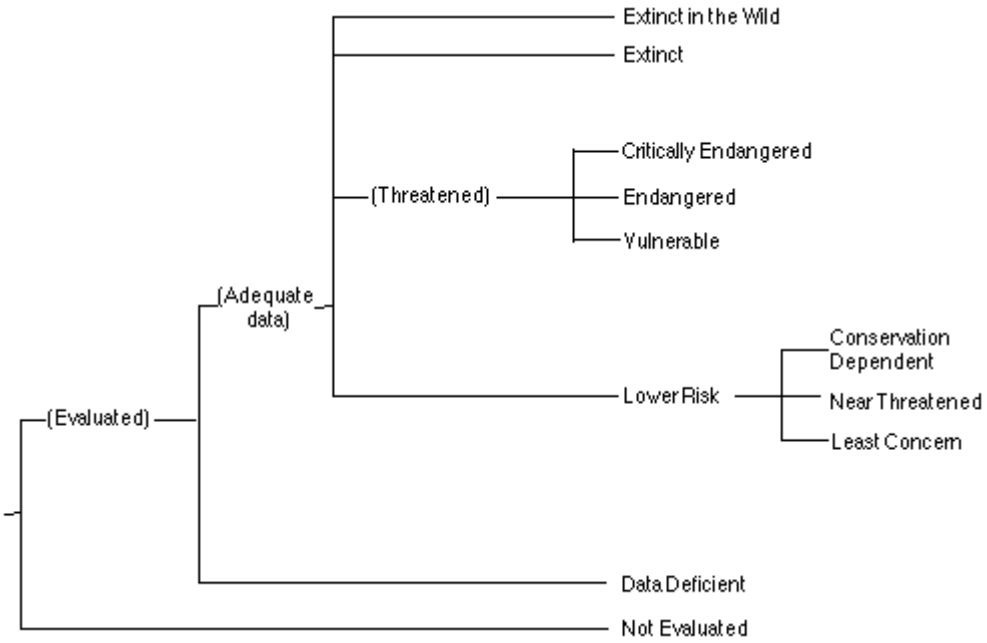


Chart: Red Listed categories

EXTINCT (EX) - A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW) - A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described below.

ENDANGERED (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.

VULNERABLE (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.

LOWER RISK (LR) - A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE) A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

Appendix 5: Lists of observed faunal species compiled by the author (the period 2004 to 2021) along this reach of the river with the Red Data species highlighted in red font.

Mammals

1. Banded Mongoose
2. Black Rhino
3. Black rat
4. Buffalo
5. Burchell's Zebra
6. Bushbuck
7. Cape Clawless Otter
8. Chacma Baboon
9. Cheetah
10. Civet (African)
11. Egyptian slit-faced bat
12. Elephant
13. Giraffe
14. Greater Cane Rat
15. Grey duiker (common)
16. Hippopotamus
17. Honey Badger
18. Impala
19. Kudu
20. Largespotted Genet
21. Leopard
22. Lion
23. Nyala
24. Pygmy Mouse
25. Scrub Hare
26. Slender Mongoose
27. Spotted Hyena
28. Thick-tailed Bushbaby
29. Tree Squirrel
30. Vervet Monkey
31. Wahlberg's/Peter's Epauletted Fruit Bat
32. Warthog
33. Waterbuck
34. White Rhino
35. Wild Dog

Birds

1. Acacia Pied Barbet
2. African Black Duck
3. African Crowned Eagle
4. African Cuckoo Hawk
5. African Darter
6. African Dusky Flycatcher
7. African Finfoot
8. African Fish-Eagle
9. African Goshawk
10. African Harrier-Hawk (Gymnogene)
11. African Hawk-Eagle
12. African Hoopoe
13. African Jacana
14. African Openbill
15. African Pied Wagtail
16. African Pygmy-Kingfisher
17. African Spoonbill
18. African Stonechat
19. African Wattled Lapwing
20. African Wood-Owl
21. Arrow-marked Babbler
22. Ashy Flycatcher (Blue-grey)
23. Barn Owl
24. Bateleur
25. Bearded Woodpecker
26. Bennett's Woodpecker
27. Black Crake
28. Black Cuckoo
29. Black Cuckooshrike
30. Black egret (heron)
31. Black flycatcher (southern)
32. Black Saw-wing
33. Black Sparrowhawk
34. Black Stork
35. Black / Amethyst sunbird
36. Black-chested Snake-Eagle
37. Black-collared Barbet
38. Black-crowned Night-Heron
39. Black-crowned Tchagra
40. Black-eyed bulbul (dark-capped)
41. Black-headed Heron
42. Black-headed Oriole
43. Black-shouldered Kite
44. Blacksmith Lapwing (plover)
45. Black-winged Stilt
46. Bleating warbler
47. Blue-billed firefinch (African)
48. Blue Waxbill
49. Bronze Mannikin
50. Brown Snake-Eagle
51. Brown-headed Parrot
52. Brown-hooded Kingfisher
53. Brown-throated Martin
54. Brubru
55. Burchell's Coucal
56. Cape batis
57. Cape Glossy Starling
58. Cape Turtle-Dove
59. Cape White-eye
60. Cardinal Woodpecker
61. Caspian tern
62. Cattle Egret
63. Chinspot Batis
64. Collared Sunbird
65. Comb Duck
66. Common Myna
67. Common Sandpiper
68. Common Scimitarbill
69. Common Waxbill
70. Crested Barbet
71. Crested Francolin
72. Crowned Lapwing (plover)
73. Cut-throat Finch
74. Diederick Cuckoo
75. Dusky Indigobird (Black widowfinch)

76. Eastern redfooted kestrel
77. Egyptian Goose
78. Eurasian Golden Oriole
79. European Bee-eater
80. European Nightjar
81. European Roller
82. European swallow
83. Fiery-necked Nightjar
84. Fork-tailed Drongo
85. Fulvous Duck
86. Gabar Goshawk
87. Garden Warbler
88. Giant eagle owl (Verreaux's)
89. Giant Kingfisher
90. Glossy Ibis
91. Golden Weaver (Holub's)
92. Golden-tailed Woodpecker
93. Goliath Heron
94. Great Egret
95. Great Reed-Warbler
96. Greater Blue-eared Starling
97. Greater Honeyguide
98. Greater Painted-snipe
99. Green pigeon
100. Green-backed Heron
101. Greenshank (Common)
102. Green-spotted dove
103. Green twinspot
104. Green-winged Pytilia (Melba finch)
105. Grey Go-away-bird/lourie
106. Grey Heron
107. Grey hornbill (African)
108. Grey Penduline-Tit
109. Grey-headed Bush-Shrike
110. Grey-headed Gull
111. Grey-headed sparrow
112. Grey-rumped Swallow
113. Ground hornbill (Southern)
114. Groundscraper Thrush
115. Hadeda Ibis
116. Half-collared Kingfisher
117. Hamerkop
118. Helmeted Guineafowl
119. Heuglin's robin (white-browed robin-chat)
120. Hooded Vulture
121. Horus Swift
122. House Sparrow
123. Icterine Warbler
124. Jacobin Cuckoo
125. Klaas's Cuckoo
126. Kurrichane Thrush
127. Lanner Falcon
128. Lappet-faced Vulture
129. Laughing Dove
130. Lesser Honeyguide
131. Lesser Masked-Weaver
132. Lesser Striped Swallow
133. Levaillant's Cuckoo/ Striped
134. Lilac-breasted Roller
135. Little Bee-eater
136. Little Egret
137. Little Sparrowhawk
138. Little Swift
139. Long-billed Crombec
140. Long-crested Eagle
141. Long-tailed Paradise-Whydah
142. Longtailed shrike (magpie)
143. Malachite Kingfisher
144. Marabou Stork
145. Marico Sunbird
146. Martial Eagle
147. Monotonous Lark
148. Mosque Swallow
149. Mourning dove (African)
150. Namaqua Dove
151. Natal Francolin
152. Olive sunbird
153. Orange-breasted Bush-Shrike
154. Osprey
155. Palm swift (African)
156. Paradise-Flycatcher (African)
157. Pearl-spotted Owlet
158. Pied Crow
159. Pied Kingfisher
160. Pin-tailed Whydah
161. Plum-coloured starling (violet-backed)
162. Puffback (black-backed)
163. Purple Heron
164. Purple-banded Sunbird
165. Purple-crested Turaco
166. Rattling Cisticola
167. Red-backed Mannikin
168. Red-backed Shrike
169. Red-billed Firefinch
170. Red-billed helmetshrike (Retz's)
171. Red-billed Hornbill
172. Red-billed Oxpecker
173. Red-billed Quelea
174. Red-billed woodhoopoe (green)
175. Red-breasted Swallow
176. Red-chested Cuckoo
177. Red-collared Widowbird
178. Red-crested Korhaan
179. Red-eyed Dove
180. Red-faced Cisticola
181. Red-faced Mousebird
182. Red-headed Weaver

183. Red-shouldered widow
184. Red-winged Starling
185. Reed Cormorant
186. Rock bunting (cinnamon-breasted)
187. Sacred Ibis
188. Saddle-billed Stork
189. Scarlet-chested Sunbird
190. Scops owl (African)
191. Sharpbilled honeyguide
192. Sombre Greenbul
193. Southern Black Tit
194. Southern Boubou
195. Southern Masked-Weaver
196. Southern Red Bishop
197. Southern Yellow-billed Hornbill
198. Speckled Mousebird
199. Spectacled weaver
200. Spotted-backed weaver
201. Spotted Flycatcher
202. Spur-winged Goose
203. Squacco Heron
204. Steppe Buzzard
205. Swainson's Spurfowl
206. Tambourine Dove
207. Tawny Eagle
208. Tawny-flanked Prinia
209. Terrestrial Brownbul
210. Thick-billed Weaver
211. Three-banded Plover
212. Three-streaked tchagra (brown-crowned)
213. Trumpeter Hornbill
214. Village Indigobird (Steelblue widowfinch)
215. Little Swift
216. Wahlberg's Eagle
217. Water Thick-knee
218. Wattled Starling
219. Whiskered tern
220. White Stork
221. White-backed Night-Heron
222. White-backed Vulture
223. White-bellied Sunbird
224. White-breasted Cormorant
225. White-crowned shrike (Southern)
226. White-faced Duck
227. White-fronted Bee-eater
228. White-headed Vulture
229. White (crested) helmetshrike
230. White-rumped Swift
231. White-winged Widowbird
232. Willow Warbler
233. Wire-tailed Swallow
234. Wood Sandpiper
235. Woodland Kingfisher
236. Woolly-necked Stork
237. Yellow-billed Egret
238. Yellow-billed Kite
239. Yellow-billed Stork
240. Yellow-breasted Apalis
241. Yellow-breasted Pipit
242. Yellow Bishop
243. Yellow-crowned Bishop
244. Yellow-eyed (fronted) Canary
245. Yellow-fronted Sparrow
246. Yellow-fronted Tinkerbird
247. Yellow-rumped Tinkerbird
248. Yellow-throated Longclaw
249. Zitting cisticola

Reptiles

1. Boomslang
2. Brown house snake
3. Cape wolf snake
4. Common dwarf gecko
5. Eastern thread snake
6. Eastern Tiger Snake
7. Flapneck Chameleon
8. Leopard Tortoise
9. Mamba
10. Marbled tree snake
11. Moreau's Tropical House Gecko
12. Mozambique spitting cobra
13. Nile crocodile
14. Olive Grass Snake
15. Puff adder
16. Red-lipped snake
17. Serrated Hinged Terrapin
18. Southern African Python
19. Southern Tree Agama
20. Speke's Hinged Tortoise
21. Striped Skink
22. Variegated bush Snake
23. Wahlberg's Snake-eyed Skink
24. Water Monitor
25. Western Natal green snake

Frogs

1. Banded Rubber Frog
2. Broadbanded Grass Frog
3. Brownbacked Tree Frog
4. Bubbling Kassina
5. Bushveld Rain Frog
6. Common River Frog
7. Dwarf Puddle Frog
8. Flatbacked Toad
9. Foam-nest frog
10. Greater Leaf-folding Frog
11. Guttural Toad
12. Natal Sand Frog
13. Painted Reed Frog
14. Plain Grass Frog
15. Raucous Toad
16. Russet-backed sand frog
17. Snoring puddle frog
18. Tinker Reed Frog
19. Tremelo Sand Frog

APPENDIX 4.4.3.
FISHWAY/LADDER STUDY AND REPORT

ASSESSMENT OF POTENTIAL MIGRATION BARRIER CAUSED BY A PROPOSED DAM IN AN UNNAMED (KMAE) TRIBUTARY OF THE CROCODILE RIVER (MALALENE, MPUMALANGA)

MAY 2021

Report reference: CSBS/A/2021

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CLEAN STREAM
BIOLOGICAL SERVICES (PTY) LTD

EXECUTIVE SUMMARY

The following primary **conclusions** were drawn from the current study:

- Based on available information, **three of the five criteria** (60%) in the "fishway necessity protocol" indicated that a **fishway is not needed/feasible**. Assessment therefore indicates that implementation of a fishway **may not be required or feasible at this site**.
- A "priority protocol" score of 42% was calculated, indicating that the provision of a fishway at this proposed barrier is considered of **very low priority**.
- Based on the above considerations it is unlikely that the cost of a fishway would be justified since little ecological benefit will be gained.
- Other more cost-effective options to move fish across the barrier could be considered, but may not be required due to the poor state and limited value of upstream habitats. Other options that may be further considered include:
    - Physical collection of fish during peak migrations and moving them over the migration barrier.
    - Utilising natural rocky areas at edges of dam wall to create "natural type fishway/rapids" (if available and applicable).

The following **recommendations** are made:

- Based on the results of this assessment it was concluded that a fishway will add little if any ecological benefit at the proposed dam site and no fishway is required for installation at the proposed dam. His recommendation is based on ecological considerations.
- Ideally the existing barrier (bridge) should be removed and if access is required a bridge should be reconstructed with minimal impact on the riverbed.
- The proposed development can contribute by taking ownership of the stream of concern. It is strongly recommended that this river reach should be rehabilitated to improve its ecological integrity and its contribution towards the receiving Crocodile River. The following aspects could be considered:
    - Clearing of all alien vegetation from riparian zone (and preferably entire catchment area by relevant authority). Indigenous riparian zone vegetation should be maintained (no clearing of indigenous riparian vegetation).
    - Cleaning of all solid waste and preventing further rubbish dumping in this stream. Preventing solid waste/rubbish to be transported via this stream towards the Crocodile River (Kruger National Park).
    - Stabilization of river banks and addressing current erosion problems. Inclusion of all possible erosion control measures within the proposed development to decrease the inflow of sediment that result in bed modification within this stream and the receiving Crocodile River (includes erosion in upstream catchment).
    - Prohibiting the introduction of any fish species (indigenous or alien) within this proposed development.
    - Regular monitoring (at least quarterly) of water quality of this stream at the inflow and outflow of property to ensure that no deterioration of water quality occur as a result of the proposed development.

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1.INTRODUCTION

The Kruger Malelane Agri Estate (KMAE) Development is planned as a unique lifestyle gated community inside a high intensity agricultural farm in the Greater Malelane Town Area, Mpumalanga Province. The ± 28.4 ha study area comprises a portion of Portions 8, 13 & 14 of the Farm Malelane Estate 140- JU. The area is located outside the 1:100 flood line of the Crocodile River and the river forms the southern boundary of the Kruger National Park. The study area is bordered by a non-perennial drainage feature to the east, by a railway line to the south, by a wholesale nursery to the west and by the Crocodile River to the north. The ground surface drains via sheetwash and the aforementioned drainage feature drains towards the north in the direction of the Crocodile River at an average gradient ranging of some 5%. Water for the project will be provided from three sources. Firstly, the property has 13Ha of water rights on the Malelane Irrigation Board water canal which will be used for the farming operation. In addition to this, there are 3 boreholes on the property. Two of the boreholes will be utilized for domestic water supply to the residential properties and the other as supplementary water for the farm. Finally, water will be recovered from the sewerage treatment plant and this will be used to supplement the irrigation water (from the canal) on the farm.

As part of the proposed development a small dam wall (that will also serve as a river crossing) at an existing low water bridge is considered. This proposed dam wall may create a migration barrier to fish and the primary objective of this study was to assess the potential migratory impact of this proposed dam and determine the necessity and priority of implementing a fishway at the proposed structure.

All rivers are naturally continuous longitudinal ecosystems, as described by the River Continuum Concept (Vannote *et al*., 1980). This concept views all rivers as possessing continuous gradients of physical and chemical conditions that are progressively and continuously modified downstream from the headwaters to the sea. There is thus a continuous gradation along the length of any river, with the gradients of physical and chemical conditions eliciting a series of biological responses. Under natural or pre-development conditions, every species, and individual, form part of a balanced ecosystem. The disturbance of this balance, such as the prevention of a species to reach its breeding or feeding grounds may result in a shift in this balance. This change may be detrimental to the specific species, but also to the entire ecosystem, which includes humans.

One of the most important socio-economic impacts on the ecological processes of river systems is fragmentation through the building of dams and weirs (Jungwirth, 1998). The change from lotic (running) to lentic (stagnant) systems causes a loss in habitat and also act as migration barriers to aquatic biota. The prevention of aquatic biota to move freely throughout river systems can be detrimental to the continued survival of some species and also negatively impact on the maintenance of population abundance and distribution in general. The free passage of aquatic biota should therefore as far as possible be maintained in river systems to ensure sustainability of its ecological integrity and socio-economic value.

In some countries, the importance of providing free passage for fish during migration is driven by their economic importance (e.g. salmon, trout, etc.). In South Africa, there is no migratory fish with similar economic importance. The importance of the free passage of South African species (and their conservation/preservation) regarding socio-economic value is generally related to recreational value of a species for angling purposes. The main importance to facilitate the free passage of fish during migration is in South African rivers should, however, be our responsibility to protect the ecological integrity of our aquatic ecosystems. The National Water Act (NWA) No. 36 of 1998 advocates the equitable and sustainable utilization of water resources in South Africa within a ***protective framework*** (DWAF, 1999). It therefore includes our responsibility to allow free passage to migratory species if we are to protect the ecological integrity, and ensure sustainability.

The **current phase** aimed to achieve the following:

- **Determining the need for providing a fishway at the said barrier (necessity protocol):** Assess the ecological need for a fishway and the feasibility of providing a successful and cost- effective fishway.
- **Determining the priority of fishway provision (priority protocol):** Quantify the ecological impact of the barrier on migratory species present – i.e. importance of providing a fishway at the barrier.

2.OBJECTIVES & SCOPE OF WORK

The primary objectives of this study are as follows:

- Establish whether potential migratory fish and macroinvertebrates utilize the river reach to be influence by the proposed dam.
- Conduct the necessary fishway assessment to determine the need of providing a fishway at the said site.
- Provide preliminary biological criteria and recommendations for consideration in the design of the fishway (not required).

3.STUDY AREA AND BACKGROUND INFORMATION

The proposed dam is situated in an unnamed tributary (named KMAE stream for the purpose of this study) of the Crocodile River (East) (Figure 1, Table 1). It is though that this stream may have been a seasonal drainage line under natural conditions and have been altered (made perennial) by irrigation return flows (sugar cane). The present ecological status of this stream is discussed in detail in the aquatic specialist report (compiled by Dr. A. Deacon) that forms part of the EIA process of the proposed development.

Table 1:Approximate location of KMAE Dam (barrier of concern) assessed.

River	Barrier name	Latitude	Longitude	SQ reach no.
Unnamed tributary of the Crocodile River	Kruger Malalane Agricultural Estate (KKMAE) Dam	25.498734°	31.477650°	N/A (Trib of X24D-994 (Crocodile East)

Figure 1: Location and catchment area of proposed barrier

4.METHODOLOGY

The typical procedure for the planning, design, provision and operation of a fishway at any particular instream structure is provided in Figure 2 (from Bok *et. al.,* 2007[1]).

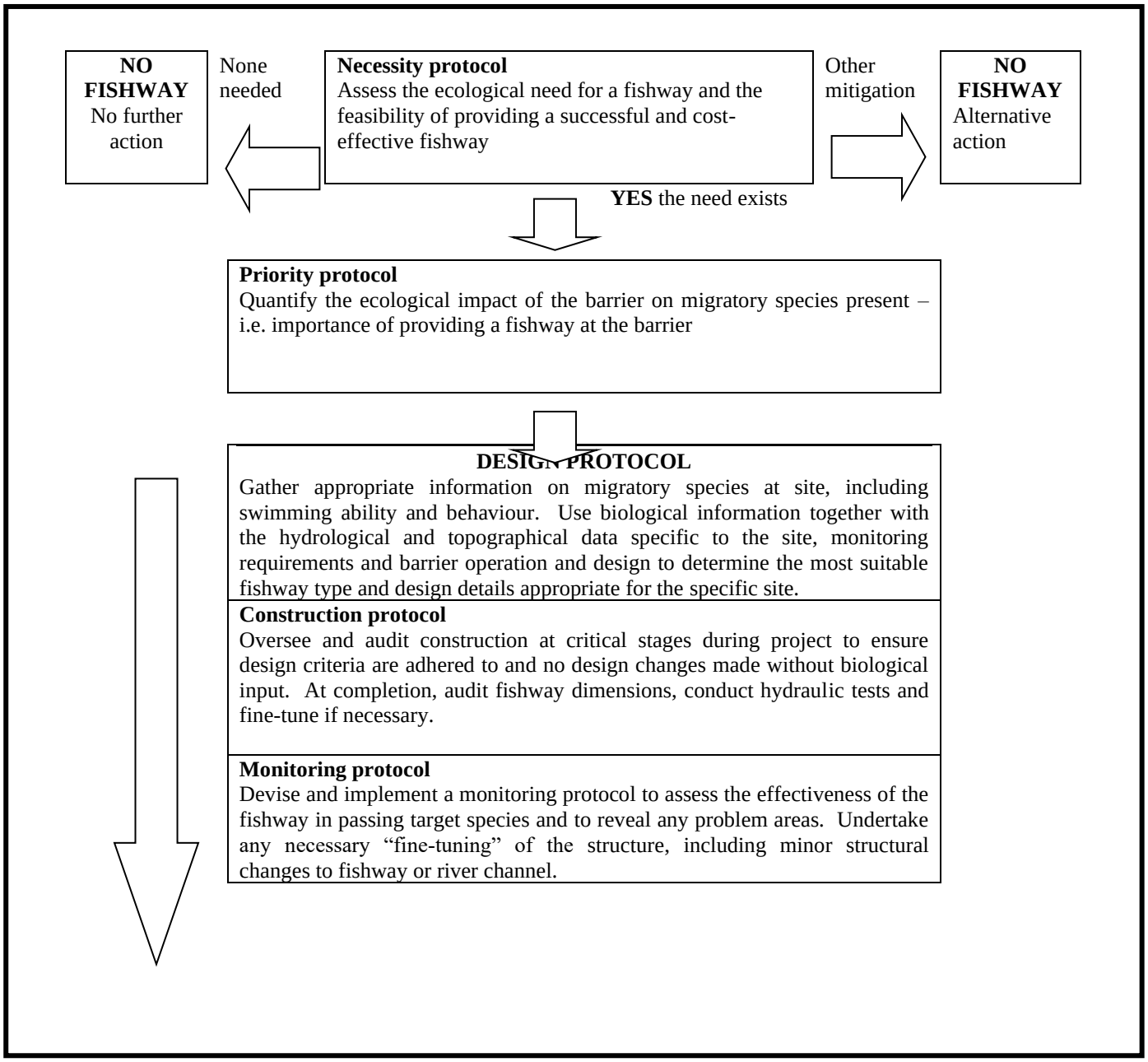

Figure 2: A summary of the procedure for the planning, design, provision and operation of a fishway at any particular in-stream structure.

[1] BOK A, KOTZE P, HEATH R and ROSSOUW J (2007) Guidelines for the planning, design and operation of fishways in South Africa. WRC Report No TT 287/07. Water Research Commission, Pta, South Africa.

