

ECOLOGICAL FAUNA AND FLORA HABITAT SURVEY

Proposed Bospoort Pipeline, Rustenburg, North West Province.



Foliage of *Pouzolzia mixta* (Soap-nettle) at rocky slopes in the study area.
Photo: Reinier F. Terblanche.

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1 INTRODUCTION

An ecological habitat survey was required for a proposed construction of pipeline at an area (a narrow strip) that runs along the R510 road north and into Rustenburg in the North West Province. The survey focused on the possibility that threatened fauna or flora known to occur in North West Province are likely to occur within the proposed development or not. Species of known high conservation priority that do not qualify for threatened status also received attention in the survey.

1.1 OBJECTIVES OF THE HABITAT STUDY

The objectives of the habitat study are to provide:

- A detailed fauna and flora habitat survey;
- A detailed habitat survey of possible threatened or localised plant species, vertebrates and invertebrates;
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Evaluate the conservation importance and significance of the site with special emphasis on the current status of threatened species;
- Literature investigation of possible species that may occur on site;
- Identification of potential ecological impacts on fauna and flora that could occur as a result of the development; and
- Make recommendations to reduce or minimise impacts, should the development be approved.

1.2 SCOPE OF STUDY

- Surveys to investigate key elements of habitats on the site, relevant to the conservation of fauna and flora.
- Recording of any sightings and/or evidence of existing fauna and flora.
- The selective and careful collecting of voucher specimens of invertebrates where deemed necessary.
- An evaluation of the conservation importance and significance of the site with special emphasis on the current status of threatened species.
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Literature investigation of possible species that might occur on site.
- Integration of the literature investigation and field observations to identify potential ecological impacts that could occur as a result of the development.
- Integration of literature investigation and field observations to make recommendations to reduce or minimise impacts, should the development be approved.

2 STUDY AREA

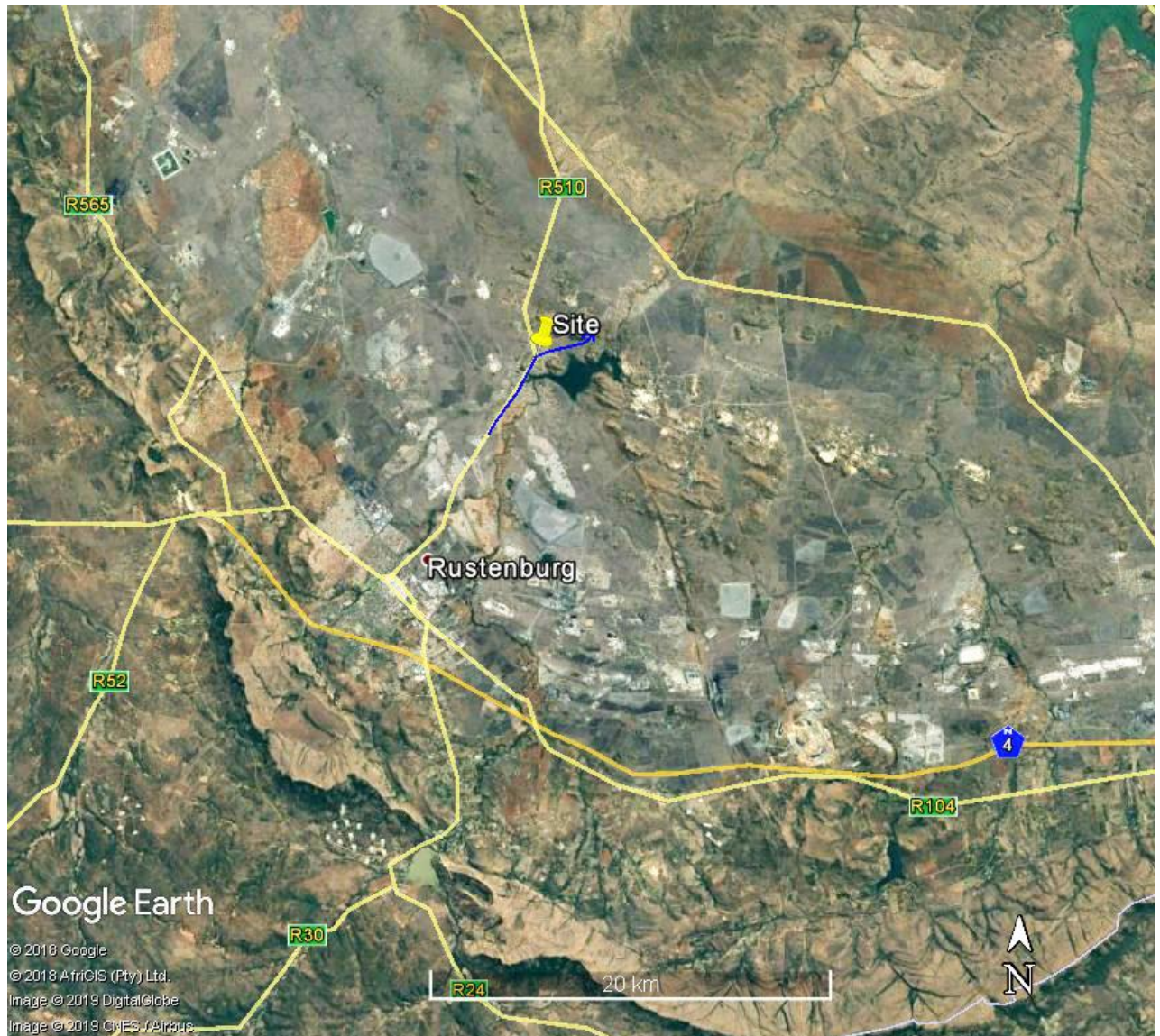


Figure 1 Map with an indication of the location of the site.

Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2019).

The study area is a narrow strip that runs along the R 510 road north of and into Rustenburg in the North West Province. The study site is situated at the Savanna Biome which is represented by the Marikana Thornveld vegetation type and in the northeastern parts of the site, the Norite Koppies Bushveld (SVcb 7) (Mucina & Rutherford 2006). An outline of the Marikana Thornveld and Norite Koppies Bushveld is given to serve as ecological context for the study site.

Marikana Thornveld SVcb 6

Distribution: The Marikana Thornveld (SVcb 6) is found in South Africa in the North West and Gauteng Provinces: Occurs on plains from the Rustenburg area in the west, through to Marikana and Brits to Pretoria area in the east. Altitude at the Marikana Thornveld varies from 1050 – 1450 m (Mucina & Rutherford 2006).

Vegetation and landscape features: Open *Acacia karroo* woodland, occurring in valleys and slightly undulating plains, and some lowland hills. Shrubs are denser along drainage lines, on termitaria and rocky outcrops or in other habitat protected from fire (Mucina & Rutherford 2006).

Geology and soils: Most of the area is underlain by the mafic intrusive rocks of the Rustenburg Layered Suite of the Bushveld Igneous Complex. Rocks include gabbro, norite, pyroxenite and anorthosite. The shales and quartzites of the Pretoria Group (Transvaal Supergroup) also contribute. Mainly vertic melanic clays with some dystrophic or mesotrophic plinthic catenas and some freely drained, deep soils (Mucina & Rutherford 2006).

Climate: Summer rainfall with very dry winters. Mean annual precipitation about 600 and 700 mm. Frost is fairly frequent in winter.

Important taxa: Tall tree: *Acacia burkei*. Small trees: *Acacia caffra*, *Acacia gerrardii*, *Acacia karroo*, *Combretum molle*, *Searsia lancea*, *Ziziphus mucronata*, *Acacia nilotica*, *Acacia tortilis* subsp. *heteracantha*, *Celtis africana*, *Dombeya rotundifolia*, *Pappea capensis*, *Peltoporum africanum*, *Terminalia sericea*. Tall shrubs: *Euclea crispa* subsp. *crispa*, *Olea europaea* subsp. *africana*, *Searsia pyroides* var. *pyroides*, *Diospyros lycioides* subsp. *guerkei*, *Ehretia rigida* subsp. *rigida*, *Euclea undulata*, *Grewia flava*, *Pavetta gardeniifolia*.

Low Shrubs: *Asparagus cooperi*, *Rhyncosia nitens*, *Indigofera zeyheri*, *Justicia flava*. Woody Climbers: *Clematis brachiata*, *Helinus integrifolius*. Herbaceous Climbers: *Pentarrhinum insipidum*, *Cyphostemma cirrhosum*. Graminoids: *Elionurus muticus*, *Eragrostis lehmanniana*, *Setaria sphacelata*, *Themeda triandra*, *Aristida scabrivalvis* subsp. *scabrivalvis*, *Fingerhutia africana*, *Heteropogon contortus*, *Hyperthelia dissoluta*, *Melinis nerviglumis*, *Pogonarthria squarrosa*. Herbs: *Hermannia depressa*, *Ipomoea obscura*, *Barleria macrostegia*, *Dianthus mooiensis* subsp. *mooiensis*, *Ipomoea oblongata*, *Vernonia oligocephala*. Geophytic Herbs: *Ledebouria revoluta*, *Ornithogalum tenuifolium*, *Sansevieria aethiopica*.

SVcb 7 Norite Koppies Bushveld

Distribution: Norite Koppies Bushveld is found in the North-West and Gauteng Provinces of South Africa. Norite Koppies Bushveld is embedded in the Marikana Thornveld, north of the Magaliesberg on rocky hills between Rustenburg and Pretoria with the highest hills (e.g. Kareepoortberg) near Brits. Altitude is about 1 100 – 1 350 m (Mucina & Rutherford, 2006).

Vegetation and landscape features of Norite Koppies Bushveld comprise a low, semi-open to closed woodland up to 5 m tall, consisting of dense deciduous shrubs and trees with very sparse undergrowth on shallow soils, with large areas not covered by vegetation. Tree and shrub layers are continuous. The stands of this unit are found on noritic outcrops and koppies, many appearing as inselbergs above the surrounding plains (Mucina & Rutherford, 2006).

Geology and soils of the Norite Koppies Bushveld are mostly gabbro and norite with interlayered anorthosite of the Pyramid Gabbro-Norite, Rustenburg Layered Suite, with small area of the Rashoop Granophyte Suite (felsic igneous rocks), both of the Bushveld Complex (Vaalian). Large rock boulders and very shallow lithosols occur. Soils are well-drained Glenrosa and Mispah forms, in some areas vertic, melanic clays are found as well. Land types mainly Ib, with some Ea also occurring.

Climate is summer rainfall with dry winters. Mean annual precipitation is 600 – 700 mm. Frost is fairly frequent around the base of hills in winter but less so on the hills (Mucina & Rutherford, 2006).