4.1 Barrier information.

The following information was gathered for the proposed dam:

- GPS coordinates of wall and estimated upstream inundation point.
- Photographic views of various points in reach.
- Information required in the completion of fishway protocols (necessity and priority rankings):
    - Height of barrier,
    - Estimation of the flow range that the obstacle may be a barrier.
    - Whether fish will survive downstream migration over the barrier.
    - If there are potentially other more cost-effective mitigation measures that can be considered.
    - The estimated ecological status of the river.
    - The presence, status and accessibility of biologically significant upstream habitats.
    - Whether negative impacts of fishway will outweigh benefits.
    - Estimated drown-out (when flow becomes high enough to eliminate the drop in water level) characteristics of weir.
    - Feasibility of constructing a successful fishway.
    - Presence of permanent/natural barriers up- and downstream of site.
    - Identification of potential areas at the site that could be used for fishway construction.
    - An estimation of the potential fishway types that could be constructed at the site.

4.2 Determining the need for providing fishways at these barriers (necessity protocol)

The first step when investigating whether a particular in-stream structure will block migrations of aquatic biota is to determine the presence of migratory aquatic species in the river reach under consideration, as well as the characteristics of the structure and the site in terms of blocking of migrations. By answering a number of questions set out in a protocol (or steps) given in Figure 3, the necessity for providing a fishway at the structure can be determined. As indicated in Figure 3, there are a number of special circumstances when the construction of a fishway is not required or cannot be justified (Bok *et al.* 2007).

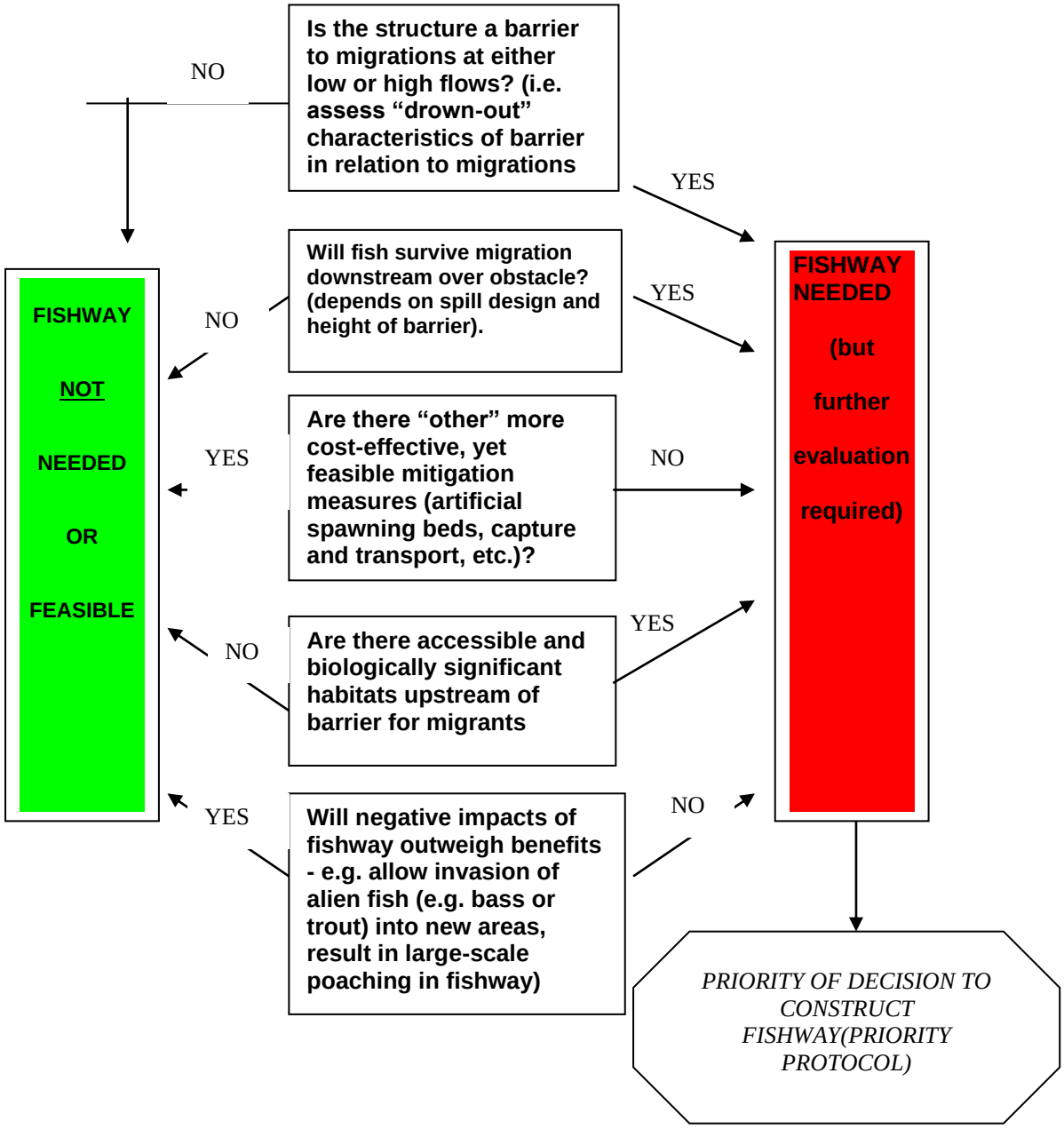

Figure 3: Protocol for assessing the need for providing a fishway at an in-stream barrier

4.3 Determining the importance or priority of fishway provision (priority protocol):

Once the necessity for providing a fishway at a proposed in-stream structure has been established, the cost-benefit or relative importance of providing fish passage past the barrier should be assessed. This will allow managers to identify priority sites for fishway construction in a standard and structured way to help ensure that the limited funding available for fishway construction is spent optimally and high priority sites receive the necessary attention. A quantitative ranking scheme, using a number of ecological and socio-economic criteria, was used during the current study (Table 2). A final score of >85 indicates "Very High Priority", 75 to 85 "High priority", 50 to 75 "Moderate priority" and less than 50 "Low priority".

Table 2: Scoring scheme to determine the importance (priority) of providing a fishway

Criteria	Max. Score	Site Score	Explanation
Socio-economic value of migratory species present	12		Value for food, angling, eco-tourism Low (4); moderate (8) and high (12)
Conservation status of migrants present (number of Red Data or threatened species)	12		Taken on a provincial level (4); national level (8); global level (12)
Ecological value of migrants (importance of role in eco-system functioning)	12		value in natural food web, e.g. high in reserves Low (4); moderate (8) and high (12)
Importance of upstream habitat to migrants	12		Low (4), moderate (8) and high (12)
Proportion of catchment/upstream habitat obstructed	9		<25% (3), 25- 50% (6), >50% (9).
Fish habitat integrity of river for migrants (i.e. PES/Management Class)	9		Poor, or Class E/F (3), moderate or Class C/D (6), good, Class A/B (9)
Percentage of stream flows that structure blocks fish passage due to drown-out characteristics of site	8		20 –40% (3); 40 – 60% (5), > 60% (8)
Feasibility of constructing a successful fishway (i. e. confidence of success)	8		Low (3), moderate (5), excellent (8)
Expense of fishway in relation to the ecological benefits	6		High (2), moderate (4), low (6)
Financial and other support from NGO's, government, special interest groups, etc.)	6		Low (2), moderate (4), high (6)
Presence of permanent/natural barriers downstream	6		None (6), rare (4), many (2)
TOTAL SCORE	**100**		

4.4 Providing preliminary biological consideration for the design of fishways at the identified barriers.

The fish species estimated to occur in the river both up- and downstream from the barrier was determined based on the latest available information. The primary source of information used during this process was the aquatic specialist report produced by Dr. A. Deacon. The migratory characteristics and requirements of the important migratory species were considered.

5.RESULTS & DISCUSSION

5.1 General observations and notes (based on site visits and Google Earth aerial imagery)

1. An existing low-water bridge located on the property and in close proximity to the inflow of the Crocodile River (approximately 100m) is already creating a migration barrier (due to drop/height during low flows and high velocity through pipes during high flows) (Plate 1).
2. The current stream utilizable for fish (aquatic biota) upstream of the current and hence proposed dam is only approximately 650m long (from dam wall/bridge to train bridge) (see aerial imagery in Figure 3). Upstream of the train bridge the catchment has been radically transformed by sugarcane (see aerial imagery in Figure 3 and plate 3). Irrigation return flows are transported in a canal along the railway line that flows into the stream at the railway bridge. The canal is of no habitat value to fish and another migration barrier to movement (due to continuous high velocity over long distance) (Plate 2).
3. The stream in its current state is highly transformed from its natural state, and it is estimated that the return flows have created a perennial stream that was once only a seasonal/ephemeral drainage line.
4. The habitat available within the approximately 650m of river is also in a poor state due to sedimentation and alien vegetation encroachment in the riparian zone and is generally of limited value to aquatic fauna.
5. Although this stream provides some refugia for fish (utilized by opportunistic biota as a result of the artificial habitat created by the return flows), it is thought to be of very limited ecological value (due to the short reach and relative low diversity).

5.2 Necessity and priority (importance) protocols

- Based on available information, **three of the five criteria** (60%) in the “necessity protocol” indicated that a **fishway is not needed/feasible** (Table 3). Assessment therefore indicates that implementation of a fishway **may not be required or feasible at this site**.
- A “priority protocol” score of 42% was calculated, indicating that the provision of a fishway at this proposed barrier is of **very low priority** (Table 4).

Plate 1: Existing bridge (barrier)

Plate 2: Canal / irrigation return flows (upstream of railway bridge).

Plate 3: Radically transformed upstream catchment (upstream of railway bridge).

Table 3: Results of the fishway necessity protocol applied for barrier of concern.

FISHWAY NECESSITY PROTOCOL			
QUESTIONS	**Yes / No / ?**	**COMMENTS**	**Result**
Is the structure a barrier to migrations at either low or high flows? (i.e. assess "drown-out" characteristics of barrier in relation to migrations)	Yes	Dam wall height of 5m. Barrier at low and high flows.	Fishway needed
Will fish survive migration downstream over obstacle? (depends on spillway design and height of barrier)	Yes		Fishway needed
Are there "other" more cost-effective, yet feasible mitigation measures (artificial spawning beds, capture & transport, etc.)?	Yes	Capture and transport.	Fishway not needed/feasible
Are there accessible and biologically significant habitats upstream of barrier for migrants	No	Catchment area small and 90% transformed (sugar cane fields). Only approximately 650m of transformed and artificially created river available for utilization (negligible).	Fishway not needed/feasible
Will negative impacts of fishway outweigh benefits - e.g. allow invasion of alien fish (e.g. bass or trout) into new areas, result in large-scale poaching in fishway)?	Yes	Potentially, as fish may be attracted to migrate upstream and after spending energy to cross barrier (fishway), there is no to very limited suitable habitats available. The proposed dam may furthermore create suitable habitat (pool) for colonization of high abundance of predatory Sharptooth catfish (and potential other unwanted species such as alien Largemouth Bass). These species will prey on and potentially eradicate all small and juvenile fish species that may enter the dam.	Fishway not needed/feasible

Table 4: Results of the fishway priority protocol (descriptions) for the barrier of concern.

IMPORTANCE RATINGS				
Criteria	**Site score**	**Explanation**	**Result**	**Comments**
Socio-economic value of migratory species present	1	Value for food, angling, eco-tourism. Low (4), Moderate (8), High (12)	Low	Limited (if any) utilization of fish in catchment.
Conservation status of migrants present (number of Red Data or threatened species)	2	Taken on provincial level (4), national level (8), global level (12)	Low	*Labeobarbus* species becoming scarcer in Mpumalanga. Only *L. marequensis* (still abundant in Lowveld reaches of Crocodile River) will unitise short reach of this stream.
Ecological value of migrants (importance of role in ecosystem functioning)	4	Value in food web, e.g. high in reserve. Low (4), moderate (8) and high (12)	Low	Small number of species utilising short stretch of this stream.
Importance of upstream habitat to migrant.	2	Low (4), moderate (8), high (12)	Low	Very small catchment, almost completely transformed (sugar cane farming), altered flows (irrigation return flows), deteriorated river condition (flow modification, sedimentation).
Proportion of catchment/upstream habitat obstructed.	3	<25% (3), 25-50% (6), >50% (9)	Low	Although this dam is present in lower reaches of this stream, the obstructed proportion of catchment that is still utilizable by fish is small/insignificant (approximately 650m).
Fish habitat integrity of river for migrants (i.e. PES/Managament class)	6	Poor: Class F (1) and E (3), moderate: class D (4) and C (6), good: class B (7), A (9)	Moderate	Estimated to be in moderately to largely transformed status due to extent of transformation in catchment.
Percentage of stream flows that structure blocks fish passage due to drown-out characteristics of site	8	20 –40% (3); 40 – 60% (5), > 60% (8)	High	Permanent barrier at most flows (low and high).
Feasibility of constructing a successful fishway (i. e. confidence of success)	5	Low (3), moderate (5), excellent (8)	Moderate	Limited potential for natural bypass.
Expense of fishway in relation to ecological benefits	2	High (2), moderate (4), low (6)	High	High cost for limited to no ecological benefit.
Financial and other support from NGO's, government, special interest groups, etc.)	4	Low (2), moderate (4), high (6)	Moderate	Potential contribution by developer (if required).
Presence of permanent/natural barriers downstream	5	None (6), rare (4), many (2)	None	None in KMEA stream, various in receiving Crocodile River
TOTAL	**42**		Low priority	

5.3 Migratory species

Background and motivation

Aquatic biota differ in their requirement for various factors such as habitat, water quality, food source as well as the need for migration (both longitudinal and lateral). The importance of migration for survival therefore differs significantly between different species and life-stages (Table 6). Some species can for instance not survive if they cannot move between fresh and seawater (such as eels), while others can successfully breed and even thrive within a single dam or a short stretch of river. The migratory life histories of fish can be divided into the following groups (McDowell, 1987; Porcher & Travade, 2002):

- **Diadromous**: Truly migratory fishes which migrate between the sea or saline water and freshwater. This category can be subdivided in the following:
    - **Catadromous** – Diadromous fishes which spend most of their lives in freshwater and migrate to the sea (or saline reaches of estuaries) to breed as adults (e.g. eels). The post-larvae and juveniles then migrate back to freshwater habitats. This term is used to include species which have an obligatory freshwater phase in their life cycle (obligatory catadromous) and ii) which have a facultative habit of entering fresh water that is carried out by only a portion of the population (facultative catadromous)
    - **Amphidromous** – Diadromous fishes where migration occurs both as adults and juveniles from freshwater to the sea, or vice-versa, is not for the purpose of breeding, but occurs regularly at some other definitive stage. These species can spawn in fresh water or in saline water (the sea or estuaries).
    - **Anadromous** – Diadromous fish that spend most of their lives in the sea and migrate to freshwater to breed.
- **Potadromous**: Truly migratory species whose entire life cycle is completed within freshwater and that undertake migrations within freshwater zones of rivers for a variety of reasons, such as for spawning, feeding, dispersion after spawning, colonisation after droughts, for over-wintering, etc.

Most aquatic biota need to migrate for survival or for the maintenance of population abundance and distribution (Harris, 1984). The most common specific reasons mentioned in literature (Chutter & Heath, 1993; Northcote, 1998; Olivier, 2003; Pethebridge *et al*., 1998; Skelton, 2001) for the migration of aquatic biota are to reach suitable habitats to breed/spawn (reproduction), to reach suitable habitats to feed (growth) and to seek refuge from harmful environmental conditions such as extreme temperatures or predators (survival).

The migratory behaviour of aquatic biota are regulated by a complex interaction between environmental cues, environmental controls on physiological functions (for example hormonal ones), and species-, size, age and sex- related changes, as well as differences in these and their related behavioral manifestations (Northcote, 1998). The factors “triggering” the movement or migrations of fish are, as yet, not fully understood for most species.

Aquatic biota usually possess specific features and adaptations to assist them through the migratory process. The primary mechanisms related to migrations include swimming ability, jumping ability and crawling ability. Fish size influences hydraulic characteristics since swimming speed is positively related to fish length. Thus, the fishway elements should be sized to suit the largest fish and for the largest number of fish expected to use it at any one time. At the same time, hydraulic conditions in the fishway, including upstream and downstream reaches, must be such that the weakest migratory species negotiate it.

KMAE Stream fish species

- Six (6) fish species were sampled in the lower reaches of the KMAE stream by Dr. A. Deacon (as part of EIA study) (refer to specialist report for details). Although some other species may also be expected to occur and/or utilize this stream at times, the overall fish species diversity is low. The natural fish species diversity in this stream may have been even lower should this stream have been ephemeral/seasonal under reference conditions.
- The most important migratory species sampled in the river reach of concern is *Labeobarbus marequensis* and two Labeo species (*L. molybdinus and L. cylindricus*). The habitat upstream of the proposed dam/bridge is however not suitable for colonization of these species (limited feeding value, no breeding value).

6. CONCLUSIONS & RECOMMENDATIONS

The following primary **conclusions** were drawn from the current study:

- Based on available information, **three of the five criteria** (60%) in the "fishway necessity protocol" indicated that a **fishway is not needed/feasible**. Assessment therefore indicates that implementation of a fishway **may not be required or feasible at this site**.
- A "priority protocol" score of 42% was calculated, indicating that the provision of a fishway at this proposed barrier is considered of **very low priority**.
- Based on the above considerations it is unlikely that the cost of a fishway would be justified since little ecological benefit will be gained.
- Other more cost-effective options to move fish across the barrier could be considered, but may not be required due to the poor state and limited value of upstream habitats. Other options that may be further considered include:
    - Physical collection of fish during peak migrations and moving them over the migration barrier.
    - Utilising natural rocky areas at edges of dam wall to create "natural type fishway/rapids" (if available and applicable).

The following **recommendations** are made:

- Based on the results of this assessment it was concluded that a fishway will add little if any ecological benefit at the proposed dam site and no fishway is required for installation at the proposed dam. His recommendation is based on ecological considerations.
- Ideally the existing barrier (bridge) should be removed and if access is required a bridge should be reconstructed with minimal impact on the riverbed.
- The proposed development can contribute by taking ownership of the stream of concern. It is strongly recommended that this river reach should be rehabilitated to improve its ecological integrity and its contribution towards the receiving Crocodile River. The following aspects could be considered:
    - Clearing of all alien vegetation from riparian zone (and preferably entire catchment area by relevant authority). Indigenous riparian zone vegetation should be maintained (no clearing of indigenous riparian vegetation).
    - Cleaning of all solid waste and preventing further rubbish dumping in this stream. Preventing solid waste/rubbish to be transported via this stream towards the Crocodile River (Kruger National Park).
    - Stabilization of riverbanks and addressing current erosion problems. Inclusion of all possible erosion control measures within the proposed development to decrease the inflow of sediment that result in bed modification within this stream and the receiving Crocodile River (includes erosion in upstream catchment).
    - Prohibiting the introduction of any fish species (indigenous or alien) within this proposed development.

Regular monitoring (at least quarterly) of water quality of this stream at the inflow and outflow of property to ensure that no deterioration of water quality occur as a result of the proposed development.

7. REFERENCES

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APPENDIX 4.4.4.
HERITAGE SPECIALIST REPORT

SPECIALIST REPORT

PHASE 1 ARCHAEOLOGICAL/HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED GOUVEIA-CROCODILE RIVER PROJECT: AGRICULTURAL AND RESIDENTIAL DEVELOPMENT ON THE REMAINDER OF PORTIONS 8 & 13 AND PORTION 14 of the farm MALELANE ESTATE A 140JU, MALELANE, MPUMALANGA PROVINCE

REPORT COMPILED FOR

RHENGU ENVIRONMENTAL SERVICES

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FEBRUARY 2021

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EXECUTIVE SUMMARY

A Phase 1 Heritage Impact Assessment (HIA) regarding archaeological and other cultural heritage resources was conducted on the footprint for the proposed agricultural and residential development on *the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU*, Malelane.

The study area is situated on topographical map 1:50 000, 2531AD / BC, which is in the Mpumalanga Province. This area falls under the jurisdiction of the Ehlanzeni District Municipality, and Nkomazi Local Municipality. The project site is in the extent of 28.431ha.

The National Heritage Resources Act, no 25 (1999)(NHRA), protects all heritage resources, which are classified as national estate. The NHRA stipulates that any person who intends to undertake a development, is subjected to the provisions of the Act.

The owner and applicant, BLUE GRASS Trading 128cc in co-operation with RHENGU Environmental Services, is requesting the development of disturbed land for agricultural as well as residential purposes, on the banks of the Crocodile River, facing the Kruger National Park. The entire project site was used to cultivate vegetables since the Gouveia family bought the farm in 1955. The original farmhouse was built during 1955/1956 and is the only feature that falls under the protection of the NHRA as it is older than 60 years and needs to be mitigated (see discussion further in text).

The survey revealed no other archaeological or historical features of significance, and no graves were observed during the survey.

Apart from the mitigation measures recommended for the historical house, the rest of the farm is situated on entirely disturbed land. The owner & developers need to be made aware that distinct archaeological material or human remains may only be revealed during the construction activities of the agricultural and residential development. It is recommended that earthmoving activities be monitored by a qualified archaeologist and that an assessment be done. Based on the survey and the findings in this report, Adansonia Heritage Consultants state that there are no compelling reasons which may prevent the proposed development to continue.

Disclaimer: *Although all possible care is taken to identify all sites of cultural significance during the investigation, it is possible that hidden or sub-surface sites could be overlooked during the study. Christine Rowe trading as Adansonia Heritage Consultants will not be held liable for such oversights or for costs incurred by the client as a result.*

CHRISTINE ROWE
FEBRUARY 2021

CONTENTS

PHASE 1 ARCHAEOLOGICAL/HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED GOUVEIA-CROCODILE RIVER PROJECT: AGRICULTURAL AND RESIDENTIAL DEVELOPMENT ON THE REMAINDER OF PORTIONS 8 & 13 AND PORTION 14 of the farm MALELANE ESTATE A 140JU, MALELANE, MPUMALANGA PROVINCE

A. BACKGROUND INFORMATION TO THE PROJECT

The owner and applicant, BLUE GRASS Trading cc, in co-operation with RHENGU ENVIRONMENTAL SERVICES is requesting the development of disturbed land for agricultural as well as residential purposes, on the banks of the Crocodile River, facing the Kruger National Park. The proposed project area is situated on the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU. The project site is in the extent of 28.431ha. [2]

The study area is situated on topographical map 1:50 000, 2531AD / BC, which is in the Mpumalanga Province. This area falls under the jurisdiction of the Ehlanzeni District Municipality, and Nkomazi Local Municipality. The proposed agricultural development is situated less than 1km north of the N4 national road, near the town of Malelane. The area is zoned as agricultural, and no rezoning will take place. The area was flat and accessible, with a network of paths and roads to access the area. [3]

Adansonia Heritage Consultants were appointed by RHENGU ENVIRONMENTAL SERVICES, to conduct a Phase 1 heritage impact assessment (HIA) on archaeological and other heritage resources on the study area. A literature study, relevant to the study area as well as a foot survey was done, to determine that no archaeological or heritage resources will be impacted upon. (See Map. 2: Topographical Map: 2531AD/BC).

The aims of this report are to source all relevant information on archaeological and heritage resources in the study area, and to advise the client on sensitive heritage areas as well as where it is viable for the development to take place in terms of the specifications as set out in the National Heritage Resources Act no., 25 of 1999 (NHRA). Recommendations for maximum conservation measures for any heritage resources will also be made. The study area is indicated in maps 1 - 7, and Appendix 1 & 2.

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[2] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.

[3] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.