Important taxa: Tall tree: *Sclerocarya birrea* subsp. *caffra*. Small trees: *Combretum molle*, *Croton gratissimus*, *Ficus abutilifolia*, *Pappea capensis*, *Acacia caffra*, *Bridelia mollis*,

Combretum apiculatum, *Cussonia paniculata*, *Dombeya rotundifolia*, *Faurea saligna*, *Ficus glumosa*, *Lannea discolor*, *Obetia tenax*, *Peltophorum africanum*, *Searsia leptodictya*, *Vangueria infausta*, *Ziziphus mucronata*. Succulent tree: *Euphorbia cooperi*. Tall shrubs: *Triaspis glaucophylla*, *Canthium gifillanii*, *Clerodendrum glabrum*, *Diplorhynchus condylocarpon*, *Euclea natalensis*, *Grewia flavescens*, *Grewia monticola*, *Gymnosporia nemorosa*, *Gymnosporia polyacantha*, *Pavetta eylesii*, *Pouzolzia mixta*, *Psydrax livida*, *Vitex zeyheri*. Low shrubs: *Jatropha latifolia* var. *latifolia*, *Abutilon austro-africanum*, *Hermannia floribunda*, *Hibiscus subreniformis*, *Searsia zeyheri*. Succulent shrub: *Tetradenia brevispicata*. Semiparasitic shrub: *Osyris lanceolata*. Woody climbers: *Helinus integrifolius*, *Rhoicissus tridentata*, *Turrea obtusifolia*. Woody succulent climber: *Sarcostemma viminalis*. Herbaceous climber: *Cyphostemma lanigerum*. Graminoids: *Chrysopogon serrulatus*, *Setaria lindenbergiana*, *Aristida congesta*, *Bulbostylis humilis*, *Eustachys paspaloides*, *Heteropogon contortus*, *Loudetia simplex*, *Melinis nerviglumis*, *Panicum maximum*, *Themeda triandra*. Herb: *Hibiscus sidiformis*. Geophytic herbs: *Pellaea calomelanos*, *Pellaea viridis*, *Scadoxus puniceus*.

Note: Some, but not all of the above plant species are present at the site.

3 METHODS

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that become available during the field observations.

A survey consisted of visits by R.F. Terblanche in November 2015, December 2015, January 2016, April 2016 and February 2019 to note key elements of habitats on the site, relevant to the conservation of fauna and flora. The main purpose of the site visit was ultimately to serve as a habitat survey that concentrated on the possible presence or not of threatened species and other species of high conservation priority.

The following sections highlight the materials and methods applicable to different aspects that were observed.

3.1 HABITAT CHARACTERISTICS AND VEGETATION

The habitat was investigated by noting habitat structure (rockiness, slope, plant structure/ physiognomy) as well as floristic composition. Voucher specimens of plant species were only taken where the taxonomy was in doubt and where the plant specimens were of significant relevance for invertebrate conservation. In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. A wealth of guides and detailed works of plant identifications, ecology and conservation is fortunately available and very useful. Field guides, biogeographic works, species lists, diagnostic outlines, conservation statuses and detail on specific plant groups were sourced from Boon (2010), Court (2010), Germishuizen (2003), Germishuizen, Meyer & Steenkamp (2006), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), Manning (2003), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008), Pooley (1998), Retief & Herman (1997), Smit (2008), Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011), Van Jaarsveld (2006), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2003), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (1997). Lists of species, species names and the conservation status of species were mainly sourced from

Raimondo, von Staden, Victor, Helme, Turner, Kamundi & Manyama (2009) and updated versions of red lists and species from the Threatened Species Programme of SANBI and the Red List of South African Plants (sanbi.org.za).

3.2 MAMMALS

Mammals were noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps (2000) are consulted. Sites have been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces were recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) were consulted for additional information and for the identification of spoor and signs. Trapping was not done since it proved not necessary in the case of this study.

Habitat characteristics were also surveyed to note potential occurrences of mammals. Many mammals can be identified from field sightings but, with a few exceptions bats, rodents and shrews can only be reliably identified in the hand, and even then some species needs examination of skulls, or even chromosomes (Apps, 2000).

3.3 BIRDS

Birds were noted as sight records, mainly with the aid of binoculars (10x30). Nearby bird calls of which the observer was sure of the identity were also recorded. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Ryan (2001) is followed. For information on identification, biogeography and ecology Barnes (2000), Hockey, Dean & Ryan, P.G. (2005), Cillié, Oberprieler & Joubert (2004), Tarboton & Erasmus (1998) and Chittenden (2007) were consulted. Ringing of birds fell beyond the scope of this survey and was not deemed necessary. Sites have been walked, covering as many habitats as possible. Signs of the presence of bird species such as spoor and nests have additionally been recorded. Habitat characteristics were surveyed to note potential occurrences of birds.

3.4 REPTILES

Reptiles were noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) were

followed. Sites were walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics are surveyed to note potential occurrences of reptiles.

3.5 AMPHIBIANS

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

3.6 BUTTERFLIES

Butterflies were noted as sight records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such as the *Aloeides*, *Chrysochrysis*, *Erikssonina*, *Lepidochrysis* and *Orachrysis* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Bredenkamp, 1999; Terblanche, Morghental & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies were therefore also recorded. After the visits to the site and the identification of the butterflies found there, a list was also compiled of butterflies that will most probably be found in the area in all the other seasons because of suitable habitat. The emphasis is on a habitat survey.

3.7 FRUIT CHAFER BEETLES

Different habitat types in the areas were explored for any sensitive or special fruit chafer species. Selection of methods to find fruit chafers depends on the different types of habitat present and the species that may be present. Fruit bait traps would probably not be

successful for capturing *Ichnestoma* species in a grassland patch (Holm & Marais 1992). Possible chafer beetles of high conservation priority were noted as sight records accompanied by the collecting of voucher specimens with grass nets or containers where deemed necessary.

3.8 ROCK SCORPIONS

Relatively homogenous habitat / vegetation areas were identified and explored to identify any sensitive or special species. Selected stones that were lifted to search for Arachnids were put back very carefully resulting in the least disturbance possible. All the above actions were accompanied by the least disturbance possible.

3.9 LIMITATIONS

For each site visited, it should be emphasized that surveys can by no means result in an exhaustive list of the plants and animals present on the site, because of the time constraint. The site surveys were conducted during November 2015, December 2015, January 2016, April 2016 and February 2019 cover an optimal time of the year to find animals such as invertebrates as well as habitat sensitive plant and vertebrate animal species high conservation priority. Weather conditions during the survey were favourable for recording fauna and flora. The focus of the survey remains a habitat survey that concentrates on the possibility that species of particular conservation priority occur on the site or not. It is unlikely that any more visits would reveal information that would change the outcome of this assessment both in terms of ecosystems of special conservation concern or suitable habitats of species of particular conservation concern. Visits that were conducted therefore appear to be sufficient to address the objectives of this study.

4 RESULTS

4.1 HABITAT AND VEGETATION CHARACTERISTICS

Table 4.1 Outline of main landscape and habitat characteristics of the site.

HABITAT FEATURE	DESCRIPTION
Topography	Most of the site proposed for the developments is on gentle slopes whereas the northern part is on moderate slopes.
Rockiness	A rocky hill is present at the northern end of the site. Rocky ridges are absent at most of the site.
Presence of wetlands	Three watercourses cross the site, from north to south Stream Crossing A, Stream Crossing B and Stream Crossing C. These are aquatic systems classified as non-perennial rivers (active channel with riparian zones).
Vegetation	<p>Flat terrestrial terrain at the site consists of mostly overgrazed and visibly ecologically degraded savanna where <i>Vachellia tortilis</i> subsp. <i>heteracantha</i> (Umbrella Thorn) is the most conspicuous thorn tree. <i>Vachellia karroo</i> (Sweet Thorn) is also abundant. <i>Vachellia tenuispina</i> is present on flat terrain at the northern parts of the site. At the urban areas and near the tar road hitherto cleared areas are characterised by indigenous pioneer plant species and many alien invasive weed species such as <i>Tagetes minuta</i> (Khaki Weed), <i>Bidens bipinnata</i> (Black Jack), <i>Conyza bonariensis</i> (Flea Bane), <i>Datura</i> (Thorn-apples) and <i>Flaveria bidentis</i> (Smelter's Bush).</p> <p>Vegetation at the northern and northeastern side of rocky hill at site has been modified owing to excavations of the past. Vegetation at southern side of rocky hill is in near pristine condition. Various indigenous trees and shrubs are present at the rocky hill such as <i>Searsia leptodictya</i>, <i>Dichrostachys cinerea</i>, <i>Croton gratissimus</i>, <i>Grewia flavescens</i>, <i>Vachellia tortilis</i>, <i>Senegalia caffra</i>, <i>Dombeya rotundifolia</i>, <i>Vangueria infausta</i>, <i>Ziziphus mucronata</i>, <i>Canthium gilfillanii</i> and <i>Pouzolzia mixta</i>. Indigenous forbs and grasses are also present but replaced at large at areas where excavations have taken place.</p> <p>Vegetation at the stream crossings is visibly modified or ecologically degraded.</p> <p>Stream Crossing A exists as a shallow narrow active channel with a riparian zone that is visibly overgrazed. Bush encroachment of <i>Vachellia karroo</i> (Sweet Thorn) and <i>Vachellia tortilis</i> (Umbrella Thorn) and short grass are present at the riparian zone.</p> <p>Stream Crossing B is a narrow drainage line that feeds into the Bospoort Dam. Grass species such as <i>Andropogon appendiculatus</i>, <i>Paspalum scrobiculatum</i> and <i>Leptochloa fusca</i> as well as rushes such as <i>Juncus effusus</i> are present at the narrow drainage line. Opposite the road, outside the footprint the drainage line meets the dam the reed <i>Phragmites australis</i> occurs in dense stands. Closer to the road sedges, grasses and the exotic aquatic weed <i>Ludwigia</i> are present.</p> <p>Riparian zone of Stream Crossing C has been cleared at large in the past. Indigenous reed <i>Phragmites australis</i> occur in small dense patches and the alien invasive aquatic weed <i>Eichhornia crassipes</i> (Water Hyacinth) is found under and near the bridge of the existing tar road at Stream Crossing C.</p>
Signs of disturbances	Signs of trampling and overgrazing are present which is reflected by the poorly developed thin grass layer in most areas, stunted appearance and small size of thorn trees in many areas (bush encroachment), abundance of pioneer plant species including

exotic weeds and extensive bare areas at many places along the strip proposed for the development. Excavations and mining have taken place at the northern side of the rocky hill at the site. Edge effects of adjacent residential areas are present and informal dumping of rubble is then found in and along the streambeds.

Connectivity of natural vegetation in the site and between the site and surrounding areas

The active channels (streambeds) and their riparian zones are important networks of considerable conservation importance in an increasingly urbanised area. Rocky hill at northern part of the site is also corridor of considerable conservation importance.



Photo 1 Area at rocky hill where excavations have taken place (green area at top where secondary succession is conspicuous).
Photo: R.F. Terblanche.



Photo 2 Mining activities are conspicuous on the northern side of the rocky hill of the study area.
Photo: R.F. Terblanche



Photo 3 Southern slope of the rocky hill at the site contains vegetation in near pristine condition.
Photo: R.F. Terblanche.



Photo 4 Widespread *Grewia flavescens* at slopes of rocky hill at site.
Photo: R.F. Terblanche



Photo 5 *Pouzolzia mixta* at the rocky hill at the site.
Photo: R.F. Terblanche.



Photo 6 Foliage of *Sclerocarya birrea* (Marula) at the study area.
Photo: R.F. Terblanche



Photo 7 View of the study area alongside the R 510 road. Bare areas, short grass layer with visibly low cover, and shrub-height *Vachellia tortilis* subsp. *heteracantha* (Umbrella Thorn) and *Vachellia karroo* (Sweet Thorn) at the site reflect ecological disturbances and modifications in the area.

Photo: R.F. Terblanche.



Photo 8 Cattle are not grazing in fenced farm management systems at Stream Crossing A and other areas at the site. Widespread Cattle Egret, *Bubulcus ibis*, is also visible in this photo taken at Stream Crossing A.