- This study forms part of an EIA, Consultant: RHENGU ENVIRONMENTAL SERVICES., P.O. Box 1046, Malelane, 1320, Cell: 0824147088 / Fax: 0866858003 / e-mail: rhengu@mweb.co.za
- Type of development: 28.431ha, are earmarked for a proposed agricultural as well as residential development, on the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU, Mpumalanga Province.
- The site is currently zoned as agricultural, and no rezoning will take place.
- Location of Province, Magisterial district / Local Authority and Property (farms): The area falls within the Mpumalanga Province under the jurisdiction of the Ehlanzeni District Municipality and Nkomazi Local Municipality.
- Land owner and applicant: BLUE GRASS Trading cc. [4]

Terms of reference: As specified by section 38 (3) of the NHRA, the following information is provided in this report.

a) The identification and mapping of heritage resources where applicable;
b) Assessment of the significance of the heritage resources;
c) Alternatives given to affected heritage resources by the development;
d) Plans for measures of mitigation.

Legal requirements:

The legal context of the report is grounded in the National Heritage Resources Act no. 25, 1999, as well as the National Environmental Management Act (1998) (NEMA) (as amended)

- **Section 38 of the NHRA**

This report constitutes a heritage impact assessment investigation linked to the environmental impact assessment required for the development. The proposed development is a listed activity in terms of Section 38 (1) of the NHRA. Section 38 (2) of the NHRA requires the submission of a HIA report for authorisation purposes to the responsible heritage resources agency, (SAHRA).

Heritage conservation and management in South Africa is governed by the NHRA and falls under the overall jurisdiction of the South African Heritage Resources Agency (SAHRA) and its provincial offices and counterparts.

[4] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.

Section 38 of the NHRA requires a Heritage Impact Assessment (HIA) to be conducted by an independent heritage management consultant, for the following development categories:

- Any development or other activity which will change the character of a site:
  - exceeding 5000m² in extent;
  - the rezoning of a site exceeding 10 000m² in extent;

In addition, the new EIA regulation promulgated in terms of NEMA, determines that any environmental report will include cultural (heritage) issues.

The end purpose of this report is to alert RHENGU ENVIRONMENTAL SERVICES, as well as the client BLUE GRASS Trading cc, and interested and affected parties about existing heritage resources that may be affected by the proposed development, and to recommend mitigation measures aimed at reducing the risks of any adverse impacts on these heritage resources. Such measures could include the recording of any heritage building or structure older than 60 years prior to demolition, in terms of section 34 of the NHRA and also other sections of this act dealing with archaeological sites, buildings and graves.

The NHRA section 2 (xvi) states that a “heritage resource” means any place or object of cultural significance, and in section 2 (vi) that “cultural significance” means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

Apart from a heritage report assisting a client to make informed development decisions, it also serves to provide the relevant heritage resources authority with the necessary data to perform their statutory duties under the NHRA. After evaluating the heritage scoping report, the heritage resources authority will decide on the status of the resource, whether the development may proceed as proposed or whether mitigation is acceptable, and whether the heritage resource require formal protection such as a Grade I, II or III, with relevant parties having to comply with all aspects pertaining to such a grading.

- **Section 35 of the NHRA**

Section 35 (4) of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object. This section may apply to any significant archaeological sites that may be discovered. In the case of such chance finds, the heritage practitioner will assist in investigating the extent and significance of the finds and consult with an archaeologist about further action. This may entail removal of material after documenting the find or mapping of larger sections before destruction. No archaeological material was found during the survey.

- **Section 36 of the NHRA**

Section 36 of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority. It is possible that chance burials might be discovered during development of the road infrastructure or agricultural activities. No graves were observed within the study area, which was also confirmed by Mr. Gouveia, who grew up on the farm. [5]

- **Section 34 of the NHRA**

Section 34 of the NHRA stipulates that no person may alter, damage, destroy, relocate etc, any building or structure older than 60 years, without a permit issued by SAHRA or a provincial heritage resources authority. This section does apply as the original farmhouse is older than 60 years and mitigation measures are recommended.

- **Section 37 of the NHRA**

This section deals with public monuments and memorials but does not apply in this report.

- **NEMA**

The regulations in terms of Chapter 5 of the National Environmental Management Act, (107/1998) (as amended), provides for an assessment of development impacts on the cultural (heritage) and social environment and for specialist studies in this regard.

[5] Personal information: Mr. G. Gouveia, Previous owner, 2021-02-09.

B BACKGROUND TO ARCHAEOLOGY AND HISTORY OF THE STUDY AREA

- **Literature review, museum databases & previous relevant impact assessments**

The study area, the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU, is located next to the town of Malelane, on the banks of the Crocodile River, overlooking the Kruger National Park (KNP). Swaziland is situated approximately 40 km to the south. An irrigation scheme was planned in 1957 for the farms south of the Crocodile River and KNP. Huge citrus farms were already established during that time. The irrigation scheme was delayed, and the farmers Danie and Dirk van Graan of Thankerton, started their own scheme, and built the 'Van Graan Dam', in the Crocodile River with a canal and three turbines on their farm. [6]

The area is quite rich in archaeological history and the first evidence of ancient mining occurred between 46 000 and 28 500 years ago during the Middle Stone Age. Hematite or red ochre was mined at Dumaneni (near Malelane), and is regarded as one of the oldest mines in the world. Iron ore was also mined in the area and a furnace, as well as iron slag were documented.[7]

Bushman (or San) presence is evident in the area as research by rock art enthusiasts revealed 109 sites in the Kruger National Park,[8] and over 100 rock art sites at Bongani Mountain Lodge and its immediate surrounds[9] (west of Malelane), as well as many sites in the Nelspruit, Rocky's Drift and White River areas. Thirty-one rock art sites were recorded on the Mpumalanga Drakensberg Escarpment. Rock art sites were also recorded in Swaziland. [10] [11] However, Smith and Zubieta claim that the area towards the east (Komatipoort) has no known rock art sites. The Bushman painters most probably obtained the ochre which was used as a pigment in the paintings, from the Dumaneni ochre mine.[12] [13]

History in the wider vicinity is closely connected to the study area and is briefly outlined below. The name Komati appears in historical records for the first time in 1589, in the form *Macomates*. It was recorded by a traveler on board the Portuguese ship *Sao Thome,* which sailed from Cochin, South India and ran aground on the shores of the *Land of the Makomati*,

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6 Bornman, H., *The Pioneers of the Lowveld*, p. 69-70.
7 Bornman, H., *The Pioneers of the Lowveld*, p. 1.
8 English, M. Die Rotskuns van die Boesmans in die NKW, *in De Vos Pienaar, U., Neem uit die Verlede*, p. 18-24.
9 Hampson, et al., The rock art of Bongani Mountain Lodge, SA Archaeological Bullitin 57: p. 15.
10 Rowe, C. 2009. Heritage Management of Archaeological, Historical and Industrial resources on the Blyde River Canyon Nature Reserve, MA dissertation. Pretoria: UP.
11 Masson, J. 2008. Views from a Swaziland Cave. The Digging Stick, Vol. 25 no 1: 1-3.
12 Bornman, H. The Pioneers of the Lowveld, p. 1.
13 Masson, J. 2008. Views from a Swaziland Cave. *The Digging Stick,* Vol. 25 no 1: 1-3.

near *Lake Sibayi*, in what became known as KwaZulu Natal. The *Land of Makomati* comprised the entire hinterland as far north as the Limpopo River, as far south as St Lucia, and as far west as the Drakensberg escarpment. It was the trading zone of the Komati gold and ivory traders who had established themselves in Delagoa Bay (which was known up to the 17th century as *Makomati*), long before the arrival of the first Portuguese in 1498. The name of the Komati River came from *Makomati* who used it for trading purposes.[14]

In order to place the areas around Malelane in an archaeological context, primary and secondary sources were consulted. Ethnographical and linguistic studies by early researchers such as Ziervogel and Van Warmelo shed light on the cultural groups living in the area since ca 1600. Historic and academic sources by Küsel, Meyer, Voight, Bergh, De Jongh, Evers, Myburgh, Thackeray and Van der Ryst were consulted, as well as historic sources (Makhura and Webb).

Primary sources were consulted from the Pilgrim's Rest Museum Archives for a background on the pre-history and history of the study area. Several circular stone-walled complexes and terraces as well as graves have been recorded in the vicinity of Hazyview[15], Bushbuckridge, Graskop and Sabie, clay potsherds and upper as well as lower grinders, are scattered at most of the sites.[16] Many of these occur in caves as a result of the Swazi attacks (1900's), on the smaller groups. The 1984 topographical map (2531BC) did not show any historical features of interest. The 1926 topographical map of *Komatipoort* revealed quite a few black settlements along the Lomati River (a branch of the Komati River), approximately 20km south of the study area (indicated in pink on Map 3).[17] These black settlements were recorded by names such as *Sonquela, Induna, Gomeni, Mahlilan*. They settled along the rivers and in the hills.

The author was also involved in desktop studies and surveys in the area, such as:

- *Study for the Proposed Eskom Powerlines, Hazyview – Dwarsloop* (2008);
- *Inspection of Umbhaba Stone-walled settlement, Hazyview,* (2001);
- a *Phase 1 Archaeological and Heritage Impact Assessment for 132Kv Powerlines from Kiepersol substation (Hazyview), to the Nwarele substation Dwarsloop (2002);*
- a *Phase 1 Archaeological and Heritage Impact Assessment for a proposed traffic training academy, Calcutta, Mkhuhlu, Bushbuckridge* (2013*);*
- Phase 1 Archaeological and Heritage Impact Assessment for the proposed *Nkambeni*

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14 Bornman, H., *The Pioneers of the Lowveld*, p. 9.
15 PRMA: Information file 9/2.
16 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 3.
17 Map: 1926 Topographical Map: Komati Poort no. 22.

cemetery in Numbi, Hazyview *(2013);*

- Phase 1 Archaeological and Heritage Impact Assessment for a *Development on the farm Agricultural Holding no 56 JU,* White River (2013) was done in the wider area;
- Phase 1 Archaeological and Heritage Impact Assessment for proposed *agricultural development on the farm SIERAAD,* Komatipoort area, (2013) revealed one possible Late Stone Age borer which was identified in a soil sample, one meter below the surface.
- Phase 1 Archaeological and Heritage Impact Assessment for *proposed debushing of natural land for agricultural use on portion 10 of Thankerton 175JU, Hectorspruit,* (2014), some LSA stone tools were observed but they were not in any archaeological context. Graves were situated outside of the study area.

The SAHRA database for archaeological and historical impact assessments was consulted and revealed other recent Archaeological Impact assessment reports in the area of Komatipoort:

- J. Van Schalkwyk: *Proposed new Lebombo Port of Entry and upgrade of Komatipoort railway station between Mpumalanga (SA) and Mozambique (2008)* – Some historic buildings were identified but no archaeological remains were observed;
- A. Van Vollenhoven: *Report on a cultural Heritage Impact Assessment for the proposed Kangwane Antracite Mine, Komatipoort (2012)* – An archaeological site with Middle and Late Stone Age tools were identified as well as some Iron Age artifacts and decorated pottery. Mitigation measures were recommended by exclusion from the development or a Phase 2 study;
- JP Celliers: *Report on Phase 1 Archaeological Impact assessment on erven at Komatipoort 182 JU Extension 4, Komatipoort (2012)* – Revealed two pieces of undecorated sherds of pottery which was of low significance. It was recommended that any earthmoving activities be monitored by a qualified archaeologist.
- A. Van Vollenhoven: *Archaeological Impact Assessment for Border site at Komatipoort (2012)* – Revealed historic remains linked to the Steinaeker's Horse regiment during the South African War.

Very little contemporary research has been done on prehistoric African settlements in the study area. Later Stone Age sites in the Kruger National Park date to the last 2500 years and are associated with pottery and microlith stone tools.[18] The only professionally excavated Early Iron Age site near the area, besides those in the Kruger National Park, is the Plaston

[18] J.S. Bergh (red),*Geskiedenis Atlas van Suid Afrika: Die vier Noordelike Provinsies,* p. 95.

site near White River, dating ca 900 AD.[19] No other archaeological excavations have been conducted to date within the study area, which have been confirmed by academic institutions and specialists in the field.[20] [21] A stone walled settlement with terracing was recorded by C. van Wyk (Rowe) close to Hazyview,[22] as well as several which were documented in the southern parts of the Kruger National Park.[23] The southern Kruger Park and Nelspruit areas have an abundance of San rock art sites,[24] as mentioned above, but none were identified in the direct vicinity of the study area.

Several early ethnographical and linguistic studies by early researchers such as D. Ziervogel and N.J. Van Warmelo, revealed that the study area was mainly inhabited by the Tsonga (Nhlanganu and Tšhangana), as well as Swazi from before the 18th century.[25] [26] (See Map 1: 1935: Map of Van Warmelo). When concentrating on ethnographical history, it is important to include a slightly wider geographical area in order for it to make sense. Van Warmelo based his 1935 survey of *Bantu Tribes of South Africa* on the number of taxpayers in an area. The survey does not include the extended households of each taxpayer, so it was impossible to actually indicate how many people were living in one area.[27]

The whole district is divided in two, with the Drakensberg Escarpment in the west, and the Low Veld (in which the study area is situated) towards the east. Today, we found that the boundaries of groups are intersected and overlapping.[28] Languages such as Zulu, Xhosa, Swazi, Nhlanganu, Nkuna, sePedi, hiPau and seRôka, are commonly spoken throughout this area.[29]

During the middle of the 18th century some Sotho and Swazi groups combined under a fighting chief Simkulu. The tribe so formed became known as the BakaNgomane. The principal settlement of Simkulu was in the vicinity of the confluence of the Crocodile and Komati Rivers. It is believed that the BakaNgomane chiefs were buried there.[30]

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19 M.M. Van der Ryst., Die Ystertydperk, *in J.S. Bergh (red.), Geskiedenis Atlas van Suid Afrika: Die vier Noordelike Provinsies.* p. 97.
20 Personal information: Dr. J. Pistorius, Pretoria, 2008-04-17.
21 Personal information: Dr. MS. Schoeman, University of Pretoria, 2008-03-27.
22 C. Van Wyk, *Inspection of Umbhaba Stone-walled settlement, Hazyview,* pp. 1-2.
23 Eloff J.F., Verslag oor Argeologiese Navorsing in die Krugerwildtuin, June / July, 1982.
24 Hampson, J., et al., The rock art of Bongani Mountain Lodge and its environs, *South African Archaeological Bulletin* 57: pp. 17-28.
25 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* pp. 90-92 & 111.
26 H. S. Webb, The Native Inhabitants of the Southern Lowveld, *in Lowveld Regional Development Association, The South-Eastern Transvaal Lowveld.* p.16.
27 N.J. van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p.9.
28 N.J. van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 51.
29 M. De Jongh (ed)., *Swatini,* p. 21.
30 Bornman H., *The Pioneers of the Lowveld* pp. 10-11.

The Swazi under Mswati II (1845), commenced on a career of large-scale raids on the prosperous tribal lands to the north of Swaziland. His regiments such as the *Nyatsi* and the *Malelane* brought terror to African homes as far afield as Mozambique.[31] During their northern expansion they forced the local inhabitants out of Swaziland, or absorbed them.[32] There is evidence of resistance, but the Eastern Sotho groups who lived in the northern parts of Swaziland, moved mainly northwards.[33] This appears to have taken place towards the end of the 18th century,[34] when these groups fled from Swaziland to areas such as Nelspruit, Bushbuckridge, Klaserie, Blyde River and Komatipoort.[35]

Mswati II built a line of military outposts from west to east of the upper Komati River and the Mlambongwane (Kaap River). At each outpost he stationed regiments to watch and stop the BaPedi returning to their old haunts.[36]

Shaka in the course of his military actions, came into conflict with Zwide Mkhatshwa (1819). Nonwithstanding Zwide's numerical superiority, Shaka defeated him. The remnants of Zwide's tribe fled into the Eastern Transvaal where they settled. They ultimately found a new kingdom in Gaza land, which extended from just north of the current Maputo, up the east coast as far as the Zambezi river.[37]

Soshangane was a very powerful chief of the Gaza people, even though he was under the rule of Zwide. Soshangane decided to leave and was given full passage through Swaziland. He passed on his way through the Komati gorge, today known as Komatipoort, taking with him a great booty of cattle and women. Meanwhile more Shangane arrived and by 1896 some 2000 refugees settled between Bushbuckridge and Acornhoek where they are still living today. With the establishment of the Sabie Game Reserve (later known as the Kruger National Park), the BakaNgomane, their Shangaan protégés and Swazis who lived within its borders, were evicted in 1902, and went westward into Klaserie and Bushbuckridge areas, or south of the Crocodile River and established themselves in the Tenbosch and Coal Mine (Strijdom Block) areas (close to the current study area), west and south of Komatipoort. The Swazi of Khandzalive moved to Mjejane or Emjejane, the current name for Hectorspruit.[38] (See also: Map 1: 1935 Map of Van Warmelo).

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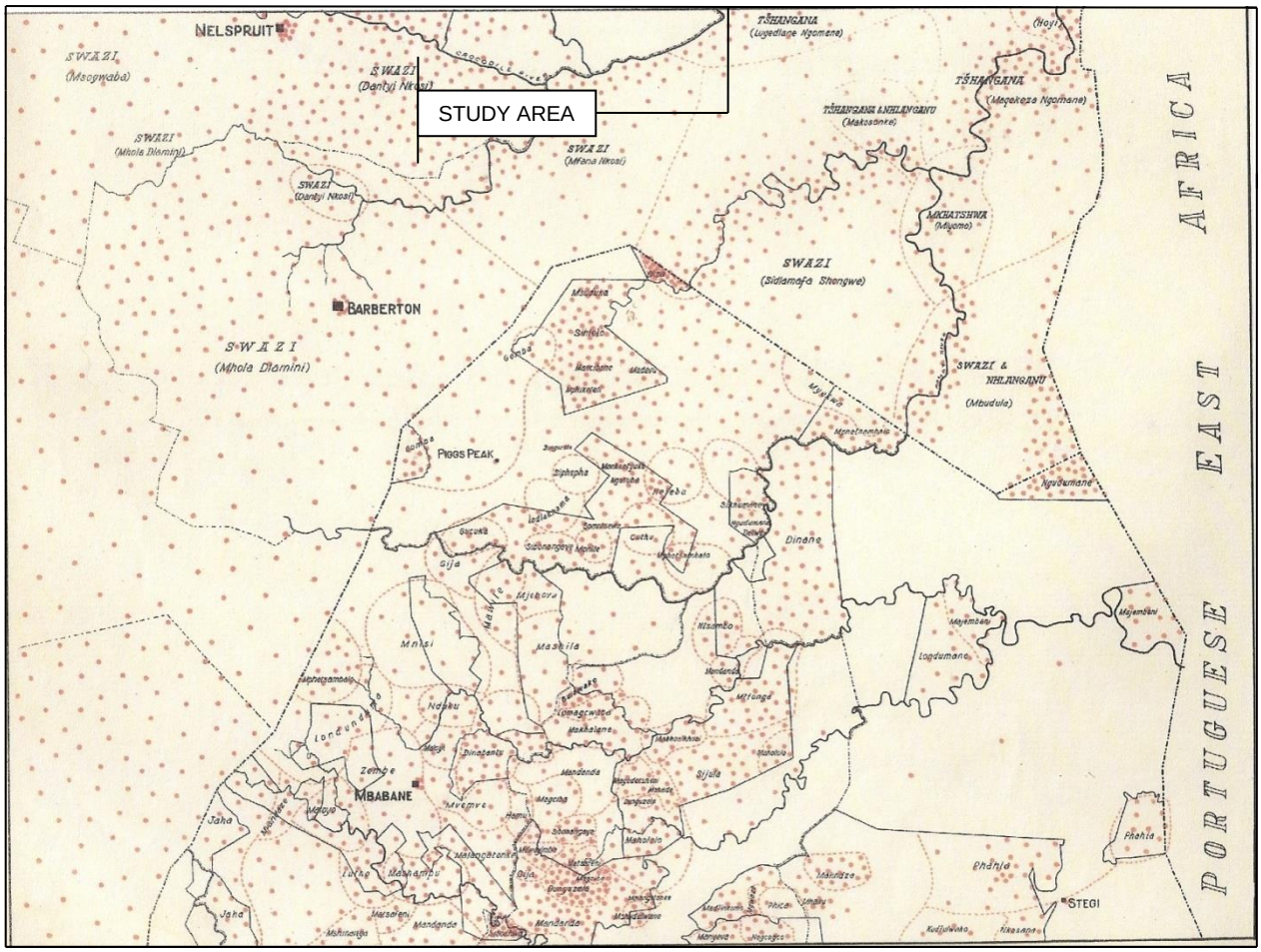
31 Bornman H., *The Pioneers of the Lowveld* p 11.
32 A.C. Myburgh, *The Tribes of Barberton District*, p. 10.
33 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* p. 111.
34 H. S. Webb, The Native Inhabitants of the Southern Lowveld, *in Lowveld Regional Development Association, The South-Eastern Transvaal Lowveld.* p. 14
35 *Ibid.,* p. 16.
36 Bornman H., *The Pioneers of the Lowveld* p. 12.
37 Bornman, H., *The Pioneers of the Lowveld*, p.17.
38 Bornman, H., *The Pioneers of the Lowveld*, p.19.



MAP 1: Van Warmelo: 1935: Study area is indicated.

Tsonga groups: The Nhlanganu and Tšhangana

The Nhlanganu and Tšhangana (also generally known as the Shangaan-Tsonga)[39] form part of the larger Tsonga group of which the original group occupied the whole of Mozambique (Portuguese East Africa), and it has been recorded that by 1554, they were already living around the Delagoa Bay area (Maputo).[40] They fled from the onslaughts of the Zulu (Nguni) nation from the Natal area, and great numbers of emigrants sought safety in the "Transvaal" as recently as the 19th century, especially in the greater Pilgrim's Rest district (including the study area that we are concerned with). The Tsonga also moved west from Mozambique into the "Transvaal". They have never formed large powerful tribes but were mostly always subdivided into loosely-knit units, and absorbed under the protection of whichever chief would give them land.[41] They were originally of Nguni origin.[42] The term "Shangaan" is commonly employed to refer to all members of the Tsonga division.[43]

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39 M. De Jongh (ed)., *Swatini,* p. 24.

40 N.J. Van Warmelo, Grouping and Ethnic History, *in Schapera I., The Bantu-Speaking Tribes of South Africa. An Ethnographical survey,* p. 55.

41 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, pp. 90-91.

The **Nhlanganu** occupied the Low Veld area in their efforts to escape the Zulu raids during 1835-1840. They lived side by side with the Tšhangana, and the differences between the two are inconsiderable. They have mixed extensively with other tribes.[44]

The **Tšhangana** are also of Nguni origin who fled in the same way as the Nhlanganu and settled in the "Transvaal" a little later than the former. Most of the Tsonga were subjects to *Soshangane,* who came from Zululand.[45] The downfall of *Ngungunyana* (son of *Soshangane*) saw his son seeking sanctuary in the "Transvaal", and the latter became known as *Thulamahashi,*[46] the name that is still used for the area east of Bushbuckridge.

The historical background of the study area confirmed that it was occupied since the 17th century by the Tsonga groups (Nhlanganu and Tšhangana). These groups have intermarried extensively or were absorbed by other groups in time.[47]

Swazi

The Swazi people descend from the southern Bantu (Nguni) who migrated from central Africa in the 15th and 16th centuries.[48] The differences between the Swazi and the Natal Nguni were probably never great, their culture as far as is known from the comparatively little research being carried out, does not show striking differences. Their language is a 'Tekeza' variation of Zulu, but through having escaped being drawn into the mainstream of the Zulus of the *Shaka* period, they became independent and their claim to be grouped apart as a culture is now well founded.[49]

- **History of Malelane & the farm Malelane Estate**

The NZASM railway line between Delagoa Bay and the Transvaal was opened in 1895 and brought more white settlers to the area. The towns Komatipoort, Hectorspruit, Malelane and Kaapmuiden, were established as a result of the railway line and the railway line reached Hectorspruit on 1 October 1891.[50] The surveying of the railway line was done by Steinmetz

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42 N.J. Van Warmelo, Grouping and Ethnic History, *in Schapera I., The Bantu-Speaking Tribes of South Africa. An Ethnographical survey,* p. 55.
43 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 92
44 *Ibid.,*.pp. 91-92.
45 N.J. Van Warmelo, Grouping and Ethnic History, *in Schapera I., The Bantu-Speaking Tribes of South Africa. An Ethnographical survey,* p. 57.
46 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 92.
47 M. De Jongh (ed)., *Swatini,* p. 40.
48 http://en.wikipedia.org/wiki/Swaziland p.1.
49 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 83.
50 Bornman, H., *The Pioneers of the Lowveld*, p. 23.

and Bouton, who also gave names to the towns. Malelane is a small farming town between Kaapmuiden and Komatipoort and produce sugarcane, subtropical fruits and vegetables.[51]

George and Alice Gouveia were early pioneers in the area and bought the Malelane Estate farm in 1955. They started to develop it extensively for the cultivation of vegetables. They built the original farmhouse in 1955/1956, where Mr. George Gouveia (jr.), was born in 1959. The house (called the Tin Shack), had no electricity or running water. The house still has the original layout and nothing was changed over the years (fig. 5). During the early 1960's, they built a modern house which is the current farm residence in the southern section of the farm, closer to the railway line (fig. 18). The property was in the possession of the Gouveia family until 2011 when they sold it. [52] In later years they established the earth canals to channel water to the various sections on the farm (figs. 6, 11 – 14, 22, 23) (See Appendix 2).

[51] http://www.org./wiki/hectorspruit Access: 15-12-13.
[52] Personal communication: Mr. G. Gouveia, previous owner, 2021-02-09.

C. DESCRIPTION OF THE AREA TO BE AFFECTED BY THE PROPOSED DEVELOPMENT

The proposed project will involve the following: Approximately 28.431ha are earmarked for the proposed agricultural and residential development. The proposed area for development is disturbed historically cultivated lands on the banks of the Crocodile River. [53] The 1970 topographical map also show that the entire area along the River was cultivated in the past (see Appendix 2 & map 2).

The property has a very moderate down slope from the south towards the north and the Crocodile River. An unnamed nonperennial watercourse (drainage line) is situated on the eastern side of the property [54] and forms the eastern boundary of the study area (fig. 29). A small section in the north-eastern corner of the study area, belongs to the Malelane irrigation board, and is fenced (fig. 30). Several earth canals and weirs form part of the irrigation network on the farm (figs. 6, 11 – 14, 22, 23).

The original pumphouse next to the Crocodile River was replaced in later years with a modern one. A few old pumps are still visible on the farm (figs 20 – 21), and the reservoirs are still in use (fig. 19). Earth canals and concrete sluices used to channel water to the various sections, but these are of no historical significance (figs. 6, 11, 14, 22, 23). The original farmhouse dating from 1955/56, is still visible on the farm (fig. 5), and has never been changed, even after the Gouveia family built a modern house in 1962 (fig. 18).

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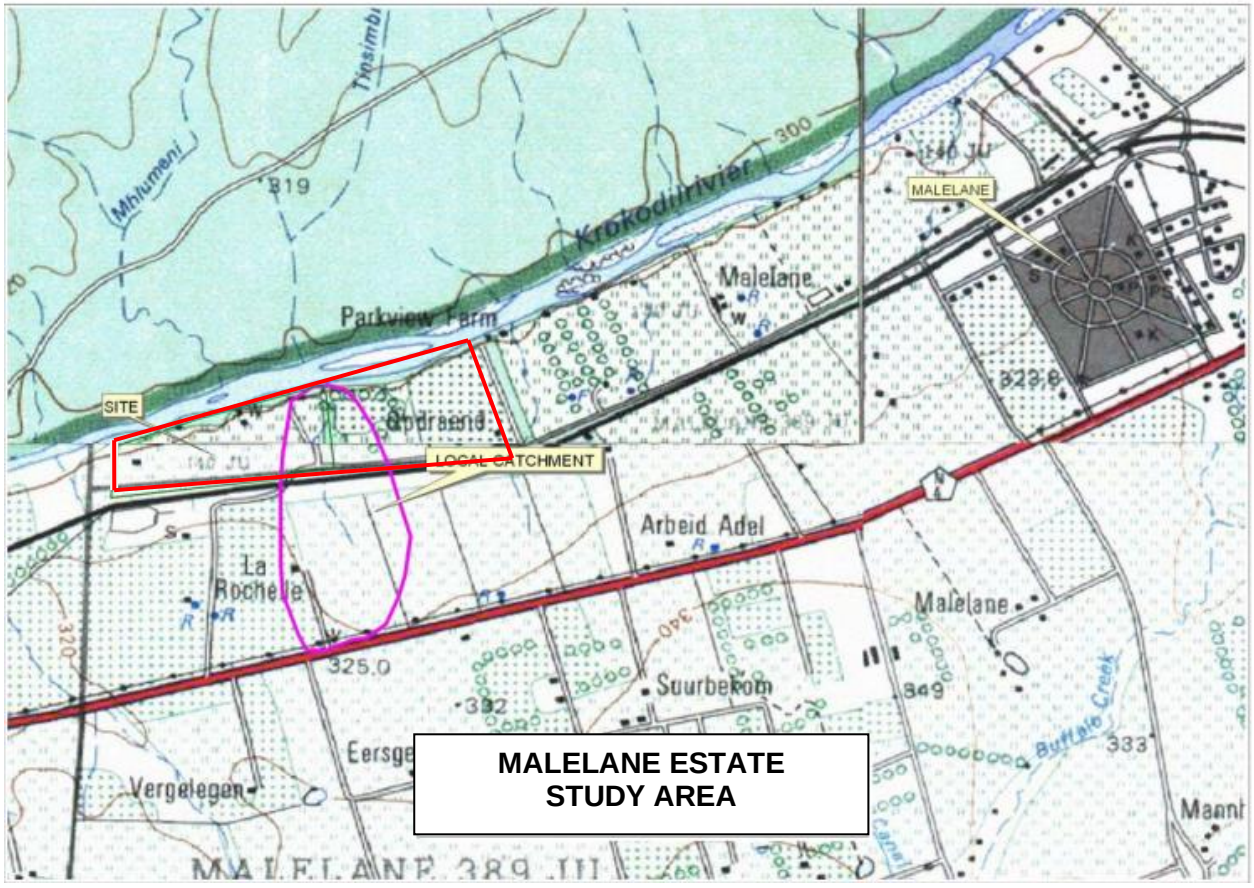
[53] Personal communication, EAP, Mr. Ralf Kalwa, 2021-01-09.

[54] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.

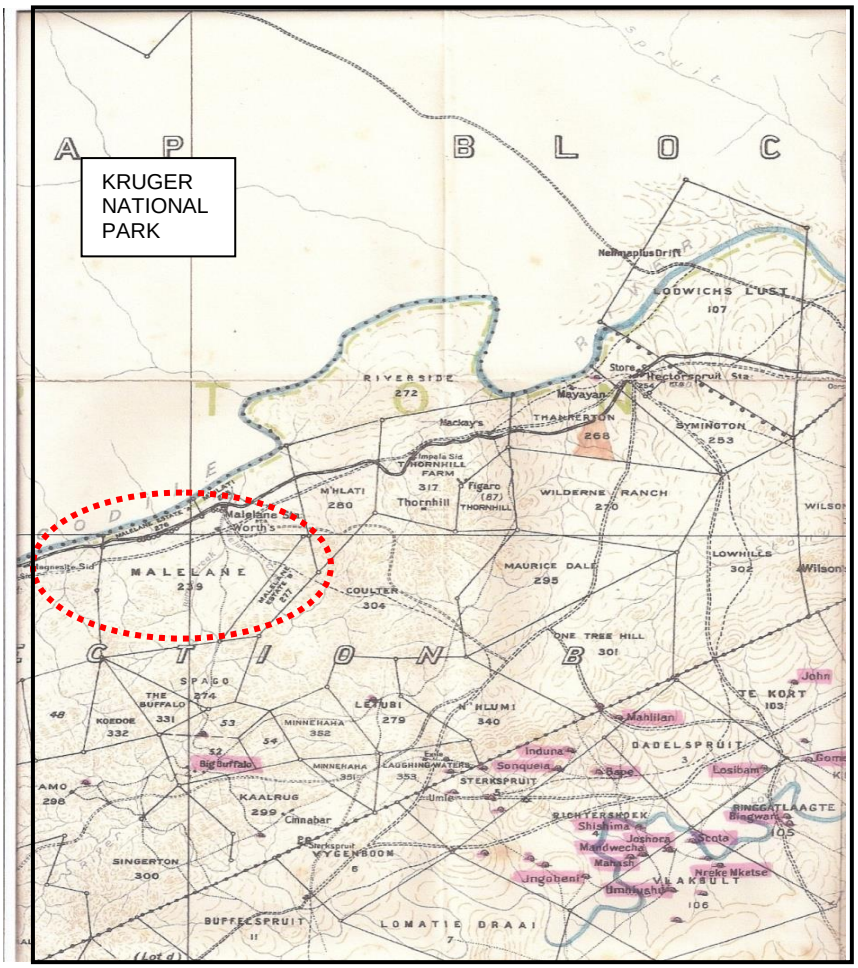


MAP 2: Topographical Map 2531AD / BC, indicating the study area (Map from Hydrological assessment). [55]

A number of other structures (farm residence, sheds, worker's accommodation and compound) are present on the farm, but are of no significance (figs. 16, 24, 25, 18, 26 – 28).

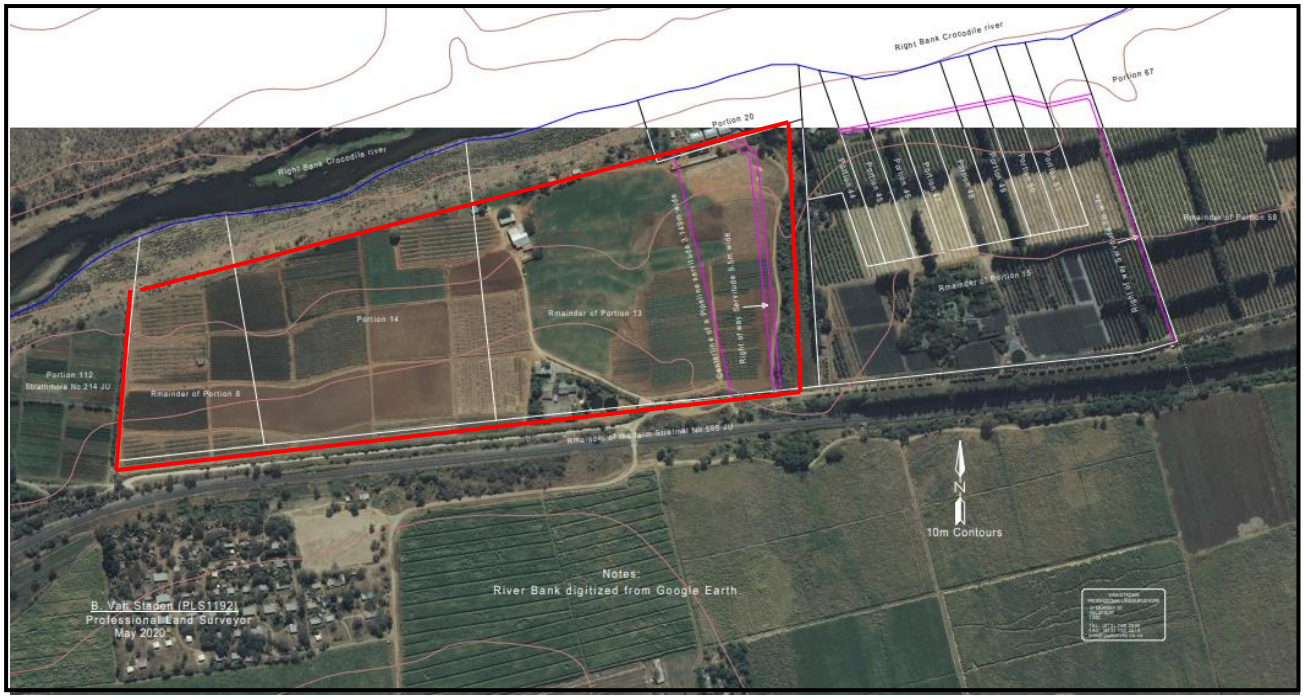
Technically the ecozone representing this area is referred to as *Mixed bushwillow woodland* on granite and *Sabie Crocodile thorn thickets* on granite.[56] Although the natural vegetation was removed in the 1950's to make way for cultivated lands, the surrounding vegetation in the area is characterized by *mixed Lowveld Bushveld* with tall woodlands made up of knob-thorn and other acacia species mixed in with trees such as marulas, bushwillow, apple-leaf, silver cluster-leafs, and jackalberry along the drainage lines. The typical granite and dolerite plains have sandy soils and clayey soils in the lower areas. [57] [58] [59]

[55] Coetzee, R., Malelane Estate Hydrological assessment, June 2020, p.20
[56] Deacon, A., e-mail access 26-01-14, after (Mucina & Rutherford 2007 & Alcocks 1953).
[57] SANPARKS, Visitors Guide to the Kruger National Park, p. 2.
[58] Van Wyk, B., & Van Wyk P., Field Guide to Trees of Southern Africa, 1997, p. 500.
[59] Deacon, A., e-mail access 26-01-14, after (Mucina & Rutherford 2007 & Alcocks 1953).



MAP 3: 1926 Topographical map: The study area is indicated in red and early settlements are indicated in pink.

The 1926 topographical map (Map 3), indicates black settlements to the south of the property along or close to the Lomati River. Only one settlement is indicated towards the north, next to the Crocodile river. No early black settlements were indicated in the study area.

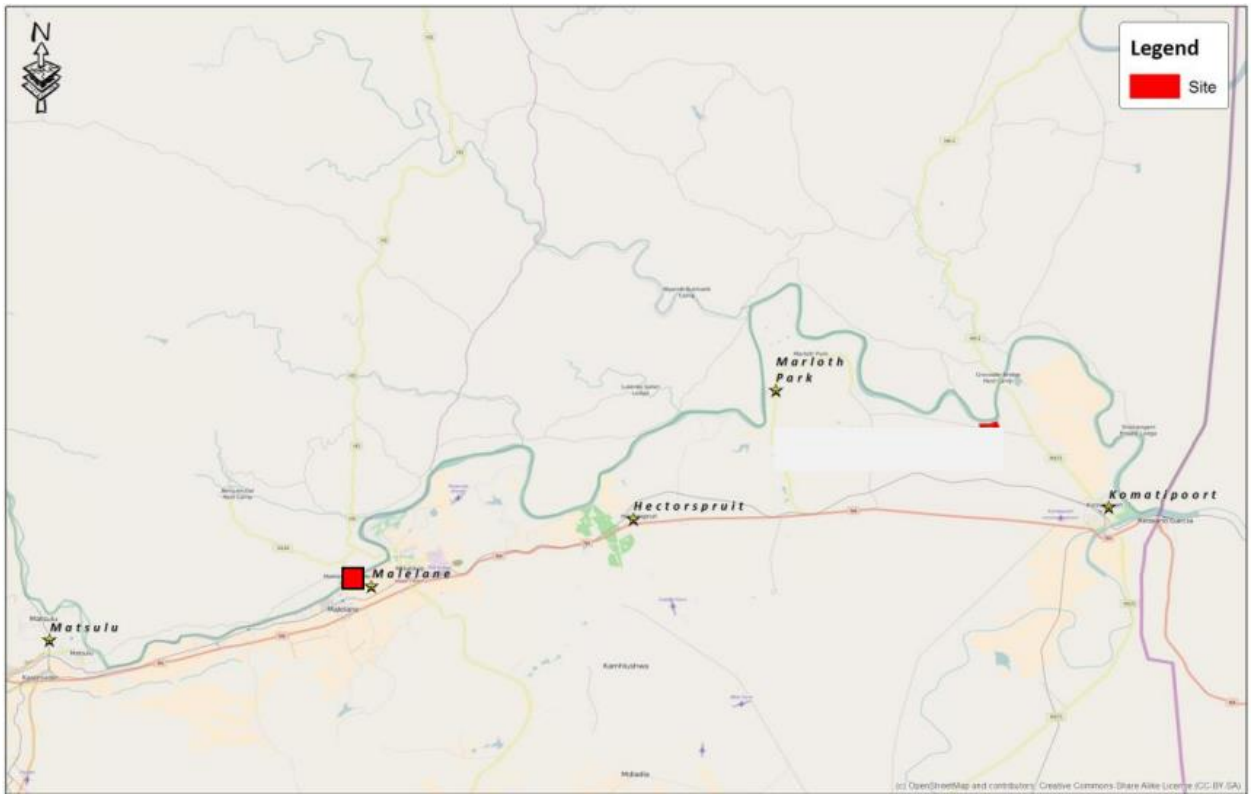


MAP 4: Google image of the project site (Map provided by RHENGU Environmental Services).

D. LOCALITY

The proposed project site, located on the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU, is situated in Malelane about 3km west of the crossing of Dwergarend Street and the District road D1239. [60] It is located just north of the N4 and is approximately 40km north of Swaziland. The project site is on the banks of the Crocodile River, overlooking the Kruger National Park.

The site falls under the Nkomazi Local Municipal jurisdiction, which in turn falls within Ehlanzeni District Municipality, in the Mpumalanga Province (see Maps 2 - 5**:** Topographical Map & Google images of sites; Appendix 2 for the study area).



Map. 5: The project site within the wider area (Map from Hydrological assessment). [61]

- **Description of methodology:**

The 1970 topographical map, (map 2), as well as a 1926 map (Map 3), and Google images of the site (Map 4 – 7), indicate the study area of the proposed development. These were intensively studied to assess the current and historically disturbed areas and infrastructure. In order to reach a comprehensive conclusion regarding the cultural heritage resources in the study area, the following methods were used:

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[60] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.

[61] Coetzee, R., Malelane Estate Hydrological assessment, June 2020, p. 7.

- The desktop study consists mainly of archival sources studied on distribution patterns of early African groups who settled in the area since the 17th century, and which have been observed in past and present ethnographical research and studies.
- Literary sources, books and government publications, which were available on the subject, have been consulted, in order to establish relevant information.
- Several specialists currently working in the field of anthropology and archaeology have also been consulted on the subject.

-Literary sources: A list of books and government publications about prehistory and history of the area were cited, and revealed some information;

-The archaeological database of SAHRA as well as the National Cultural History Museum were consulted. Heritage Impact Assessment reports of specialists who worked in the area were studied and are quoted in section B.

- The entire study area was historically disturbed (cultivated), and belonged to the Gouveia family who farmed extensively with vegetables. [62]
- The site visit consisted of 2 people. Features of interest were pointed out during the visit, such as the historical house.
- The fieldwork and survey were conducted extensively on foot and with a vehicle. Gravel roads in the various sections were used to access the area (See Appendix 1).
- The terrain was flat, even and accessible, with some areas which had recent crops and some sections which were lying fallow. Visibility throughout the survey was excellent.
- The relevant data was located with a GPS instrument (Garmin Etrex) datum WGS 84, and plotted. Co-ordinates were within 4-6 meters of identified sites.
- Evaluation of the resources which might be impacted upon by the footprint, was done within the framework provided by the National Heritage Resources Act, no. 25 (1999);
- Personal communication with relevant stakeholders on the specific study area, were held, such as the farm manager, Mr. Jansen Van Vuuren [63], and environmental practitioner Mr. R. Kalwa.[64]
- GPS co-ordinates were used to locate the perimeters and any heritage features within the study area (Co-ordinates provided by RHENGU Environmental Services, Map 7).

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62 Personal communication: Mr. G. Gouveia, previous owner, 2021-02-09.
63 Personal information: Mr. Jansen Van Vuuren (farm Manager: 2021-01-09.
64 Personal information: Mr. R. Kalwa, Rhengu Environmental Services, 2020-01-09.

GPS CO-ORDINATES			
Location	**South**	**East**	**Elevation**
A	S 25° 30' 02.03"	E 31° 28' 09.48"	297m
B	S 25° 29' 56.51"	E 31° 28' 33.94"	304m
C	S 25° 29' 54.69"	E 31° 28' 40.05"	304m
D	S 25° 30' 06.05"	E 31° 28' 40.30"	304m
E	S 25° 30' 09.88"	E 31° 28' 08.98"	302m

E. DESCRIPTION OF IDENTIFIED SITES

The owner and applicant, BLUE GRASS Trading cc, in co-operation with RHENGU ENVIRONMENTAL SERVICES is requesting the development 28.431ha of disturbed agricultural land for agricultural as well as residential purposes, on the banks of the Crocodile River, facing the Kruger National Park (see map 6). The proposed project area is situated on the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU. [65]

The study area falls within the Malelane area which has historically been known for agricultural farming. Large sections on adjacent properties are cultivated with citrus, mangoes or sugarcane. The area is flat, accessible and without any rocky outcrops. Modern topographical maps also clearly show extensive farming activities in the surrounding area (Map 2). The 1926 topographical map (Map 3) does not indicate any historic settlements directly in the study area, although several settlements were indicated (in pink), in the hills towards the current Swaziland and along the Lomati and Komati rivers (to the south and east). The 1935 map by Van Warmelo indicated the groups living in the area as mainly Shangaan and Swazi (Map 1).
The study area is indicated in maps 2 & 4 (see Appendix 2). The sections were accessible between the historically disturbed cultivated lands and were surveyed on foot and per vehicle.

The only feature of interest on the property is the original farmhouse, built by the pioneer couple, George and Alice Gouveia, who bought the property for the purpose of farming vegetables. They built the original farmhouse in 1955/1956, where Mr. George Gouveia (jr.), was born in 1959. The house (called the Tin Shack), had no electricity or running water. The house still has the original layout and nothing was changed over the years (fig. 5). During the early 1960's, they built a modern house with surrounding infrastructure which is the current managers residence in the southern section of the farm, closer to the railway line (fig. 18). The property was in the possession of the Gouveia family until 2011 when they sold it [66] (see Appendix 2).

All comments should be studied in conjunction with the maps, figures and appendices, which indicate the study area, and which corresponds with the summary below. Photographs in Appendix 2 show the general view of the study area.