Photo: R.F. Terblanche



Photo 9 Loose stones and building material at ecologically disturbed area at Stream Crossing A at the site.
Photo: R.F. Terblanche.



Photo 10 Culvert at the northern side of the tar road at Stream Crossing A.
Photo: R.F. Terblanche.



Photo 11 *Juncus effusus* (Soft rush) at active channel at Stream Crossing A.
Photo: R.F. Terblanche.



Photo 12 *Vachellia tortilis* (Umbrella Thorn) foliage and thorns at Stream Crossing A.
Photo: R.F. Terblanche



Photo 13 Small narrow drainage line opposite the road at Stream Crossing 3. This narrow drainage line runs towards the Bospoort Dam where, in the picture, a fringe of indigenous common reed *Phragmites australis* is present.

Photo: R.F. Terblanche.



Photo 14 Alien invasive *Eichhornia crassipes*, the Water Hyacinth, at Stream Crossing C at the site.

Photo: R.F. Terblanche.



Photo 15 Inflorescence of the indigenous reed *Phragmites australis*, a plant species that occurs in dense patches where riparian vegetation has not been cleared at Stream Crossing C.
Photo: R.F. Terblanche.



Photo 16 Visibly disturbed riparian zone at Stream Crossing C.
Photo: R.F. Terblanche

4.2 ASSESSMENT OF PLANT SPECIES OF PARTICULAR CONSERVATION PRIORITY

4.2.1 Plant species of particular conservation concern according to the red list of plants

Table 4.2 Threatened plant species of the North West Province which are listed in the **Critically Endangered** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Brachystelma canum</i>	Critically Endangered	No
<i>Brachystelma gracillimum</i>	Critically Endangered	No

Table 4.3 Threatened plant species of the North West Province which are listed in the **Endangered** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Aloe peglerae</i>	Endangered	No
<i>Brachystelma discoideum</i>	Endangered	No

Table 4.4 Threatened plant species of the North West Province which are listed in the **Vulnerable** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	Vulnerable	No
<i>Brachystelma incanum</i>	Vulnerable	No
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	Vulnerable	No
<i>Ceropegia stentiae</i>	Vulnerable	No
<i>Ledebouria atrobrunnea</i>	Vulnerable	No

<i>Marsilea farinosa</i>	Vulnerable	No
<i>Melolobium subspicatum</i>	Vulnerable	No
<i>Prunus africana</i>	Vulnerable	No
<i>Rennera stellata</i>	Vulnerable	No
<i>Searsia maricoan</i>	Vulnerable	No

Table 4.5 Near Threatened plant species of the North West Province. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	Near Threatened	No
<i>Ceropegia turricola</i>	Near Threatened	No
<i>Cineraria austrotransvaalensis</i>	Near Threatened	No
<i>Cleome conrathii</i>	Near Threatened	No
<i>Delosperma leendertziae</i>	Near Threatened	No
<i>Drimia sanguinea</i>	Near Threatened	No
<i>Elaeodendron transvaalense</i>	Near Threatened	No
<i>Kniphofia typhoides</i>	Near Threatened	No
<i>Lithops leslei</i> subsp. <i>leslei</i>	Near Threatened	No
<i>Nerine gracilis</i>	Near Threatened	No
<i>Sporobolus oxyphyllus</i>	Near Threatened	No
<i>Stenostelma umbelluliferum</i>	Near Threatened	No

Table 4.6 Plant species of the North West Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Critically Rare** category (Raimondo *et al.* 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Gladiolus filiformis</i>	Critically Rare	No

Table 4.7 Plant species of the North West Province which are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Raimondo *et al.* 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
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<i>Brachystelma dimorphum</i> subsp. <i>gratum</i>	Rare	No
<i>Ceropegia insignis</i>	Rare	No
<i>Frithia pulchra</i>	Rare	No
<i>Gnaphalium nelsonii</i>	Rare	No
<i>Habenaria culveri</i>	Rare	No

Table 4.8 Plant species of the North West Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Declining** category (Raimondo *et al.* 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Boophone disticha</i>	Declining	No
<i>Crinum bulbispermum</i>	Declining	No
<i>Crinum macowanii</i>	Declining	No
<i>Drimia altissima</i>	Declining	No
<i>Eucomis autumnalis</i>	Declining	No
<i>Gunnera perpensa</i>	Declining	No
<i>Hypoxis hemerocallidea</i>	Declining	No
<i>Ilex mitis</i>	Declining	No
<i>Pelargonium sidoides</i>	Declining	No
<i>Vachellia erioloba</i>	Declining	No

4.2.2 Plant species of particular conservation concern: protected species

Table 4.9 Tree species of the North West Province which are listed as **Protected Species** under the National Forests Act No. 84 of 1998, Section 15(1). No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Boscia albitrunca</i> (Sheppard's tree)	Protected	No
<i>Sclerocarya birrea</i> (Marula)	Protected	Yes but possibly not at the proposed footprint
<i>Vachellia erioloba</i> (Camel Thorn Tree)	Protected	No

4.3 ASSESSMENT OF VERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.3.1 Mammals of particular high conservation priority

Table 4.10 Threatened, Endangered mammal species of the North West Province. Main source: Child, Roxburgh, Do Linh San, Raimondo & Davies-Mostert (2016) with updates by several authors per species. With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status (Regional)	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Cloeotis percivali</i> Short-eared Trident Bat	Endangered	No	No
<i>Diceros bicornis</i> Black Rhinocerus	Endangered	No	No
<i>Lycaon pictus</i> African Wild Dog	Endangered	No	No
<i>Redunca fulvorufula fulvorufula</i> Southern Mountain Reedbuck	Endangered	No	No