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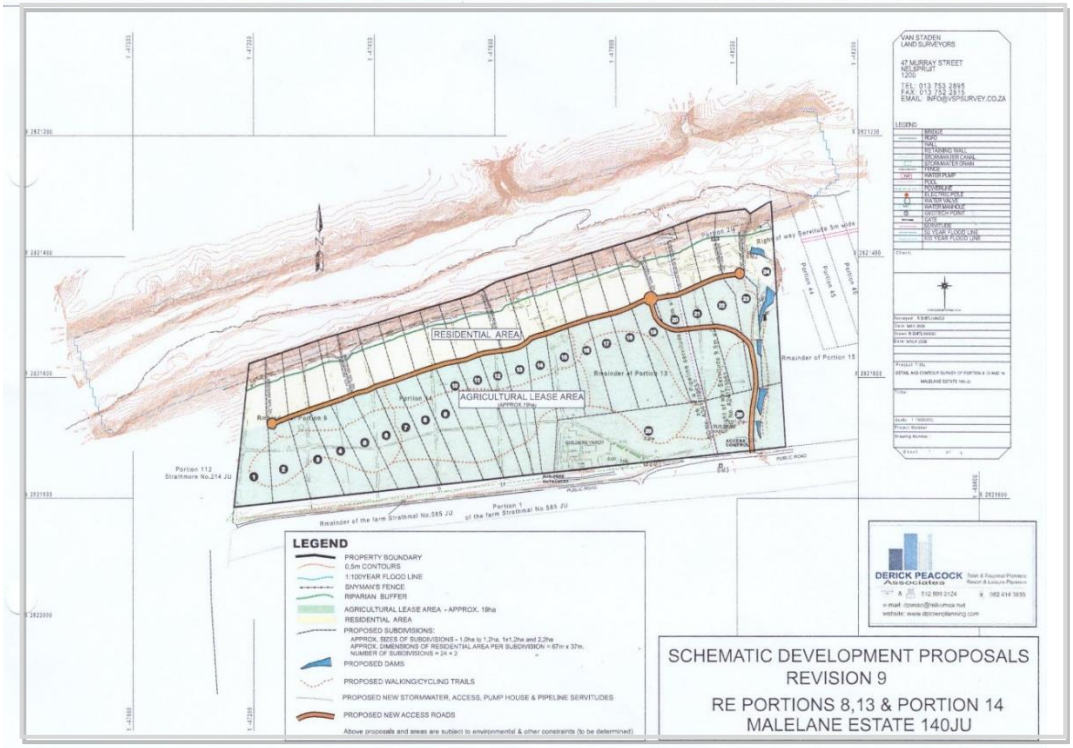
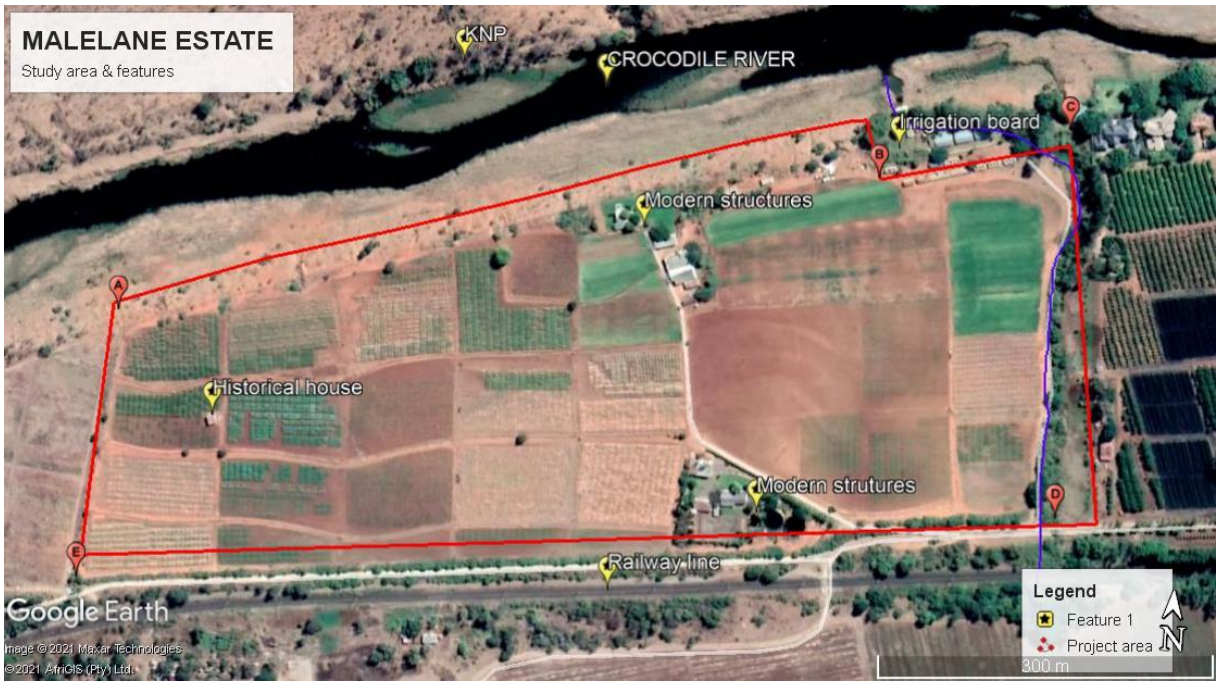
[65] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.
[66] Personal communication: Mr. G. Gouveia, previous owner, 2021-02-09.

No archaeological sites of significance were identified, but the original historic farmhouse is older than 60 years and mitigation measures area proposed.



MAP 6: Proposed layout of the new development (map from report [67]).



Map 7: Heritage and other features on the study area.

[67] D. Peacock, Memorandum in support of the application for the consolidation, subdivision and lease of remainder portion 8, remainder portion 13 and portion 14 MALELANE ESTATE A 140 JU, p. 4.

Heritage features (See Map 7):

Heritage Feature	Description / Comments	Site Location
Original farmhouse	Farmhouse built in 1955 / 56 for the Gouveia family. According to George Gouveia jr. the house has never been changed from its original plan. [68] Brick & corrugated iron.	S25º 30' 04.93" E31º 28' 12.88" Elev. 300m Fig. 5

Section 34 of the NHRA stipulates that no person may alter, damage, destroy, relocate etc, any building or structure older than 60 years, without a permit issued by SAHRA or a provincial heritage resources authority and therefore mitigation measures are proposed.

No other archaeological features, structures of significance or graves were identified in the study area during the survey.

[68] Personal communication: Mr. G. Gouveia, previous owner, 2021-02-09.

F. DISCUSSION ON THE FOOTPRINT OF THE PROPOSED DEVELOPMENT

ACT	*COMPONENT*	*IMPLICATION*	*RELEVANCE*	*COMPLIANCE*
NHRA	S 34	Impact on buildings and structures older than 60 years	Original Gouveia farmhouse, 1955/56	Mitigation measures proposed
NHRA	S35	Impacts on archaeological heritage resources	None	None
NHRA	S36	Impact on graves	None	None
NHRA	S37	Impact on public monuments	None present	None
NHRA	S38	Developments requiring an HIA	Development is a listed activity	HIA done
NEMA	EIA regulations	Activities requiring an EIA	Development is subject to an EIA	HIA is part of EIA

- **Summarised identification and cultural significance assessment of affected heritage resources: General issues of site and context:**

Context		
Urban environmental context	No	NA
Rural environmental context	No	NA
Natural environmental context	No	NA.
Formal protection (NHRA)		
(S. 28) Is the property part of a protected area?	No	NA
(S. 31) Is the property part of a heritage area?	No	NA
Other		
Is the property near to or visible from any protected heritage sites	No	NA
Is the property part of a conservation area of special area in terms of the Zoning scheme?	No	NA

Context		
Does the site form part of a historical settlement or townscape?	No	NA
Does the site form part of a rural cultural landscape?	No	NA
Does the site form part of a natural landscape of cultural significance?	No	NA
Is the site adjacent to a scenic route?	No	NA
Is the property within or adjacent to any other area which has special environmental or heritage protection?	Yes	Opposite the Kruger National Park
Does the general context or any adjoining properties have cultural significance?	No	NA

Property features and characteristics		
Have there been any previous development impacts on the property?	Yes	Entire property was cultivated in the past
Are there any significant landscape features on the property?	No	NA
Are there any sites or features of geological significance on the property?	No	NA
Does the property have any rocky outcrops on it?	No	NA
Does the property have any fresh water sources (springs, streams, rivers) on or alongside it?	Yes	Crocodile River directly north & a drainage line forms the eastern boundary

Heritage resources on the property		
Formal protection (NHRA)		
National heritage sites (S. 27)	No	NA
Provincial heritage sites (S. 27)	No	NA
Provincial protection (S. 29)	No	NA
Place listed in heritage register (S. 30)	No	NA

Heritage resources on the property		
General protection (NHRA)		
Structures older than 60 years (S. 34)	Yes	Gouveia farmhouse dating from 1955/56
Archaeological site or material (S. 35)	No	NA
Graves or burial grounds (S. 36)	No	NA
Public monuments or memorials (S. 37)	No	NA
Other		
Any heritage resource identified in a heritage survey (author / date / grading)	No	NA
Any other heritage resources (describe)	No	NA

NHRA S (3)2 Heritage resource category	***ELEMENT***	***INDICATORS OF HERITAGE SIGNIFICANCE***										***RISK***
		Historical	Rare	Scientific	Typical	Technological	Aesthetic	Person or community	Landmark	Material condition	Sustainability	
Buildings or structures of cultural significance	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Will be impacted upon by the development
Areas attached to oral traditions /intangible heritage	No	No	No	No	No	No	No	No	No	No	No	-
Historical settlement or townscapes	No	-	-	-	-	-	-	-	-	-	-	-
Landscape of cultural significance	No	-	-	-	-	-	-	-	-	-	-	-
Geological site of scientific/ cultural importance	No	-	-	-	-	-	-	-	-	-	-	-
Archaeological sites	No	-	-	-	-	-	-	-	-	-	-	-

NHRA	***ELEMENT***	***INDICATORS OF HERITAGE SIGNIFICANCE***										***RISK***
Grave or burial grounds	No	-	-	-	-	-	-	-	-	-	-	-
Areas of significance related to labour history	No	-	-	-	-	-	-	-	-	-	-	-
Movable objects	No	-	-	-	-	-	-	-	-	-	-	-

Summarised recommended impact management interventions

NHRA S (3)2 Heritage resource category	***SITE***	***IMPACT SIGNIFICANCE Cultural significance rating***		***Impact management***	***Motivation***
		Cultural significance	***Impact significance***		
Buildings / structures of cultural significance	Yes	Yes	Yes	Mitigation	House older than 60 years
Areas attached to oral traditions / intangible heritage	No	None	None	-	-
Historical settlement or townscape	No	None	None	-	-
Landscape of cultural significance	No	None	None	-	-
Geological site of scientific/ cultural importance	No	None	None	-	-

NHRA S (3)2	***SITE***	***IMPACT SIGNIFICANCE Cultural significance rating***		***Impact management***	***Motivation***
Archaeological sites	No	None	None	-	-
Grave / burial grounds	No	No	None	-	-
Areas of significance related to labour history	No	None	None	-	-
Movable objects	No	None	None	-	-

ACT	***COMPONENT***	***IMPLICATION***	***RELEVANCE***	***COMPLIANCE***
NHRA	S 34	Impact on buildings and structures older than 60 years	Original farmhouse built in 1955/56	Mitigation proposed
NHRA	S35	Impacts on archaeological heritage resources	None present	None
NHRA	S36	Impact on graves	None present	None
NHRA	S37	Impact on public monuments	None present	None
NHRA	S38	Developments requiring an HIA	Development is a listed activity	Full HIA
NEMA	EIA regulations	Activities requiring an EIA	Development is subject to an EIA	HIA is part of EIA

G. STATEMENT OF SIGNIFICANCE & EVALUATION OF HERITAGE RESOURCES

Section 38 of the NHRA, rates all heritage resources into National, Provincial or Local significance, and proposals in terms of the above is made for all identified heritage features.

- **Evaluation methods**

Site significance is important to establish the measure of mitigation and / or management of the resources. Sites are evaluated as *HIGH (National importance), MEDIUM (Provincial importance) or LOW, (local importance),* as specified in the NHRA. It is explained as follows:

- **National Heritage Resources Act**

The National Heritage Resources Act no. 25, 1999 (NHRA) aims to promote good management of the national estate, and to enable and encourage communities to conserve their legacy so that it may be bequeathed to future generations. Heritage is unique and it cannot be renewed, and contributes to redressing past inequities.[69] It promotes previously neglected research areas.

All archaeological and other cultural heritage resources are evaluated according to the NHRA, section 3(3). A place or object is considered to be part of the national estate if it has cultural significance or other special value in terms of:

(a) its importance in the community, or pattern of South Africa's history;

(c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

(h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.[70]

- **The significance and evaluation of the archaeological and cultural heritage features in the study area, can be summarised as follows:**

Site no	Cultural Heritage features	Significance	Measures of mitigation
Gouveia farmhouse	Farmhouse built in 1955/56, and is older than 60 years	Cultural value – significance Low – local importance.	House must be documented and preserved/management plan; **OR** documented, and an application put in for destruction.

[69] National Heritage Resources Act, no. 25 of 1999. p. 2.
[70] National Heritage Resources Act, no. 25 of 1999. pp. 12-14

- **Field rating:**

The field rating is viewed in terms of the NHRA (25, 1999) sections 3 (3) a, c & h. The Gouveia farmhouse has not been compromised over the years and although in a derelict state, still has its original layout and material. Cultural value is attached to the historical house of the Gouveia family which was built during 1955 /56, and is regarded as important to a certain family / community (NHRA 3.3a); It has potential to yield social and cultural information to a particular family / community which may contribute to an understanding of South Africa's cultural heritage (NHRA 3.3c & h), especially in the life of a family who is regarded as pioneers in the Lowveld district. The structure will be impacted upon by the proposed development and therefore mitigation measures are recommended.

H. RECOMMENDATIONS & CONCLUSION

The proposed project site, on the remainder of portions 8 & 13 and portion 14 of the farm MALELANE ESTATE A no. 140JU, is situated on entirely disturbed agricultural land. The original farmhouse of the Gouveia family is the only feature with historical significance on the property. It is recommended that the house be documented and preserved with a possibility of restoring it for future use in the proposed development. A management plan will be drawn up to ensure its long-term preservation. (Examples for its use may be the establishment of a museum which depicts the history of the Gouveia family or the immediate surroundings such as the town of Malelane, or it may be utilized as a tearoom etc.).

The owners/applicants also have the option to apply for a destruction permit for the farmhouse after a Phase 2 documentation report was done on the historical house, should they not be interested in preserving it, and develop the site.

Based on the survey and the findings in this report, Adansonia Heritage Consultants state that there are no compelling reasons which may prevent the proposed development to continue, apart from the conditions as set out above. The applicants must be made aware that distinct archaeological material or human remains may only be revealed during the agricultural operation and other development activities, and earthmoving activities must be monitored by a qualified archaeologist. An assessment should be made if any archaeological material or graves are revealed.

Adansonia Heritage Consultants cannot be held responsible for any archaeological material or graves which were not located during the survey.

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K1 ELECTRONIC INFORMATION SOURCES

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- http://www.org./wiki/hectorspruit Access: 15-12-13.
- http://en.wikipedia.org/wiki/Swaziland, Access: 2013-06-13.

K2 PERSONAL INFORMATION

- Personal communication: Mr. G. Gouveia, Previous owner, 2021-02-09.
- Personal communication: Dr. M.S. Schoeman, University of Pretoria, 2008-03-27.
- Personal communication: Dr. J. Pistorius, Pretoria, 2008-04-17.
- Personal communication: Mr. R. Kalwa, 2021-01-09.
- Personal information: Dr. A. Deacon, e-mail access: 2014-01-26.

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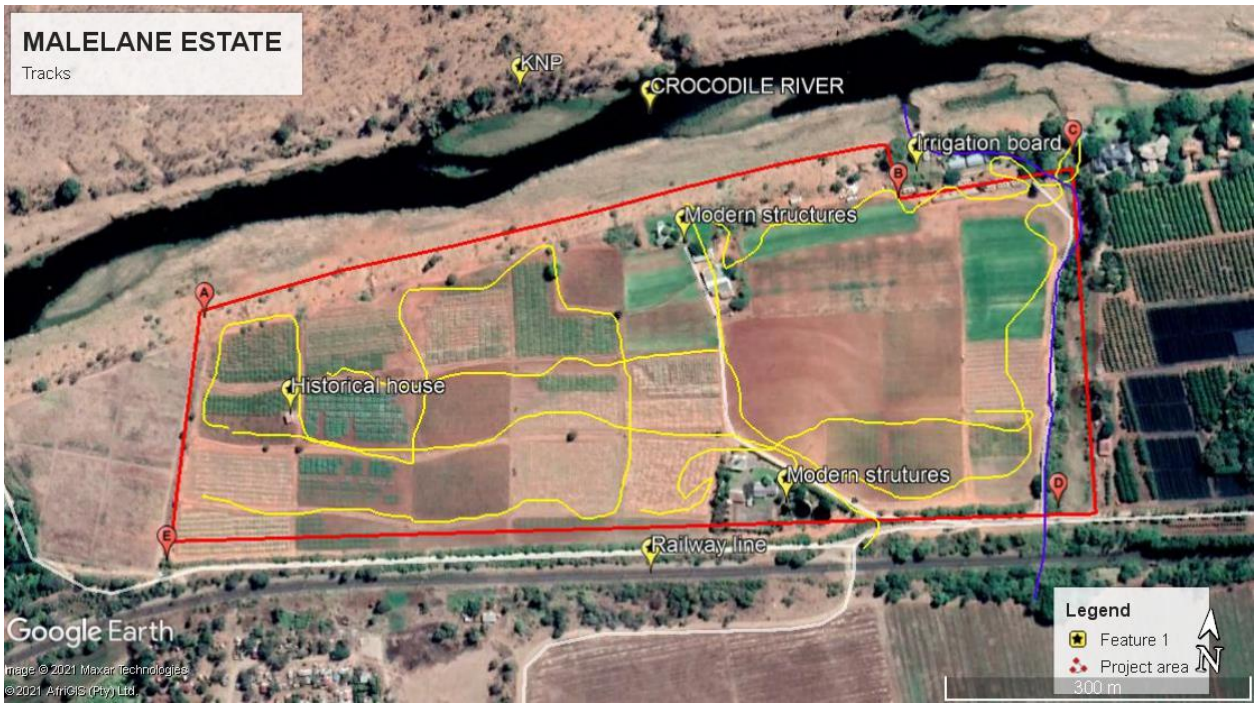
APPENDIX 1

TRACKS & PATHS



Tracks used during the survey.

APPENDIX 2: PHOTOGRAPHIC DOCUMENTATION MALELANE ESTATE

Western section (Remainder of portion 8)

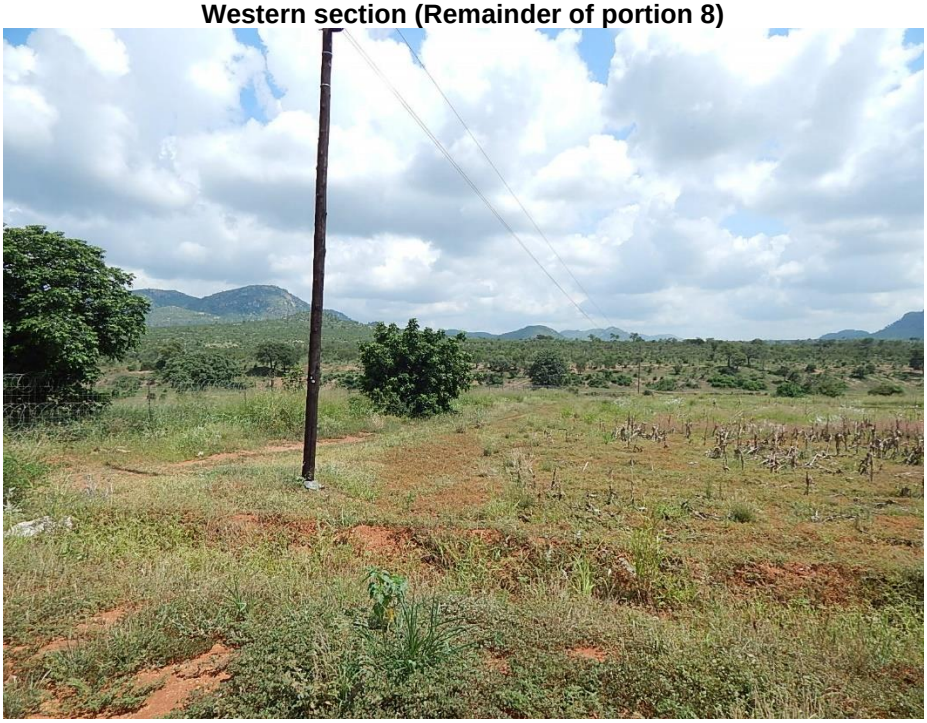


Fig. 1: The western boundary of the project area facing the Crocodile River (north). The cultivated lands and earth canal is visible in the foreground.

Fig. 2: The western section facing south-east of the railway line (red line), and farm residence (arrow). The (fallow) cultivated lands are visible in the foreground.

Fig. 3: The western section, facing east. The historical building is visible in a distance.

Fig. 4: The western section facing north east. The cultivated lands and historical building are visible.

Fig. 5: The historical building (Tin Shack) in the western section.

Middle section (Portion 14)

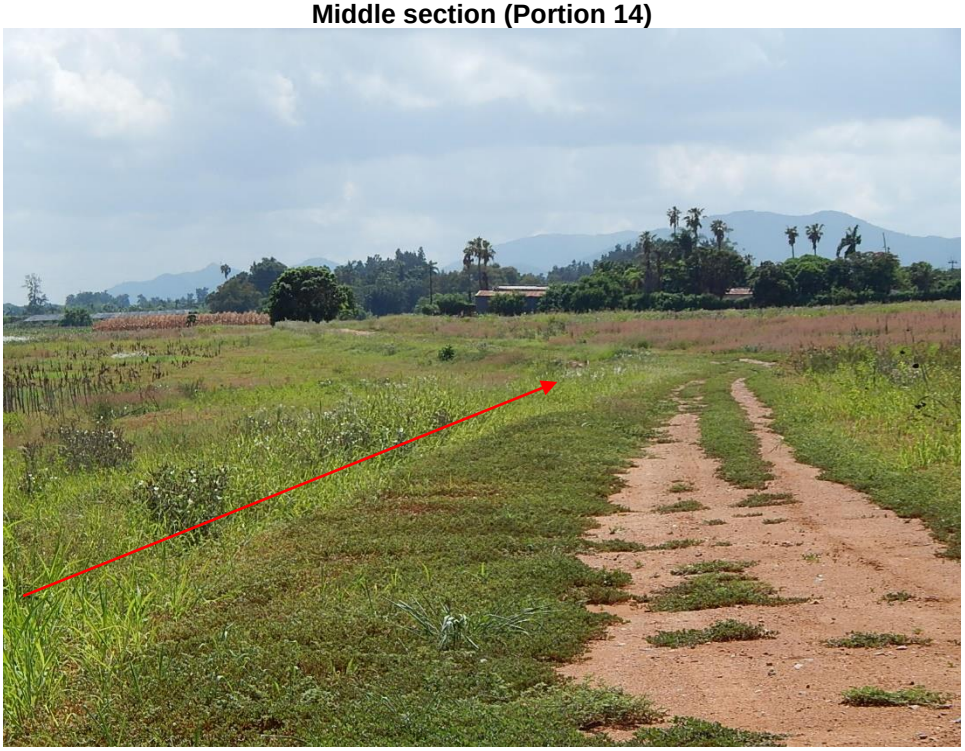


Fig. 6: The middle section in the west, facing east towards the farm residence. The canal follows the road contour and is visible to the left (red line).

Fig. 7: The middle section in the east, facing north-west. The Crocodile River is indicated by the blue line.

Fig. 8: A general view of the middle section (facing west) which consist entirely of cultivated lands.

Fig. 9: A general view of the middle section (facing east), towards the sheds.

Fig. 10: A general view of the middle section (facing east), towards the farm residence.

Fig. 11: The middle section, with the earth canal visible next to the road.

Fig. 12: Another view of the middle section facing west, the earth canal is to the right of the road.

Fig. 13: The middle section facing south towards the railway line. An earth canal is visible (red line).

Fig. 14: Several sluices are visible within the earth canal to regulate water, on the study area.

Eastern section (Remainder of portion 13)

Fig. 15: A general view of the eastern section (facing east).