Table 4.11 Threatened, Vulnerable mammal species of the North West Province. Main source: Child, Roxburgh, Do Linh San, Raimondo & Davies-Mostert (2016) with updates by several authors per species. With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status (Regional)	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Acinonyx jubatus</i> Cheetah	Vulnerable	No	No
<i>Felis nigripes</i> Black-footed Cat	Vulnerable	No	No

<i>Hydrictis maculicollis</i> Spotted-necked Otter	Vulnerable	No	No
<i>Mystromys albicaudatus</i> White-tailed Rat	Vulnerable	No	No
<i>Panthera pardus</i> Leopard	Vulnerable	No	No
<i>Smutsia temminckii</i> Temminck's Ground Pangolin	Vulnerable	No	No

Table 4.13 Near Threatened mammal species of the North West Province. Main source: Child, Roxburgh, Do Linh San, Raimondo & Davies-Mostert (2016) with updates by several authors per species. With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status (Regional)	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Aonyx capensis</i> Cape Clawless Otter	Near Threatened	No	No
<i>Atelerix frontalis</i> Southern African Hedgehog	Near Threatened	No	No
<i>Ceratotherium simum simum</i> Southern White Rhinoceros	Near Threatened	No	No
<i>Crocuta crocuta</i> Spotted Hyaena	Near Threatened	No	No
<i>Leptailurus serval</i> Serval	Near Threatened	No	No
<i>Parahyaena brunnea</i> Brown Hyaena	Near Threatened	No	No
<i>Pelea capreolus</i> Grey Rhebok	Near Threatened	No	No
<i>Poecilogale albinucha</i> African Striped Weasel	Near Threatened	No	No

4.3.2 Birds of particular high conservation priority

Table 4.13 Threatened bird species of the North West Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Not recorded at site/ Unlikely to use site as breeding area or particular habitat on which the species depends. Yes = Recorded at site/ Likely to use site as breeding area or particular habitat on which the species depends.

Species	Common name	Threatened Status	Recorded at site during survey	Likely to use site as breeding area or habitat
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	Vulnerable	No	No
<i>Anthropoides paradiseus</i>	Blue Crane	Vulnerable	No	No
<i>Aquila rapax</i>	Tawny Eagle	Vulnerable	No	No
<i>Ardeotis kori</i>	Kori Bustard	Vulnerable	No	No
<i>Balearica regulorum</i>	Grey Crowned Crane (Mahem)	Vulnerable	No	No
<i>Botaurus stellaris</i>	Eurasian Bittern	Critically Endangered	No	No
<i>Circus ranivorus</i>	African Marsh-Harrier	Vulnerable	No	No
<i>Crex crex</i>	Corn Crake	Vulnerable	No	No
<i>Eupodotis senegalensis</i>	White-bellied Korhaan	Vulnerable	No	No
<i>Falco naumanni</i>	Lesser Kestrel	Vulnerable	No	No
<i>Geronticus calvus</i>	Southern Bald Ibis	Vulnerable	No	No
<i>Gorsachius leuconotus</i>	White-backed Night-heron	Vulnerable	No	No
<i>Gypaetus barbatus</i>	Bearded Vulture	Endangered	No	No
<i>Gyps africanus</i>	White-backed Vulture	Vulnerable	No	No
<i>Gyps coprotheres</i>	Cape Vulture	Vulnerable	No	No
<i>Pelecanus rufescens</i>	Pink-backed Pelican	Vulnerable	No	No
<i>Polemaetus bellicosus</i>	Martial Eagle	Vulnerable	No	No
<i>Rhynchops flavirostris</i>	African Skimmer	Endangered	No	No
<i>Sagittarius serpentarius</i>	Secretarybird	Vulnerable	No	No
<i>Sarothrura ayresi</i>	White-winged Flufftail	Critically Endangered	No	No
<i>Tyto capensis</i>	African Grass-Owl	Vulnerable	No	No

* Though some of the above bird species that roams over large areas may occasionally be found at the site, the site does not appear to be a habitat of particular importance to these birds, and these birds also do not use the site as breeding area.

Table 4.14 Near threatened bird species of the North West Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Not recorded at site/ Unlikely to be particularly dependent on the site as breeding area or habitat. Yes = Recorded at site/ Likely to be particularly dependant on the site as breeding area or habitat.

Species	Common name	Threatened Status	Recorded at site during survey	Likely to use site breeding area or habitat
<i>Certhilauda chuana</i>	Short-clawed Lark	Near threatened	No	No
<i>Charadrius pallidus</i>	Chestnut-banded Plover	Near threatened	No	No
<i>Ciconia nigra</i>	Black Stork	Near threatened	No	No
<i>Circus macrourus</i>	Pallid Harrier	Near threatened	No	No
<i>Eupodotis caerulescens</i>	Blue Korhaan	Near threatened	No	No
<i>Falco biarmicus</i>	Lanner Falcon	Near threatened	No	No
<i>Falco peregrinus</i>	Peregrine Falcon	Near threatened	No	No
<i>Glareola nordmanni</i>	Black-winged Pratincole	Near threatened	No	No
<i>Leptoptilos crumeniferus</i>	Marabou Stork	Near threatened	No	No
<i>Mirafra cheniana</i>	Melodious lark	Near threatened	No	No
<i>Mycteria ibis</i>	Yellow-billed Stork	Near threatened	No	No
<i>Phoenicopterus minor</i>	Lesser Flamingo	Near threatened	No	No
<i>Phoenicopterus ruber</i>	Greater Flamingo	Near threatened	No	No
<i>Rostratula benghalensis</i>	Greater Painted-snipe	Near threatened	No	No
<i>Sterna caspia</i>	Caspian Tern	Near threatened	No	No

* Though some of the above bird species that roams over large areas may occasionally be found at the site, the site does not appear to be a habitat of particular importance to these birds, and these birds also do not use the site as breeding area.

4.3.3 Reptiles of particular high conservation priority

The following tables list possible presence or absence of threatened reptile or near threatened reptile species in the study area. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment.

Table 4.15 Threatened reptile species in North West Province. Main Source: (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Crocodylus niloticus</i> Nile Crocodile	Vulnerable	No	No	No

Table 4.16 Near threatened reptile species in North West Province. Main Source: Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers (2014). Though *Homoroselaps dorsalis* has not yet been recorded from the North West Province, its presence in some areas or the Province is anticipated. No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Homoroselaps dorsalis</i> Striped Harlequin Snake	Near threatened	No	No	No

4.3.4 Amphibian species of particular high conservation priority

Table 4.17 Near threatened amphibian species in North West Province. No = Amphibian species is not a resident on the site; Yes = Amphibian species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Pyxicephalus adspersus</i> Giant Bullfrog	Least Concern (IUCN) Remains a species of particular conservation concern.	No	No	No

4.4 ASSESSMENT OF INVERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.4.1 Butterflies of particular conservation priority

Table 4.18 Threatened butterfly species in North West Province and Gauteng Province. Sources: Henning, Terblanche & Ball (2009), Mecenero *et al.* (2013). Invertebrates such as threatened butterfly species are often very habitat specific and residential status imply a unique ecosystem that is at stake.

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Aloeides dentatis dentatis</i> Roodepoort Copper	Endangered	No	Highly unlikely
<i>Chrysochrysis aureus</i> Golden Copper	Endangered	No	Highly unlikely
<i>Lepidochrysops praeterita</i> Highveld Blue	Endangered	No	Highly unlikely
<i>Orachrysops mijburghi</i> Mijburgh's Blue	Endangered	No	Highly unlikely

Table 4.19 Butterfly species of the North West Province and Gauteng Province that are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Mecenero *et al.*, 2013). No = Butterfly species is unlikely to be a resident at the study area; Yes = Butterfly species is a resident at the study area.

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Colotis celimene amina</i> Lilac Tip	Rare (Low density)	No	Unlikely
<i>Lepidochrysops procera</i> Savanna Blue	Rare (Habitat specialist)	No	Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Rare (Habitat specialist)	No	Highly unlikely
<i>Platylesches dolomitica</i> Hilltop Hopper	Rare (low density)	No	Highly unlikely

4.4.2 Beetles of particular conservation priority

Table 4.20 Fruit chafer species (Coleoptera: Scarabaeidae: Cetoniinae) in the Gauteng Province and North-West Province which are of known high conservation priority.

Species	Threatened Status	Recorded at site during survey	Likely to be resident based on habitat assessment
<i>Ichnestoma stobbiai</i>	Uncertain	No	No
<i>Trichocephala brincki</i>	Uncertain	No	No

4.4.3 Scorpion species of particular conservation priority

Table 4.21 Rock scorpion species (Scorpiones: Ischnuridae) species that are of known high conservation priority in the Gauteng Province and North-West Province.

Species	Threatened Status	Recorded at site during survey	Likely to be resident at site based on habitat assessment
<i>Hadogenes gracilis</i>	Uncertain	No	No

<i>Hadogenes gunningi</i>	Uncertain	No	No
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5 DISCUSSION

5.1 HABITAT AND VEGETATION CHARACTERISTICS

An outline of the habitat and vegetation characteristics is given in Table 4.1.

5.2 PLANT SPECIES

Extinct, threatened, near threatened and other plant species of high conservation priority in North West Province are listed in Tables 4.2 – 4.8. Protected tree species are listed in Table 4.9. The presence or not of all the species listed in the tables were investigated during the survey. None of the Threatened and Near Threatened plant species are likely to occur on the site. One protected tree species *Sclerocarya birrea* (Marula), occurs at the bottom slopes of the rocky hill at the study area. In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

Apart from *Sclerocarya birrea*, no of the other plant species of particular conservation priority appears to occur at the site.

5.3 VERTEBRATES

5.3.1 Mammals

Table 4.10, Table 4.11 and Table 4.12 list the possible presence or absence of threatened mammal species, near threatened mammal species and mammal species of which the status is uncertain, respectively, at the site. Literature sources that were used are Friedman & Daly (2004), Skinner & Chimimba (2005) and Wilson & Reeder (2005). Since the site falls outside reserves, threatened species such as the black rhinoceros (*Diceros bicornis*) and the African wild dog (*Lycaon pictus*) are obviously not present. No smaller mammals of particular high conservation significance are likely to be found on the site as well.

5.3.2 Birds

Table 4.13 and Table 4.14 list the possible presence or absence of threatened bird species and near threatened bird species at the site. With bird species which often have a large distributional range, their presence does not imply that they are particularly dependent on a site as breeding location. Therefore the emphasis in Table 4.12 and Table 4.13 is on the particular likely dependence or not of bird species on the site. Literature sources that were mainly consulted are Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No threat to any threatened bird species or any bird species of particular conservation importance are foreseen.

5.3.3 Reptiles

Table 4.15 and Table 4.16 list the possible presence or absence of threatened and near threatened reptile species on the site. The Southern African Reptile Conservation Assessment (SARCA) was launched in May 2005 (Branch, Tolley, Cunningham, Bauer, Alexander, Harrison, Turner & Bates, 2006). Its primary aim is to produce a conservation assessment for reptiles of South Africa, Lesotho and Swaziland within a four year period, ending 2009 (Branch *et al.*, 2006). Therefore a full up-dated conservation assessment of reptiles, taking into account the recent IUCN (2001) criteria, will only be available in the near future. While the conservation statuses of reptile species are under revision Alexander & Marais (2007) as well as Tolley & Burger (2007) give useful indications of possible red listings in the near future. There appears to be no threat to any reptile species of particular high conservation importance if the site is developed.