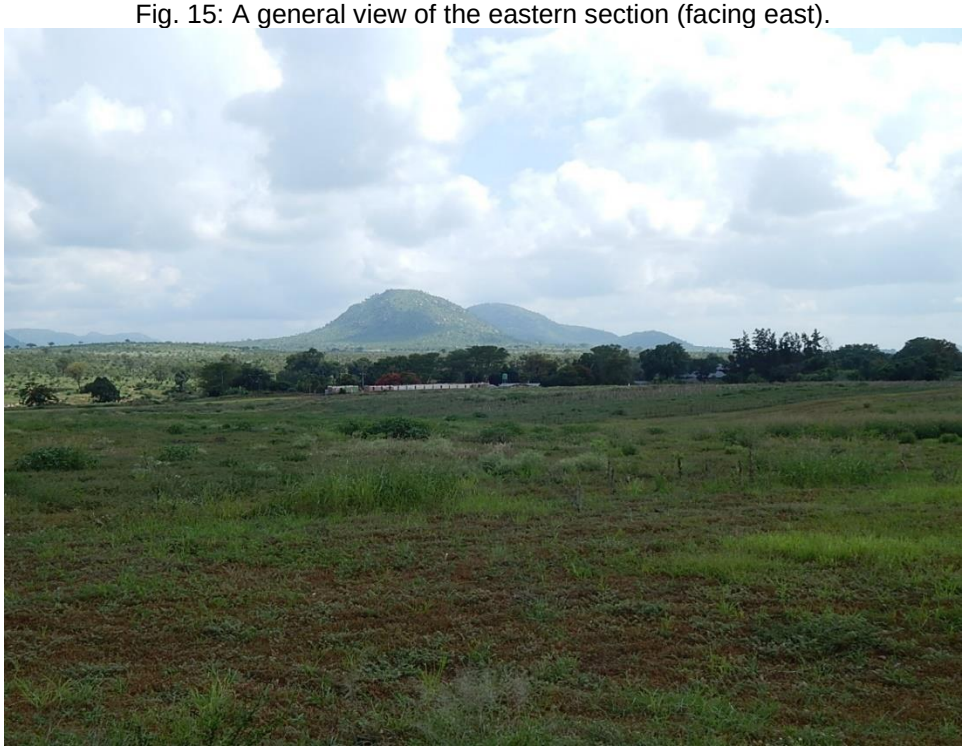


Fig. 16: A general view of the eastern section (facing north towards the Crocodile River and Kruger National Park).

Fig. 17: A general view of the eastern section, in the south (facing east).

Fig. 18: The farm residence is situated in the southern section of the study area.

Fig. 19: Large water reservoirs are visible next to the farm residence.

Fig. 20: The infrastructure of a water pump.

Fig. 21: Another pump for use on the farm.

Fig. 22: The earth canal in the eastern section is visible next to the gravel road, facing east.

Fig. 23: A few small weirs are visible near the farm residence, to regulate water into the canals.

Fig. 24: View towards the north (NKP). Farm infrastructure is visible in the north together with workers accommodation.

Fig. 25: The farm sheds in the north, and near the banks of the Crocodile River.

Fig. 26: Workers accommodation on the banks of the Crocodile River in the north.

Fig. 27: Previous farm workers accommodation (compound) in the northern section, which is now derelict.

Fig. 28: The back of the farm workers accommodation in the eastern section of the study area (facing west).

Fig. 29: The eastern section of the farm. A drainage line is visible in the foreground, with a concrete bridge to cross over to the other side. A Middle Stone Age implement was found within the drainage line.

Fig. 30: A small section in the north-east still belongs to the Malelane Irrigation board and is currently excluded from the study area.

APPENDIX 4.4.5.
VIEW SHED ANALYSIS

Advanced ViewShed Analysis for Kruger Malelane Agri Estate (KMAE)

Visibility Report
Malelane Estate No. 140-JU

Sandra MacFadyen
05 April 2021

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EXECUTIVE SUMMARY

BioGIS was contracted to run a visibility or 'viewshed' analysis to assess the visual impacts of proposed developments in the new Kruger Malelane Agri Estate (KMAE) on the surrounding landscape. Specifically, to identify areas within the Kruger Malelane Agri Estate (KMAE) with the potential to impact existing wilderness qualities inside the Kruger National Park (Kruger). This analysis forms part of the larger KMAE Environmental Impact Assessment (EIA) produced by Rhengu Environmental Services, and aims to ensure any future KMAE developments do not impact Kruger's tourist experience. Overall the visual impact of KMAE is minimal, provided heights of any future developments remain under 7.5m. Under such conditions, KMAE infrastructure and lights should only be visible from some higher lying areas including Khandizwe, Nsikazi, Mangwato and Tlhalabye outcrops, as well as Malelane satellite camp, specific locations along the S110 (totalling 2km) and a jeep track (totalling 8.7km) along the Crocodile River used by Wolhuter and Bushman Trails. Results are detailed in this report and available as an interactive 3D terrain and viewshed model upon request.

INTRODUCTION

A visibility or 'viewshed' analysis, to identify areas with the potential to impact existing wilderness qualities in the Kruger National Park (hereafter Kruger), was undertaken in accordance with the National Environmental Management: Protected Areas Act (57/2003): Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks (Gazette No. 35020 – Notice 106). Similarly, Kruger Malelane Agri Estate's (KMAE) Architectural and Building Guidelines (Annexure E) state that single storey buildings will be encouraged to preserve the natural aesthetics of KMAE and Kruger's environment. Any double storey building will be held to the following strict standards: i) Lighting control; ii) Low pitched mono-pitch or V-roofs will be encouraged; iii) A Professional Land Surveyor must confirm the natural ground level, contours and height of all structures; iv) No part of the dwelling (incl. roof or chimney) may be more than 7m above ground level (a.g.l). The viewshed analysis herein therefore assesses the visibility risk of KMAE developments at maximum heights of 7.5m, 6.0m and 5.0m.

METHODS

Study Area

The proposed KMAE development is situated in the Mpumalanga province of South Africa between latitudes -25.4985 to -25.5026 and longitudes 31.4692 to 31.4782. Bisected by 1:50 000 mapsheets 2531AD (Gutshawa) and 2531CB (Kaapmuiden), it covers an area of ± 27.82 ha and falls within the Savanna-Granite portion of the Lowveld Bioregion of South Africa (Mucina and Rutherford 2006). The underlying geology consists of predominantly ultramafic to felsic lavas and pyroclastic rocks of the Barberton Greenstone Belt with Haplic Cambisols (Hartmann and Moosdorf 2012; Council for Geoscience 2016). Long-term average temperatures range from 16 °C in winter to 27 °C in summer and rainfall

falls predominately in summer, concentrated particularly between November and February (MacFadyen et al 2018). Topography slopes gently downward from ± 312m a.s.l to ± 291m a.s.l (south to north), ending in the Crocodile River floodplain (Van Niekerk 2012). The area is classified as an Ecological Support Area by the Mpumalanga Biodiversity Sector Plan (Lötter et al 2014) and harbours a tiger fish support area nearby according to the South African Inventory of Inland Aquatic Ecosystems (van Deventer 2018). KMAE borders Kruger to the north, along the Crocodile River. Vegetation inside Kruger (i.e. on the opposite bank), is classified as Malelane Mountain Bushveld in which granitic mountains and *Combretum apiculatum* bush savannah is typical (Venter 1990). Significant granitic outcrops in the area include Khandizwe (841m a.s.l), less than 5km from KMAE, it is the tallest topographic feature in Kruger (MacFadyen et al 2018). Other outcrops, in order of altitude, include Mangwato (755m a.s.l); Nsikazi (755m a.s.l); Mangakikop (703m a.s.l); Newu (668m a.s.l); Maqili (667m a.s.l); Mubhaba (647m a.s.l); Tlhalabye (631m a.s.l); Skatkoppie (568m a.s.l) and Klokweni (567m a.s.l) (NGI 2009).

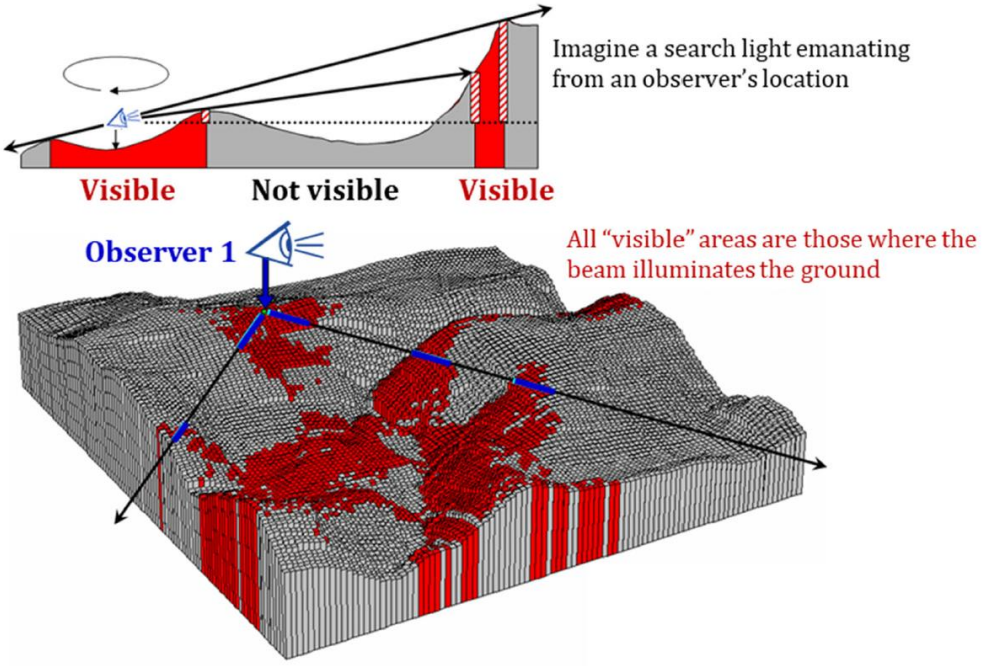

Figure 1: Example of how a viewshed analysis incorporates topographic information with observer locations to identify areas seen (red) and not seen (grey) from different points in the landscape (adapted from Berry 2013).

Viewshed Analysis

The viewshed analysis was carried out using Quantum GIS (QGIS 2021) and plugins - *Visibility Analysis* (Čučković 2016) and *Qgis2threejs* (Akagi 2021). First observer points were located within KMAE by creating 121 equally spaced (50m) grid-points within the KMAE development boundary. Viewpoints were then created using these observer points and a Digital Elevation Model (DEM) reflecting ground elevation at 5m intervals (van Niekerk 2012). The maximum distance for visibility testing was set to 40km (radius of analysis) to ensure adequate coverage. Observer and target heights were initially set to 7.5m and 2.0m above ground level respectively. The area's small size negates the need to account for the earth's curvature or light refraction, so no additional parameters were set. Using the resulting viewpoints, a binary viewshed analysis was conducted where visibility (Y/N or 1/0) is calculated for each observer point over the DEM. A visibility map is then produced by combining all visible points (1) into a cumulative viewshed model (Figure 1). Results were overlaid with all tourist infrastructure in Kruger and presented using *Qgis2threejs* (Akagi 2013) to produce a 3D visualization of KMAE's DEM and viewshed (Figure 2). Final results are further summarised by proposed property/subdivision boundaries 1 to 25 (Figure 3).

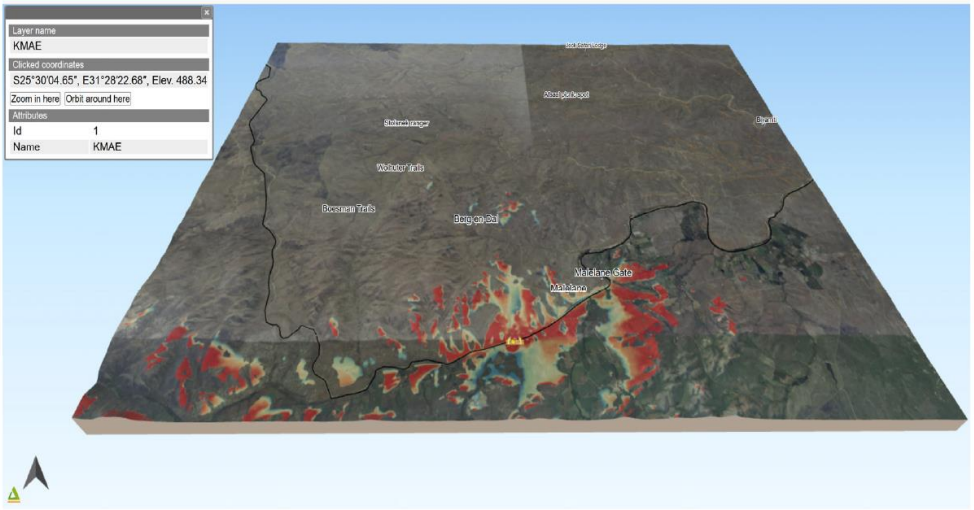

Figure 2: A 3D visualisation of Kruger Malelane Agri Estate's (KMAE) topography and areas identified as potentially sensitive to developing visual impacts to tourists in the Kruger National Park (ranging from pink to dark red in order of risk). Existing tourist infrastructure in Kruger is represented by different icons (camps or picnic spots) and lines (Kruger boundary and roads) on the map. KMAE is visible roughly in the middle of the map (houses icon). To interact with the map: i) use the mouse wheel to zoom in or out; ii) hold down the left mouse button to pivot the map in any direction and ii) hold down the Ctrl key on your keyboard and the left mouse button to pan in any direction. Left mouse click once anywhere on the map to get the clicked coordinates. A yellow circle will be placed on the map where you clicked and a control panel will appear in the top-left corner. Click "*Zoom in here*" to zoom to the yellow circle or "*Orbit around here*" to start an orbital animation. Click on any layer (e.g. camps) to get more information about the other features added to the map. See interactive pages for full 3D visualisation.

RESULTS

The maximum distance from KMAE to the furthest point visible in Kruger's landscape was 15km. KMAE developments of 7.5m, 6.0m and 5.0m will be visible from Khandizwe, Mangwato and Tlhalabye outcrops, although these points are not generally accessible to tourists. However, there are a number of sites along the S110 (adding up to 2km) and a jeep track (adding up to 8.7km) running along the Crocodile River which is used by Wolhuter and Bushman Trails, from which KMAE developments 7.5m high or higher will be visible. Developments may also be visible from Malelane satellite camp and surrounding tourist and staff roads. These results can be better visualised using the interactive 3D product described in Figure 2 below. Reducing the maximum allowable heights of all developments down to 6.0m or 5.0m, only reduces the visual impact by 2% or 3% respectively. The viewshed results are further summarised by the proposed property/subdivision boundaries 1 to 25 to visualise development risk for each subdivision (Figure 3). Subdivisions 15 and 16 have the highest risk of future developments being visible to Kruger's tourists, followed by 23 and 14 (Figure 3a). In most cases however, visibility risk does vary spatially within each subdivision (Figure 3b).

CONCLUSION

The viewshed analysis presented here assessed the visual impacts of KMAE on the surrounding landscape in Kruger with specific emphasis on the sensitivity of all existing tourism infrastructure to potential visual impacts associated with developments in KMAE. Results show KMAE will be visible from selected granitic outcrops and from certain sections of road S110. However, a number of other developments already exist along the Crocodile River outside Kruger, including other residential estates, agricultural fields and sugar-cane factories. Also, the viewshed analysis has been done using ground elevation and does not take into account vegetation (like tall trees) which may help hide certain infrastructure. Therefore the visibility risk KMAE poses to Kruger is minimal, provided all developments do not exceed 7.5m in height. Visual impacts can however be further reduced by 1) restricting developments heights further to 6.0m or 5.0m, which will reduce the visual impacts down by 2% or 3%; 2) Plant indigenous tall trees to help hide roof-tops etc.

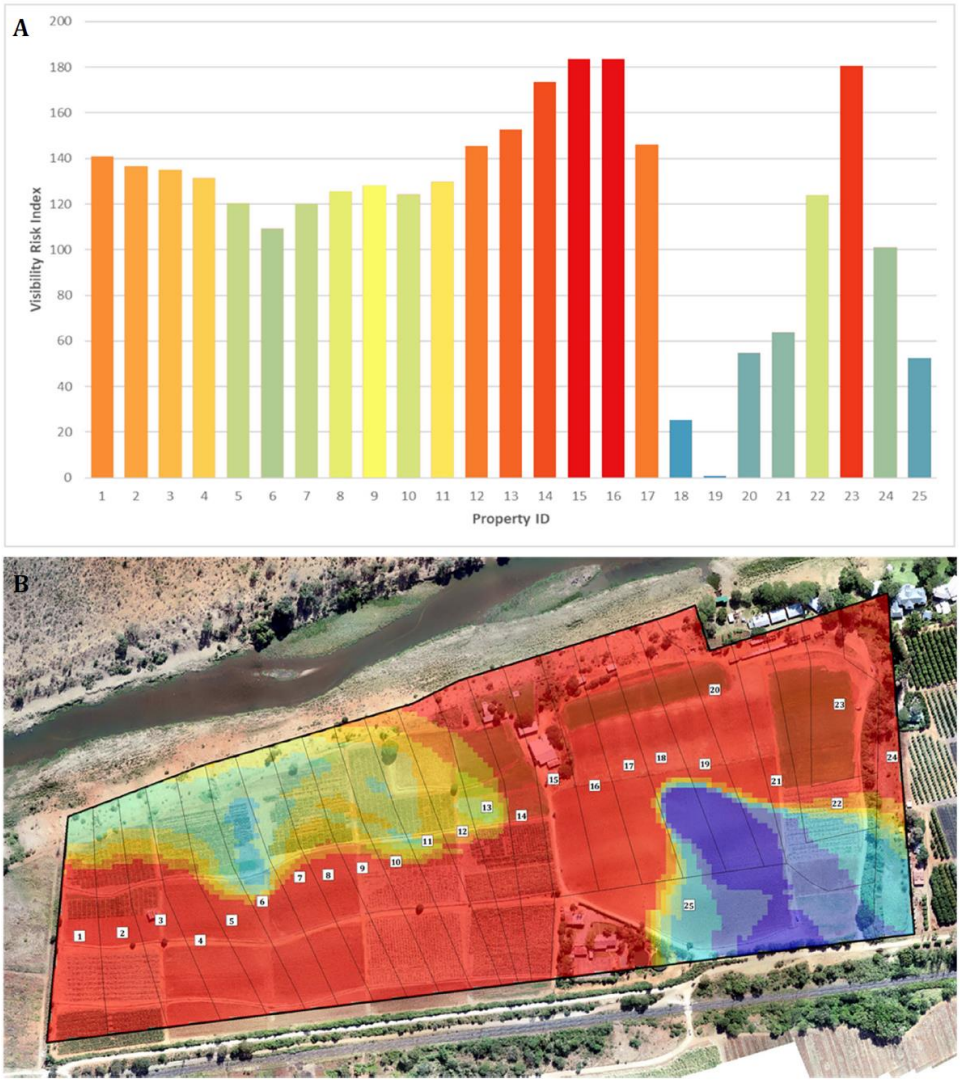

Figure 3: Risk of future developments (7.5m in height) in Kruger Malelane Agri Estate's (KMAE) being visible to tourists in the Kruger National Park. A) Boxplot showing the range of visibility risk by property/subdivision boundaries. B) Map of KMAE, showing the visibility risk of properties spatially. Colours represent the level of risk from low (blue), medium (yellow) and high (red).

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APPENDIX 5:
ENVIRONMENTAL MANAGEMENT PROGRAMME

DEVELOPMENT OF AN AGRICULTURAL ESTATE ON REMAINDER PORTIONS 8, 13 AND 14 OF MALELANE ESTATE 140 JU: MALELANE, MPUMALANGA

1. ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr): DEVELOPMENT ACTIVITIES

1.1. The environmental management programme will address the development phase of the proposed activity. This will include the installation of services (sewerage, water, power and the upgrading of the access bridge/dam) by contractors and agricultural specialists. Furthermore, it will include the preparation of the orchards and the installation of services (irrigation) including the development of each residential unit.

1.2. The EMPr will primarily be used by the applicant/construction teams under the guidance of the ECO. For this purpose the EMPr must serve a number of functions. These are:

- Instructions and conditions included in the EMPr must be written in a clear, down to earth language.
- All aspects of the EMPr must be practical and unambiguous.
- Instructions and conditions must be concise and to the point.
- Aspects of the EMPr must reflect the recommendations and mitigation measures listed in the Environmental Impact Assessment Report/s.
- Aspects of the EMPr must reflect the recommendations and mitigation measures listed in the Specialist Studies and the comments by Interested and Affected Parties/Government Departments. See **Appendix 2** and the recommendations in the EIR.
- The EMPr must be used to monitor compliance to the conditions stipulated in the Environmental Authorisation of the Project as issued by DARDLEA.
- Aspects of the EMPr can be referred to in an Operational Management Programme (OMPr) during future Environmental Audit Assessments.
- The EMPr must ensure the protection of the natural environment and cover all aspects of rehabilitation/sustainable preparation of the impacted sites.
- The EMPr will guide the process from initiation until sign off the project.
- **Note:** The EMPr will remain a dynamic document which can be updated with the approval by DARDLEA.

1.3. The implementation of the EMPr will be guided by an Environmental Control Officer (ECO).

- The applicant/developer is responsible for the appointment of the ECO.
- The name and contact details of the ECO must be submitted to DARDLEA once the project commences.
- All Interested and Affected Parties (I&AP's) must be informed of the name and contact details of the ECO.

1.4. Monitoring and Auditing

The Environmental Control Officer (ECO) will ensure that all the **conditions** as set out in the **Environmental Authorisation (EA**) **and any other requirements as issued by DARDLEA or any other applicable Department, e.g. DWS**, are met and implemented as stipulated.

The ECO must submit to DARDLEA, a **quarterly audit report (or as determined by DARDLEA as appropriate)** on the activities of the development. Quarterly audit reports will be made available to I&AP's on request.

The role of the ECO and independent audit teams are well defined within the framework of Integrated Environmental Management (IEM). The developer, together with the ECO will ensure **compliance** in terms of this process**.**

1.5. Initial Role-players: Contact Details:

1. Developer/Applicant Representative: Andre De Zwardt	Cell: 082 820 4228
2. ECO: To be appointed	Cell: To be confirmed.
3. EAP: Ralf Kalwa	Cell: 082 414 7088

2. DEVELOPMENT PHASE: ENVIRONMENTAL MANAGEMENT PROGRAMME (EMP)

This programme must be read in conjunction with the **Contract Documents** for the project. This environmental management programme will address the development/preparation phases of the proposed development as described in Environmental Impact Assessment Report.

KEY ISSUES: EMPr

This programme is designed for the entire development period and includes the rehabilitation of areas where development/storage activities took place. The Contractor/Applicant together with the Environmental Control Officer (ECO) will be responsible to ensure that all construction workers, sub-contractors, suppliers and relevant personnel associated with the development:

- Understand the contents of the Environmental Management Programme (EMPr).
- Ensure that all the construction personnel are fully aware of all environmental issues relating to the development activities.
- Adhere to all the precautionary and mitigating measures described in the EMPr.
- Ensure that all the construction personnel understand the implications and stipulations of the Environmental Rules and Regulations described in the Development Contract.
- The ECO shall instruct the Applicant/Developer to suspend the works if the Contractor and/or any Sub-Contractors do not comply with the contents of the EMPr.
- The ECO will submit quarterly audit reports to DARDLEA, the Contractor and the Developer.
- The EMPr describes the responsibilities of all the staff during the development phase.
- The ECO will oversee the operations and ensure compliance with the EMPr.

Non Compliance: The Contractor/Applicant is deemed NOT to have complied with the EMPr, the Environmental Authorisation and the EIA if:

- Within the boundaries of the site, site extensions and haul/access roads there is evidence of contravention of the Specification/Conditions of the EMPr;
- Environmental damage ensues due to negligence;
- The Contractor fails to comply with corrective or other instructions issued by the ECO within a specific time;
- The Contractor fails to respond adequately to complaints from the public;

Prior to construction: The Contractor/Applicant, in liaison with the ECO will submit a **final layout plan** of the development site indicating all of the following: storage areas, hazardous substances storage area (if applicable), different stockpile areas, material stores, waste disposal areas, on site offices, workshops, ablutions, access roads, no go areas etc. This construction site layout plan must be submitted to DARDLEA and the ECO prior to site establishment. Once the layout is approved by the ECO the Contractor will be required to sign acceptance of the EMPr and commence with the development. **Note:** Contractor = Installer of Irrigation Systems (pump houses, valve chambers) or construction of Bridge/Residential Construction sites etc.

2. DEVELOPMENT PHASE: ENVIRONMENTAL MANAGEMENT PROGRAMME: The ECO will monitor compliance of this EMPr		
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
1. Site Establishment and Logistics.	**1. Site Office and Logistics**: Establish a site office for the development. The Farmhouse can serve this purpose. The following procedures and equipment must be made available at the office: • Copies of the EIA (Final BAR) and the EMPr. • Copy of the Environmental Authorisation. • Copies of the Development/Site Layout Plan. • A Complaints Register. • A Corrective Actions and Site Instruction Register. • An Emergency/Evacuation Procedure. • A Monitoring- and Audit Register. • Emergency Contact Numbers including but not limited to telephone contact details for medical doctors; hospitals; emergency helicopters; emergency fire management; the ECO and Project/Site Manager. • Fire Extinguishers. • First Aid Kit. • A register of all applicable Standard Operational Procedures and Method Statements (e.g. handling of hazardous materials) of materials and equipment that are used and stored on site.	**Contractor**
	2. Final Walk Inspection (Pre-Construction): A final walk through the site with the ECO to point out the presence sensitive areas, e.g. Special Plants/Habitat/Drainage Line/Floodline/Buffer Zones, or any other aspect which requires protection has to be undertaken prior to site establishment.	
	• All staff must be trained to respect the importance of rare/conservation significant plants and cultural artefacts. This is specifically applicable to the no go area around the drainage lines and buffer areas.	
	• Special features (large indigenous trees; rivers; wetland; etc.) must be indicated on the development map and demarcated on site prior to construction. Damage to such features must be rehabilitated to the satisfaction of the ECO and the developer.	
	• All drainage lines must be demarcated to ensure that all machinery is kept out of these zones.	
	• **Timing**: All development should preferably take place in the period March-September.	
	3. Demarcation: Demarcate the boundaries of the total development site for management purposes using steel droppers/standards spaced at regular intervals with a combination of nylon rope/barrier tape/shade cloth curtains between the droppers. **This will be required on all building sites and especially in the vicinity of the riparian zones and sites with special plants of concern.**	

	• The Contractor shall maintain the demarcation line and ensure that materials used for construction on site do not blow on or move outside the site or pose a threat to any neighbours or adjoining property owners.	
	• Where applicable, structures must be located in such a manner as to reduce visual intrusion and minimal disturbance to neighbouring properties. Make use of coloured netting or corrugated cladding to hide unsightly features.	
	• Construction activities are restricted within these boundaries, thus all construction equipment, materials and personnel will remain within this demarcated area at all times.	
	• Ensure that access to the site including related infra-structure and machinery is restricted to authorised personnel only.	
	4. Site Control: Limit the construction/development site to existing infrastructure and or to disturbed areas.	
	• Ensure that only approved workers and Sub-Contractors are accommodated and allowed access to the site. • Ensure that all activities required by the Irrigation Board staff are allowed to continue unhindered and without delay.	
	5. Site Facilities: The construction site and storage areas must be safeguarded against fire. • Ensure that each Contractors Site is fully functional in terms of water- and sewerage supply (temporary toilets) prior to the contractors coming on site.	
	• Contractor to be held responsible for providing construction-, drinking- and washing water for all the activities on site.	
	6. Access Routes and Control: No temporary access routes and haul roads are required for this activity. • No vehicle movement outside demarcated areas/routes/existing roads is permitted without authorisation from the ECO.	
	• Dust control measures, i.e. dampening access routes with water, must be implemented where necessary.	
	• Damage to any existing roads as a result of construction activities will be repaired to the satisfaction of the ECO and the Developer.	

	7. Storage- and Material Laydown Areas: Irrigation piping, pumps, cement, re-inforced steel, bricks etc. will require a site, e.g. farm yard, when these materials are delivered and until these items are installed/used.	
	• All equipment, materials; pipelines etc. must be stored at the farm maintenance centre or on the residential building site under construction.	
	8. Site Closure: Once the development period e.g. bridge crossing site/residential unit is completed the following conditions will apply:	
	• The Contractor shall ensure that all temporary structures/facilities, equipment, materials and waste used for construction activities are removed after completion of development.	
	• The contractor shall clear and clean the construction site to the satisfaction of the ECO and the developer upon completion of the development.	
	• Remove all components of demarcation when the development phase is completed.	
	• Rehabilitate disturbed areas. This will include but not be limited to: • Break up any hardened soil surfaces allowing seeds and rainwater an opportunity to penetrate the soil surface. • Brush pack/landscape bare areas and reduce the potential run off of water. • Shape/level off any unnatural areas to fit in with the surrounding landscape and the lie of the land.	
	Site Closure: Should the site be closed for a period of more than one week (Christmas break), a report on compliance will be lodged with the ECO, and the following will be confirmed: • Stores will be left at as low a volume as practically possible with no leaks. • The storage area will be secure and locked. • Fire extinguishers will be serviced and accessible. • The area will be secure from accidental damages. • Emergency- and contact numbers will be available and prominently displayed. • Toilets will be empty and secured. • Refuse bins will be empty and secured. • Access to the site must be limited to authorised personnel only. • Security staff will patrol and guard the site.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
2. Site Biodiversity Management. (The ECO must be consulted at all times during this process).	**1. Vegetation Management**: Vegetation clearing must be undertaken in a judicious and responsible manner. The following approach will apply:	**Contractor and ECO where applicable.**
	• Where applicable, six weeks prior to the vegetation being cleared all **Protected Tree Species** must be clearly marked by the ECO and DAFF/MTPA Permits must be obtained to ensure permitted removals and translocations. • The Biodiversity Specialist has recommended that should any tree require translocation that it should be replanted on site. If this cannot be achieved for whatever reason, then the above statement will apply.	
	• **Vegetation Clearing:** As per the contents of the Biodiversity Report very little natural vegetation is found on the project site. The following will however apply where some vegetation clearance will be required: • During the clearing of vegetation in the project area most vertebrates will move away from the project site. • During this activity the project team may encounter slow moving reptiles and smaller mammals. • These animals should be allowed to move away unharmed or be assisted and allowed to enter the Kruger National Park on the northern boundary of the project site.	
	• **Riparian Corridor:** All drainage lines and riparian zones as identified by the Biodiversity Specialist/Project Ecologist will be kept intact. The riparian zones will act as a corridor for migrating fauna.	
	2. Alien Invader Plants (Also from the SANParks Guideline): Control of alien invasive species will be undertaken on the development footprint in line with the requirements of the Conservation of Agricultural Resources Act. The ECO will identify plants (where applicable) which require removal and management. The applicant has commenced with this process as part of a Best Practice philosophy.	
	• Alien invasive plant material will be preferentially removed through mechanical means (e.g. chainsaw, hand-pulling of smaller specimens).	
	• Chemical control is only required as a last resort or as a support mechanism to control coppicing and sprouting.	
	• All exotic plants must be identified and earmarked for removal. The ECO will assist with identifications (where applicable).	
	• A number of workers must be used to remove the vegetation i.e. 4/6 workers. ECO to monitor.	
	• If during the establishment period, any noxious or excessive weed growth occurs, such vegetation will be removed by the contractor.	

	3. Fauna and Flora Management (Also from the SANParks Guideline): Collection of firewood/seeds/fruit/plants/animals or any biological material (where applicable) is strictly prohibited.	
	• No animals including snakes should be killed or injured by workers during the construction- and or the operational phases of the project.	
	• No poaching will be allowed on site.	
	• No interaction with animals inside the Kruger National Park is allowed. This includes the provision of game licks, water points and providing fodder.	
	• No luring or calling of animals is allowed.	
	• The Contractor is not allowed to deface, paint or mark and/or damage natural features/vegetation on the site.	
	4. Topsoil Protection: Topsoil will have to be removed/moved from all areas where pipelines etc. are to be installed.	
	• Topsoil to be handled twice only; once to strip and stockpile (in low heaps of 1m) in the Right of Way (ROW) next to the trench, and secondly to replace along the contour, level, shape and scarify.	
	• The topsoil must be replaced as soon as possible.	
	• Topsoil may not be compacted, nor should any object be stored or stockpiled upon it.	
	• No vehicle traffic will be allowed on the topsoil.	
	• The Contractor shall prevent pollution incidents on the topsoil. ECO to monitor.	
	5. Biodiversity Protection: **See Appendix 4.4.2. Refer to applicable maps in Appendix 1.** • **Ecological Corridors/Buffer Zones/Riparian Areas**: The corridors created by buffers and the delineation of the riparian areas **connect and protect** the sensitive areas on the project site which link up to the Kruger National Park. • This network of sensitive areas will provide viable corridors (from south to north and vice versa) and dwellings for smaller animals/birds undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements and range expansion. • The protected network, which includes the drainage line to the east of the project site will function as a sanctuary for both animals and plants.	

	• Summary of **Impact Mitigation on Biodiversity Components**: **ECO to monitor and control**: • See **Appendix 4.5.2** for detail on all aspects of the biodiversity associated with the Project Area. The potential impacts of the project on the biodiversity of the study area are assessed under the following broad categories, namely: • **Activity 1: Construction of the residential units:** • **Impact 1.1: Stormwater and erosion/siltation.** • **Applicable Activity:** Surface flows from residential areas will be released as stormwater into the receiving environment, which may cause erosion and siltation. • **Nature of Impact:** A development, such as the KMAE project implies that areas of natural/agricultural vegetation are replaced with housing units, roads and other forms of impervious surfaces in the residential areas. • The effect of this is that water runs from the new hard ground surfaces and enters streams or watercourses in greater volumes and over a shorter period of time. However, the KMAE development can be considered as a very low-density development which directly implies that runoff will not **increase impermeable areas significantly.** • **Mitigation Recommendation**: It is proposed that soakaways be used within the residential sites to lessen the impact of runoff from the roofs combined with permeable paving. • Another source control which could be considered is rainwater harvesting (ConSolv, 2020). It is further proposed that swales be constructed adjacent to all the access roads as the primary local control. • Should water be channelled in any event from the property, it is suggested that the water should be slowed down before it reaches the KNP fence/boundary with a slowdown system such as infiltration trenches. • It is envisaged that the current open, erosion prone fallow lands will rapidly be transformed into lush gardens of local indigenous vegetation as soon as construction is completed. • Some indigenous trees have already been planted as part of the initial rehabilitation. These gardens will each also act as slowdown systems for stormwater generated by paved surfaces and roofs on the unit.	

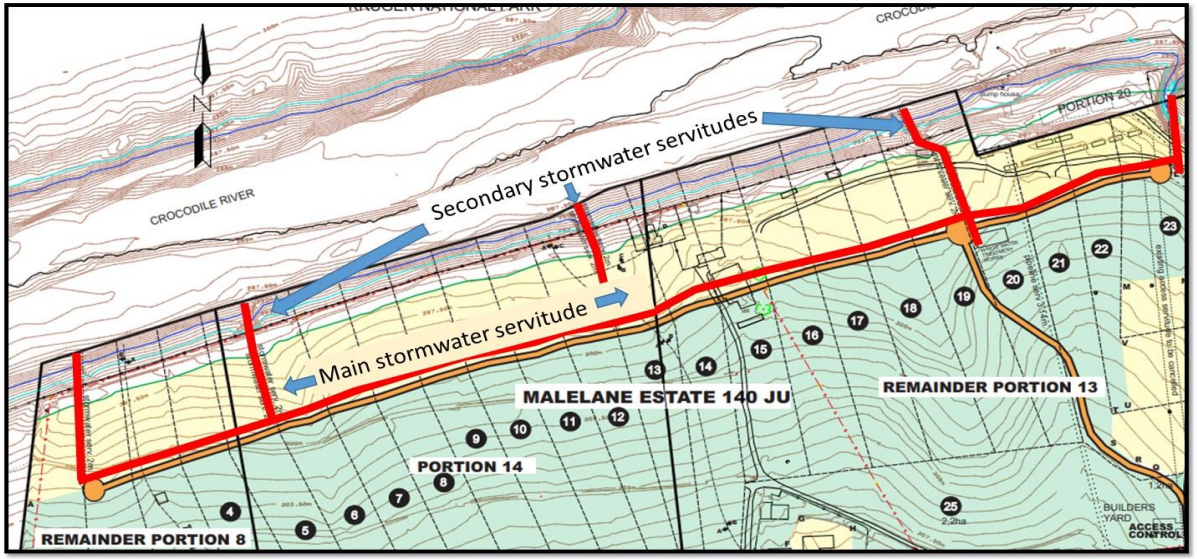
	• **Impact 1.2 Pollution: 1.2.1 Sewerage**: • **Applicable Activity**: Wastewater treatment. • **Nature of Impact**: Poorly maintained septic tanks can result in nutrient-rich runoff being discharged. These waste waters create unfavourable conditions for natural vegetation and encourage growth of weeds. When nutrients such as nitrogen and phosphorus are discharged from septic systems into the groundwater, they represent a potentially important nonpoint source of pollution to the Crocodile River. • This could also negatively affect the unnamed watercourse on the eastern boundary due to inter alia inadequately treated effluent, a risk associated with the passive biological treatment process of septic tanks. • **Mitigation Description of Impact 1.2.1**: A waterborne sewerage system will thus be installed (no septic tanks) with a Maskam Fusion Waste Water Treatment Plant package. • The outflow from this system must conform to General DWS Standards and will be used for irrigation of the macadamia orchards. One pump station (situated on proposed portion 19) will feed the treatment plant. • All the sewerage from the reticulated sites within the development will be treated at the treatment plant. The Wastewater Treatment Plant will be constructed next to the water treatment plant and the treated water will be used for irrigation. • The treated effluent must comply with the general standards required by the Department of Water and Sanitation and must be of such quality that the treated water can be used for irrigation purposes. • The project area drains towards the north-east, and the lowest point is next to the Crocodile River. It is proposed that the sewer lines be placed **outside the riparian buffer**. • No reticulation lines will be constructed within the 1:100-year flood line.	

	• **Impact 1.2 Pollution:** 1.2.2 Hazardous substances associated with construction activities. • **Applicable Activity**: Alterations to water quality due to pollution from hazardous chemicals released through effluents, storm water runoff or accidental spillages from the project area into the receiving aquatic environment. • **Nature of Impact**: **Potential Substances**: Oil, fuel, lime-containing (high pH) construction materials (concrete, cement and grouts), and chemicals such as hydrocarbons, carbonaceous sediments, flushed-out pesticides, house-hold detergents. • A range of hazardous chemicals, some of which are lethal to in-stream biota (fish and invertebrates) could contaminate the watercourses during various stages of this project if due precautions are not taken. Hazardous chemicals can leak or be accidentally spilled by construction vehicles during construction and might contaminate the soil, ground water and receiving wetlands. It is essential to prevent pollution of the waters of the Kruger National Park and the resulting poisoning of fish, birds and other animals. • **Mitigation Description of Impact 1.2.2**: The buffer boundaries for the water courses as assessed with the DWS buffer tool must be implemented between the development and surrounding environment. These buffers around the riparian zones and wetlands were calculated as follows: • Crocodile River: 23m wide. • Small stream on the eastern boundary (valley bottom wetland): 10m wide. • **These buffers will protect the riverine area from the following potential sources of pollution:** • Construction camps, storage areas, soil stockpile areas and laydown areas must be located outside the riparian or wetland buffer zones. • Prohibit the dumping of waste material within the riparian or wetland buffer zones. Spoil material must be appropriately disposed of at a registered waste disposal facility. • Portable toilets must be located outside the riparian- or wetland buffer zones.	

	• **Impact 1.2 Pollution (Also from the SANParks Guideline):** 1.2.3 Solid waste. • **Applicable Activity**: Solid waste disposal and management. • **Nature of Impact**: Improper solid waste disposal and management causes all types of pollution: air, soil, and water. Uncontrolled burning of solid waste and improper incineration contributes significantly to urban air pollution. • Health and safety issues also arise from improper solid waste management. Insect and rodent vectors are attracted to the waste and can spread diseases. The availability of household trash can alter the composition of wildlife communities by providing food for animal populations that thrive on trash (such as rats, baboons and monkeys) to the detriment of those that do not, e.g., small mammals and birds. • **Mitigation Description of Impact 1.2.3**: Refuse removal functions will be provided by the KMAE Management. Waste will be collected weekly by the Nkomazi Municipality. See **Appendix 6.6**. which confirms the removal of solid waste. • It is proposed that solid waste be taken daily in municipal refuse bags to a holding facility (fenced in cage with welded mesh and concrete floor) at the entrance gate of the development. • A surfaced area with screening walls will be constructed at the entrance gate to accommodate a number of "skips". • The holding facility must be constructed with brick and concrete. The facility will include a concrete floor, washing- and drainage facilities. • The KMAE Management Team must implement a green waste management and recycling approach as per good governance and best practice principles.	
	• **Activity 2**. Construction of a dam at an existing bridge crossing in an unnamed drainage line. • **Impact 2.1:** Inundation of the stream. • **Applicable Activity**: Drowning of a section of the riparian zone. • **Nature of Impact**: This impact refers to the permanent loss of untransformed habitat, especially the interruption of the riparian corridor. • **Mitigation Description of Impact 2.1**: Very little mitigation will be available during the flooding of the riparian zone. • Establish a 10m buffer zone (established with the DWS Buffer Tool) around the full-water mark and replant some of the key riparian tree species from the basin onto the dam margin boundary. • Currently there are some intact riparian zones upstream and downstream of the proposed dam basin along the stream banks of the drainage line. • The riparian zone of the designated drainage line should be protected and excluded from any further development in order to maintain and support the integrity of the remaining riparian corridor.	

	• **Activity 3:** Establishment of the orchards. • **Impact 3.1**: Stormwater and erosion/siltation • **Applicable Activity**: Erosion and siltation due to channelled and thus concentrated stormwater flowing from the orchards. • **Nature of Impact**: Whether the stormwater arrives via non-point sources or via storm-water systems, it inevitably discharges directly into the receiving waters without any prior treatment. Even moderate runoff volumes and velocities give rise to a wide variety of water quality problems that are linked to flooding and wash-off. The typical categories of problems that arise are sedimentation, erosion (channel widening and streambed alteration) and habitat changes, as well as loss of aquatic- or riparian habitats. • It is clear, that historical land uses resulted in concentrated stormwater channelling between croplands and where this channelled water was released on the other side of the KNP fence, visible erosion took place, leaving the scars of erosion dongas on the floodplain. • It is also clear by the colour of the soil below the property on the KNP side of the fence that sheet erosion through the years transported a great deal of soil from the agricultural lands into the Park. • Both the loss of good agricultural soil and the deposition of washed-out alluvial sediment into the KNP must be considered a significant adverse impact. • **Mitigation Description of Impact 3.1**: Proper stormwater management is essential to ensure protection of life and property from flood hazards and that the natural environment is protected. • The **objectives of stormwater management** can be summarised as follow: • to provide a stormwater drainage system for the protection of the property from damage by runoff from frequent storms; • to prevent loss of life and reduce damage of the property from severe storms; • to prevent land and watercourse erosion; • to protect water resources from pollution; • to preserve natural watercourses and their eco-systems; • to achieve the foregoing objectives at optimal total cost. • The stormwater channels and structures will be designed for a 1:2-year storm recurrence, except at the piped crossings where a 1:5-year storm recurrence is catered for. The infrastructure will be located within the road servitudes. (See **Service Report** in **Appendix 6.1**). • The introduction of efficient stormwater drainage systems to deal with the erosion and siltation problem implies that the runoff must be conveyed as efficiently as possible to the natural watercourses. This has the effect of decreasing the time runoff takes to reach the natural watercourses. The result is a **reduction of overland flow**, meandering watercourses and the like, through a system which drains runoff to the watercourses as quickly as possible. The flood problem is therefore transferred downstream. • It is suggested that Best Practice Guidelines and Specifications relating to stormwater management should be used to implement measures to slow down flows channelled through the orchards, right from where the orchards start at the southern boundary.	

- The layout below illustrates the proposed stormwater servitudes in the project area. It is clear that this system will mainly serve the agricultural stormwater emanating from the orchards. It therefore comes down to the fact that each residential unit must be able to manage the stormwater on its own property.
- The main stormwater servitude runs parallel along the east to west road servitude, and five secondary stormwater servitudes run from the main stormwater servitude directly to the northern boundary of the project area. The most eastern line will release its volume of stormwater into the unnamed drainage line, a natural drainage system for rainwater.
- This layout predicts that the main stormwater line will collect most of the stormwater draining from the orchards, and then release the flow via the secondary stormwater lines into the Crocodile River floodplain.
- It is clear that if all the stormwater is released equally through the secondary stormwater lines, the impact of erosion will not be alleviated. The dongas will remain or even deteriorate due to the concentrated stormwater flows during high rainfall events. To **mitigate for this impact**, the following are suggested:
- The main stormwater channel should be a few centimetres deeper than the secondary stormwater channels, in order for most of the initial inflows to be diverted to the natural stream outlet and no erosion is expected to occur here;
- It may be appropriate to release the stormwater below the dam wall in order to protect the structure from higher than usual flood peaks;
- When the main stormwater channel fills up, more water will be released into the secondary stormwater channels and the water diverted towards the northern boundary of the project area and the KNP fence;
- In order to prevent high volumes of stormwater being released straight into the downstream environment, it is suggested that the stormwater channels first let the water flow into a system of drains and rock-filled sumps to slow down the flows and then dissipate the released water **over gabion mattresses** to prevent further erosion and siltation on the KNP section of the fence.



	• **Impact 4 (Also from the SANParks Guideline):** Human Wildlife Conflict. • **Applicable Activity**: Human-animal conflict. • **Nature of Impact**: Human-animal conflict is often caused by learned behaviour. The eradication of the problem animal is often the result. • Situations might arise where certain animals and their behaviour become problematic to the management of a place bordering a wilderness area or so close to a Big Five location (Kruger Park). • It is therefore important to design the facilities in a way that prevents this undesirable learnt behaviour. The most common problem animals in this regard are: elephants, hyaena, baboons, vervet monkeys and badgers. • Although there is a strong barrier between the KMAE and the park, animals are opportunists and will sometimes find a way to get past the barrier. Smaller species such as baboons, vervet monkeys and badgers can easily climb through or over the fence. • **Mitigation Description of Impact 4**: It will be expected from the KMAE management to implement the necessary preventative measures to avoid the development of problem animals. A **Problem Animal Policy** for the owners may include the following strategy: • **Potential food sources**: It is important to avoid the animals associating humans with easy food, therefore food should never be left visible, unattended and/or accessible. • Educate and sensitise contractors, owners, guests and visitors on the issues related to problem animals. • Fences around waste storage facilities must be functional. • It must be made clear to owners and their guests that the feeding of any animals, even birds, is unacceptable. • Fruit trees, such as oranges, should not be planted. Plant indigenous trees. • **Interfering with biota**: No person shall disturb or destroy any fauna or flora. • Do not disturb any animal inside the project area. • Do not remove, cut or damage an indigenous plant inside the project area. • No snake (poisonous or non-poisonous) may under any circumstances be killed unless a human life is at stake. • No trapping, snaring, hunting, fishing or killing of any animal may occur inside the project area. • Baiting of wildlife to enhance viewing is not permitted. • **General Conditions**: Strict lighting controls will be enforced to limit light pollution. No floodlights and open lighting will be allowed for night lighting. The number and wattage of outdoor lights will be limited/low key and shields must be used to direct lighting downwards. • No fires may be lit except in designated areas. • No loud noise or disturbance will be permitted.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
3. Project Specifics and Excavation Management: Trenching; Backfilling and Levelling.	**1. Excavation**: During excavation topsoil has to be stockpiled as specified in low 1m heaps next to the trench in the ROW. • Excavation of soil to solid ground to be done carefully and to ensure proper drainage.	**Contractor and ECO where applicable.**
	• Remove soil/sand and debris and expose all rocky material.	
	• Excess (spoil) excavated rocky material (rock and boulders) to be used for erosion control/cladding/gabions where applicable or for purposes of landscaping.	
	2.Backfilling: All soils must be returned into the trench in the sequence in which they were excavated. • Soil will be excavated and used for re-filling trenches using the **rollover method**, i.e. progressive re-instatement: This entails the following approach: • Soil from the first trench section will be stockpiled. • Soil excavated from subsequent trench lengths will be used to backfill once the pipelines have been laid on an ongoing basis. • The final trench length will be re-filled using the originally stockpiled soil.	
	3. Levelling: Excess sand/soil (after construction) must be filled in and landscaped into natural sandbanks blending in with the topography of the surroundings.	
	• Excess stockpiled building material must be removed completely and all areas levelled.	
	• Excess sand and soil resulting from levelling activities of the work area to be stored in low heaps on the access road/or already disturbed areas.	
	• Excess topsoil to be spread evenly over the area in a manner that blends in with the natural topography.	
	• When the bulk of material stockpiles have been cleared, the disturbed areas are to be levelled and cleared of any unnatural foreign material manually using shovels and rakes.	
	4. Trenching: This activity is limited to the pipeline installations to the new orchards and all service lines to the residential units. • Trenching will be minimised through the use of single trenches.	
	• Planning and selection of trench routes will be indicated on the Site Development Layout Plan.	
	• Trench routes with permitted working areas will be clearly defined and marked with painted stakes prior to excavation.	

	• All trenches must be clearly marked (Flags; coloured posts; reflective banners; lights) in order to alert people to the potential hazard thereof.	
	• All open trenches must be patrolled on a minimum of a daily basis to ensure that animals, e.g. lizards, small rodents, have not become trapped. Such animals will be removed and released. A log must be placed at strategic spots each afternoon to allow any animal that accidentally falls into the trench an opportunity to escape.	
	• Stripping and separation of topsoil will occur as stipulated in the EMPr above.	
	• Trench lengths will be kept as short as practically possible.	
	• Trenches will be re-filled to the same level as, or slightly higher to allow for settlement of the surrounding land surface to minimise erosion. Excess soil will be stockpiled in an appropriate manner.	
	• Immediately after refilling, the disturbed areas will be stabilised.	
	• The Contractor will not pollute any eco-system as a result of construction activities. All cement mixing activities must take place on an impermeable layer, e.g. metal sheet or plastic cover. • **NB**: No mixing of cement may take place directly on the soil surface.	
	5.Irrigation Methods/Equipment: • The efficient use of water and the implementation of a site-specific irrigation system will go a long way towards the sustainable use of irrigation water on the new orchards.	
	• It is therefore essential that a cost-effective system is used which optimises the use of water and prevents run-off and erosion. For this reason, the **Low Flow Irrigation System (LFIS)** must be implemented:	
	Advantages of the LFIS: • **Broader water distribution:** As water enters the ground at a slow pace, it spreads around the sides of the plant rather than seeping downward. • **Better nutrient utilisation:** Since water stays closer to the area where the roots are most active, more nutrients are available to the plant with fewer ground pollutants. • **Larger and enhanced yields:** Since the in-ground air-water ratio at any given moment is higher, crop yields are larger and of a better quality. • **Lower nutrient usage:** As all the fertiliser is distributed at the active root-zone level, the plant receives a high percentage of the amount distributed, leading to lower quantities of applied fertiliser. • **Water saving:** Irrigation is placed underneath the agricultural fabric; the low flow drip ensures no over irrigation.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
4. Waste Management: Solid Waste.	**<u>1. Litter and Builders Waste (Also from the SANParks Guideline):</u>** All waste to be disposed of off-site at an approved landfill site as per the local Nkomazi Municipal regulations. • Contractor not to dispose of any waste and/or construction debris through burning or by burying.	**Contractor**
	• Contractor to supply tamper proof waste bins throughout the site at locations where construction workers are working.	
	• Tamper-proof refuse bins to be emptied on a daily basis. Refuse bins not to be used for any other purpose.	
	• Contractor has to designate specific areas for staff to enjoy their lunches and tea and he must provide for access to adequate refuse bins at these sites.	
	• All litter must be removed off site daily and deposited at the designated waste collection point near the Waste Holding Facility.	
	• Waste includes cigarette boxes, cigarette butts, paper, plastic bags, tin, glass, wires, cable ties, and organic waste e.g. peels and bones.	
	• Under no circumstances will cigarette butts be discarded anywhere on the development site.	
	• No waste of any kind or type is allowed to pollute the Kruger National Park.	
	• Once operational all residential units must be equipped with locked waste cages (welded mesh) including tamper proof dustbins.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
5. Waste Management: Liquid Waste.	**<u>1. Construction Water</u>**: Construction water refers to all water affected by construction activities. • No River/Stream/Natural Drainage Line must be used for cleaning of tools and equipment. This includes the washing of clothes and bathing/recreational purposes.	**Contractor**
	• All washing of equipment to be undertaken at the designated facilities in the Site Yard (near the farmhouse).	
	• Water from any other cleaning operations in the Site Yard to be collected in a “conservancy” tank removed from site and disposed of in the agreed manner.	
	• Water and slurry to be contained to prevent the pollution of the ground surrounding the mixing and/or disposal points.	
	• No spills to be channelled into natural environment. Contractor to take reasonable precautions to prevent pollution of the ground and water resources.	
	• Contractor to ensure that no fuels (petrol/diesel), oils, lubricants and/or other chemicals are discarded onto the ground. Use drip trays in all potentially risky situations, e.g. refuelling a mobile generator.	

	2. Sewerage Management: Adequate temporary (e.g. Enviro-loos) ablution facilities to be put in place on sites located near to working areas. • 1 Enviro-loo per 10 workers.	
	• Toilet paper must be provided by the contractor.	
	• All toilets must be checked daily and serviced accordingly by an accredited service provider.	
	• No spillages into the surrounding environment will be allowed.	
	• The entrances to the toilets must be adequately screened from public view.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
6. Waste Management: Hazardous Waste (The use of hazardous materials are not envisaged during the development phase, however unforeseen events may occur which are not known to the EAP at this stage of the process. This aspect is therefore included as a precautionary measure).	**1. Hazardous Waste Process**: The EAP has not been made aware of any hazardous substances that may be used during the development construction process. To ensure that the EMPr maximises the implications of the precautionary approach the following conditions are included in the event that substances such as fuel (mobile generator); paints; varnishes; chemicals for alien plant control etc. are used at any stage of the development. • A Contractor staff member must be designated to manage this process.	**Contractor**
	• Contractor to comply to all national, regional, and local legislation with regards to the storage, transport, use and disposal of petroleum, chemicals, harmful and hazardous materials and substances.	
	• Contractor to provide the ECO with a list of all petroleum, chemical, harmful and hazardous materials and substances on site, together with all the storage, handling and disposal procedures for these materials. A register must be kept at the site office containing all the written/prescribed handling procedures.	
	• Contractor to be responsible for training and education of workers that will be working with these materials. Training to include the proper use, handling and disposal of the substances.	
	• Storage of chemicals to be safe, tamper proof (under lock and key) and under strict control.	
	• Storage and handling of fuels, lubricants, chemicals and other hazardous substances to be protected by placing an impermeable liner, e.g. bund beneath the above ground storage containers in order to prevent accidental contamination of the soil.	
	• The contractor will ensure that there is a supply of absorbent material (or absorption blankets) readily available on site to absorb, break down and where possible control any spillages that may occur. The amount and type of absorbent material must be appropriate to the volumes of hazardous liquids on site.	
	• Any accidental chemical/fuel spills to be addressed and reported immediately to the ECO. The ECO will inform the applicable authorities and initiate a containment- and control programme as applicable.	

	• Contractor to be responsible for establishing an emergency procedure for dealing with spills/releases of fuels, chemicals, hazardous substances and medical emergencies. • All spills/accidents to be recorded (in the Incident Register) and reported to the ECO. • The cleanup of spills and any damage caused shall be for the Contractor's account.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
7. Access Roads.	**1. Existing Roads**: The farm is well serviced with all-weather farm roads to the various sections and facilities on the property. The proposed project and all deliveries will make use of these access routes. These routes will however be formalised with stormwater control measures and engineering road design protocols.	**Contractor**
	• Adhere to the local speed limit on the farm (40km/h) at all times.	
	• Contractors to limit the number of deliveries where possible through appropriate advance planning.	
	• Contractors will be required to submit a delivery timetable to the ECO.	
	• Construction personnel should only use authorised paths and roads.	
	• Any damage caused by the construction activities to any access or public roads must be rehabilitated thoroughly upon completion of the construction.	
	2. New Roads (Less than 3.5m wide): Implement the Road Design Protocols in Appendices 6.1, 6.2 and 6.5: All orchard roads created for the purposes of the development must be designed and planned in advance with the ECO. • Access will be required to each orchard. Orchard roads must be designed to incorporate adequate drainage and water attenuation structures.	
	• Where applicable the road must be stabilised with all-weather gravel (patch gravelling).	
	• A **designated roads contractor** must oversee this aspect of the development process.	
	• **Stabilise/All Weather Access**: Although these farm roads will not carry significant loads of traffic on a daily basis access to the orchards will be required during the harvesting process. The road surfaces must thus be stabilised for all weather use.	
	• **Prevention of Erosion**: Erosion problems on roads must be addressed immediately as and when these occur. This must be done by installing humps across the roads at regular intervals, in order to redirect the water away from the road or track.	
	• **Humps** must be large enough to withstand stormwater events. They must be constructed across the entire width of the road (from side to side and into the adjoining vegetation). The humps must be at least 50cm higher than the surrounding ground level. This will ensure that run-off of water is directed out of the road and not down the road.	

	• **Mitre Drain**: All water run-off from the roads must be channelled into mitre drains. These drains must be kept open (free of vegetation and blockages). All drains must be opened by the end of September annually.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
8. Construction Staff	**1. Staff Management (Also from the SANParks Guideline)**: The Code of Conduct for Contractors as described in the Tender Document will apply to all Construction Staff. • The EMPr must be included as a condition of the Tender Document.	**Contractor**
	• Contractors must adhere to all conditions of the Occupational Health and Safety Act.	
	• A Safety Plan must be submitted to the ECO prior to the commencement of construction.	
	• No contractor staff will be housed on the development site.	
	• All contractor staff will abide with the Rules and Regulations of the KMAE Development. This includes all aspects to gain entrance and to exit the property.	
	• All staff must use the water- and sewerage facilities judiciously and keep these facilities neat and clean.	
	• All staff must remain within the development footprint and behind the demarcated boundaries.	
	• No open fires will be allowed for cooking- and or heating purposes.	
	• Staff must supply their own lunches and refreshments. No cooking will be allowed on site.	
	• Staff must respect the surrounding environment and prevent all littering and damage to fauna and flora.	
	• **Site Specifics: Induction Courses (Contractor to conduct)**: All staff will undergo an intensive induction course on worker safety and safety procedures for the various sections of the site.	
	• **EMPr**: The conditions of the Environmental Management Programme must be explained to all workers and staff on site.	
	• All staff on site must sign an acceptance of understanding the EMPr form prior to being allowed on site.	

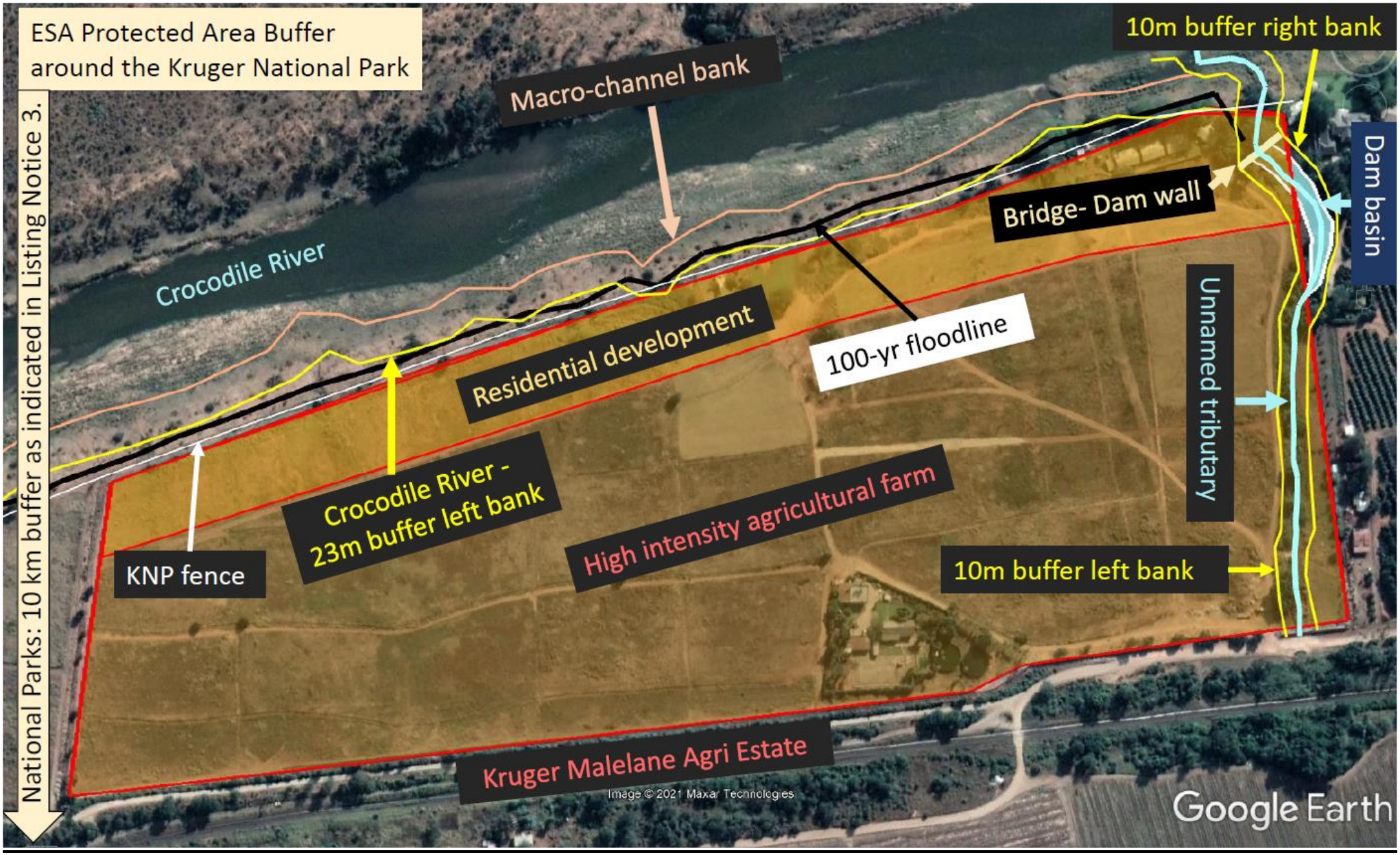
ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
9. Fire.	**1. Fire Management (Also from the SANParks Guideline)**: Contractor to take all the necessary precautions to ensure that no fires are caused as a result of activities on site. • A Contractor staff member must be designated to manage this process.	**Contractor**
	• Contractor to supply all facilities, site offices, workshop areas, storage areas, with approved fire-fighting equipment. This aspect must be carried over into the operational phase of the project.	
	• All staff on site will be made aware of general fire prevention and control methods and the name of the responsible person to alert to the presence of a fire.	
	• The Contractor will advise the relevant authority of a fire outside of a demarcated area as soon as it starts and will not wait until he can no longer control it.	
	• All fire-fighting equipment to be maintained in good operating order.	
	• No open fires for heating or cooking are allowed on site.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
10. Accidents.	**1. Staff Safety**: Contractor to comply with the Occupational Health and Safety Act (OHASA) and any other labour regulations with regard to safety on site.	**Contractor**
	• Contractor to provide an Occupational Health and Safety Management Plan to the ECO for approval prior to the commencement of works in terms of the Construction Regulations.	
	• A Contractor staff member must be designated to manage this process.	
	• Fencing and barriers will be in place in accordance with the Occupational Health and Safety Act (Act No. 85 of 1993).	
	• Applicable notice boards and hazard warning notices will be put in place and secured. Night hazards, e.g. open trenches, will be suitably indicated (e.g. reflectors, lighting, and traffic signage).	
	• No unauthorised firearms or weapons of any kind will be permitted on the site.	
	• Contractor to ensure that all staff are familiar with all the emergency procedures.	
	• All staff must undergo a basic First Aid Course.	
	• Contractor to ensure that lists of all emergency telephone numbers/contact people are available and are posted at relevant locations, e.g. site office, at all times and that they are updated regularly.	
	• Contractor to be responsible for establishing an emergency procedure for dealing with medical emergencies. All incidents to be recorded (in the Incident Register) and reported to the ECO.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
11. Adverse Weather Conditions and Erosion Protection.	**<u>1. Wet Weather: Overflows and Erosion Protection</u>**: Development on this project will preferably take place during the period March-September.	**Contractor**
	• Contractor to set up a procedure for rapidly emptying any collection points to prevent them filling with rainwater.	
	• Contractor to ensure that no sumps (where applicable) are emptied unnecessarily. Special care to be taken during rainy periods/adverse weather conditions to prevent contents from overflowing.	
	• Contractor to ensure that a procedure is established for dealing with potentially polluted rainwater. Procedures/method statements must be filed in the register in the site office.	
	• Stockpiles of fine material such as sand, topsoil, etc. to be protected from rain run-off and wind.	
	• During construction, Contractor to protect all areas susceptible to erosion by installing all the necessary temporary and permanent drainage works ASAP. Contractor must also prevent water scouring of the slopes, embankments (where applicable) and any other areas.	
	• Correct any cause of erosion at the onset thereof through the most appropriate mechanism. Discuss any remedial actions with the resident ECO.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
12. Noise, Visual and Dust Impacts.	**<u>1. Noise Impacts (Also from the SANParks Guideline)</u>**: Contractor to use the equipment that is appropriate to the task in order to minimise the extent of damage to the environment and minimise the noise levels.	**Contractor**
	• The provisions of SABS 1200A will apply to all areas within audible distance of the site.	
	• Noise levels to be kept within acceptable limits for a conservation/agricultural area, and not to be of such a nature as to detract from the experience of persons in the area.	
	• No amplified music will be allowed.	
	• Construction activities generating output levels of 85dB or more will be confined to the hours 07h00 to 17h00 Mondays to Fridays.	
	<u>2. Dust:</u> Dust to be controlled on site at all times.	
	• Dust emissions may occur during the clearing of vegetation and delivery of equipment and supplies on the farm roads to the project area.	
	• Contractor must control dust emissions using a water tanker as and when the impact arises.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
13. Cultural Artefacts.	**1. Handling of Unexpected Cultural Finds**: The proposed project does not traverse, impact and or influence aspects of historical value, however the following conditions are listed in the event that an unexpected find or artefact is unearthed. • An accredited archaeologist must oversee the clearance of vegetation and trenching process.	**Contractor**
	• Sensitise the Contractor/labourers to be aware of the importance of cultural artefacts/fossils and implement the recommended procedure below in the event that such a discovery is made accidentally during construction.	
	• Should any artefact, historical site or fossil be discovered during excavations for irrigation trenches as well as in future, all works must cease with immediate effect. • A buffer of 30m must be established around the find.	
	• The find must be reported to the ECO and the Project Manager for the project. • These representatives will initiate an Action Plan in conjunction with an accredited archaeologist/palaeontologist (Contact SAHRA) to address the management and handling of the find.	
	2.Existing Farmhouse (Stand 25): The existing farmhouse may not be demolished without permission as it is older than 60 years. ECO to advise where applicable.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
14. SANParks Additional Guidelines.	**1.Gates and Fence:** No gates are allowed in the Kruger National Park boundary fence. The fence alignment cannot be changed and or amended without SANParks (KNP) approval. • At no stage may persons enter the KNP over/through the boundary fence.	**Contractor and or Applicant**
	2.Visual Impact: **Earthy Colours**: All structures must be naturally coloured and blend in with the surrounding environment and landscape. • **Windows**: All glass panes must be UV resistant with non-reflective glass. • **Lights and Solar Panels**: All outdoor lights must face downwards (45 degrees) and not higher than 3m from the ground level. • No floodlights are allowed. No lights may be directed onto the watercourse in the KNP. • Only use hand-held spotlights at night. • Solar Panels angled towards the KNP are not allowed. • **Height**: All buildings must not exceed 7.5m above ground level.	
	3.Design or Layout Changes: Changes in the project layout and design (or the approved project description) must be discussed with the SANParks (KNP) for approval. • All new developments or extensions must be discussed SANParks (KNP) for approval.	

	4.Water Consumption and Use: Water consumption must be minimsed at all times. • The development will use 57.5kl of water per day and all residential properties will be restricted to 1.3-2.0 kl/day/unit.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
15. Site Clean Up and Closure.	**1. Removal and Clearance (Also from the SANParks Guideline)**: Contractor to ensure that all temporary structures, materials, water and waste facilities used for construction activities are removed upon completion of the project.	**Contractor**
	• All signs of disturbance and contractor activity must be rehabilitated to a state as on day of site handover.	
	• All toilets must be removed.	
	• All left over stock and bits and pieces of materials must be removed.	
	• All waste bags must be deposited at the waste management facility.	
	2.Rehabilitation: It is not envisaged that major rehabilitation efforts will be required, however applying the precautionary approach the following conditions are placed on record:	
	• All re-seeding activities will be undertaken at the end of the dry season to ensure optimal conditions for germination and rapid vegetation establishment.	
	• When ripping for rehabilitation the contractor will rip to refusal or a minimum of 300 mm.	
	• The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertiliser uniformly.	
	• Inspect rehabilitated area at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures.	
	• Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.	
	• Only indigenous vegetation commensurate with the Malelane landscape is to be used in any landscaping/reseeding which may be undertaken.	
	3. Project Sign Off: The ECO must sign off the works and the site during a Final Audit Assessment. The Final Audit Report will be submitted to DARDLEA for approval and verification.	

FINAL DEVELOPMENT MAP: FIGURE BIODIVERSITY REPORT: AGRICULTURAL ESTATE ON REMAINDER PORTIONS 8, 13, 14 AND 20 OF MALELANE ESTATE 140 JU


ESA Protected Area Buffer
around the Kruger National Park
National Parks: 10 km buffer as indicated in Listing Notice 3.
Macro-channel bank
10m buffer right bank
Dam basin
Bridge- Dam wall
Crocodile River
Residential development
100-yr floodline
Unnamed tributary
Crocodile River -
23m buffer left bank
KNP fence
High intensity agricultural farm
10m buffer left bank
Kruger Malelane Agri Estate
Image © 2021 Maxar Technologies
Google Earth

Kruger Malelane Agri Estate - unique lifestyle gated community inside a high intensity agricultural farm (28.4 ha) in the Greater Malelane Town Area, Mpumalanga Province.

High intensity agricultural farm – Agriculture lease area (20 ha); currently fallow lands; economical irrigation unit with 12.4 ha listed water.

Residential development - consist of 25 subdivisions; 8.4 ha.

KNP fence – Fence on southern boundary of the Kruger National Park.

100-yr flood line: 1:100 yr flood line of the Crocodile River.

Macro-channel bank: Used to establish the ecological buffer in the absence of a defined riparian zone.

Crocodile River - 23m buffer left bank: Riverine buffer.

Unnamed tributary - non-perennial drainage feature.

10m buffers on left and right bank of Unnamed tributary.

Bridge- Dam wall – Proposed dam small dam wall that will also serve as a river crossing; approximately 650m long.

Dam basin – of proposed dam.

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ACCEPTANCE OF EMPr: AGRICULTURAL ESTATE ON REMAINDER PORTIONS 8, 13 AND 14 OF MALELANE ESTATE 140 JU:

DECLARATION

I/We, the undersigned as the proponent/s/person/s responsible for the above-proposed activity undertake to abide by the above-designated EMP and associated conditions.

Name: _____

Signature: _____

Date: _____

Name: _____

Signature: _____

Date: _____

CHECKED BY ENVIRONMENTAL CONTROL OFFICER

Name: _____

Signature: _____

Date: _____