5.3.4 Amphibians

No frog species that occur in the North West are listed as Threatened species (Vulnerable, Endangered or Critically Endangered) or Near Threatened species according to IUCN Amphibian Specialist Group (2013). Table 4.17 lists *Pyxicephalus adspersus* (Giant Bullfrog) as Least Concern globally. According to the Biodiversity Management Directorate of GDARD (Gauteng Department of Agriculture and Rural Development) (2014) there are no amphibians in Gauteng that qualify for red listed status (red listed here indicates a category

of special conservation concern such as threatened or near threatened). Suitable habitat for Giant Bullfrog at site appears to be absent.

5.4 INVERTEBRATES

5.4.1 Butterflies

Studies about the vegetation and habitat of threatened butterfly species in South Africa showed that ecosystems with a unique combination of features are selected by these often localised threatened butterfly species (Deutschländer and Bredenkamp 1999; Edge 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Threatened butterfly species in South Africa can then be regarded as bio-indicators of rare ecosystems.

Four species of butterfly in Gauteng Province and North West Province combined are listed as threatened in the recent butterfly conservation assessment of South Africa (Mecenero *et al.*, 2013). The expected presence or not of these threatened butterfly species as well as species of high conservation priority that are not threatened, at the site (Table 4.18 and Table 4.19) follows.

5.4.1.1 Assessment of threatened butterfly species

***Aloeides dentatis dentatis* (Roodepoort Copper)**

The proposed global red list status for *Aloeides dentatis dentatis* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). *Aloeides dentatis dentatis* colonies are found where one of its host plants *Hermannia depressa* or *Lotononis eriantha* is present. Larval ant association is with *Lepisiota capensis* (S.F. Henning 1983; S.F. Henning & G.A. Henning 1989). The habitat requirements of *Aloeides dentatis dentatis* are complex and not fully understood yet. See Deutschländer and Bredenkamp (1999) for the description of the vegetation and habitat characteristics of one locality of *Aloeides dentatis* subsp. *dentatis* at Ruimsig, Roodepoort, Gauteng Province. There is not an ideal habitat of *Aloeides dentatis* subsp. *dentatis* on the site and it is unlikely that the butterfly is present at the site.

***Chrysochrysis aureus* (Golden Opal/ Heidelberg Copper)**

The proposed global red list status for *Chrysothrix aureus* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). *Chrysothrix aureus* (Golden Opal/ Heidelberg Copper) is a resident where the larval host plant, *Clusia pulchella* is present. However, the distribution of the butterfly is much more restricted than that of the larval host plant (S.F. Henning 1983; Terblanche, Morgenthal & Cilliers 2003). One of the reasons for the localised distribution of *Chrysothrix aureus* is that a specific host ant *Crematogaster liengmei* must also be present at the habitat. Fire appears to be an essential factor for the maintenance of suitable habitat (Terblanche, Morgenthal & Cilliers 2003). Research revealed that *Chrysothrix aureus* (Golden Opal/ Heidelberg Copper) has very specific habitat requirements, which include rocky ridges with a steep slope and a southern aspect (Terblanche, Morgenthal & Cilliers 2003). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon is highly unlikely.

***Lepidochrysops praeterita* (Highveld Blue)**

The proposed global red list status for *Lepidochrysops praeterita* according to the most recent IUCN criteria and categories is Endangered (G.A. Henning, Terblanche & Ball, 2009; Mecenero *et al.*, 2013). *Lepidochrysops praeterita* is a butterfly that occurs where the larval host plant *Ocimum obovatum* (= *Becium obovatum*) is present (Pringle, G.A. Henning & Ball, 1994), but the distribution of the butterfly is much more restricted than the distribution of the host plant. *Lepidochrysops praeterita* is found on selected rocky ridges and rocky hillsides in parts of Gauteng, the extreme northern Free State and the south-eastern Gauteng Province. No ideal habitat appears to be present for the butterfly on the site. It is unlikely that *Lepidochrysops praeterita* would be present on the site and at the footprint proposed for the development.

***Orachrysops mijburghii* (Mijburgh's Blue)**

The proposed global red status for *Orachrysops mijburghii* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). *Orachrysops mijburghii* favours grassland depressions where specific *Indigofera* plant species occur (Terblanche & Edge 2007). The Heilbron population of *Orachrysops mijburghii* in the Free State uses *Indigofera evansiana* as a larval host plant (Edge, 2005) while the Suikerbosrand population in Gauteng uses *Indigofera dimidiata* as a larval host plant (Terblanche & Edge 2007). There is no suitable habitat for *Orachrysops mijburghii* on the site and it is unlikely that *Orachrysops mijburghii* would be present on the site.

Conclusion on threatened butterfly species

There appears to be no threat to any threatened butterfly species if the site is developed.

5.4.1.2 Assessment of butterfly species that are not threatened but also of high conservation priority

Colotis celimene amina (Lilac tip)

Colotis celimene amina is listed as Rare (Low density) by Mecenero *et al.* (2013). In South Africa *Colotis celimene amina* is present from Pietermaritzburg in the south and northwards into parts of Kwa-Zulu Natal, Gauteng, Limpopo, Mpumalanga and the North West Provinces (Mecenero *et al.* In press.). Reasons for its rarity are poorly understood. It is highly unlikely that *Colotis celimene amina* would be resident at the site.

Lepidochrysops procera (Savanna Blue)

Lepidochrysops procera is listed as Rare (Habitat specialist) by Mecenero *et al.* (2013). *Lepidochrysops procera* is endemic to South Africa and found in Gauteng, KwaZulu-Natal, Mpumalanga and North West (Mecenero *et al.*, 2013). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

Metisella meninx (Marsh Sylph)

Henning and Henning (1989) in the first South African Red Data Book of Butterflies, listed *Metisella meninx* as threatened under the former IUCN category Indeterminate. Even earlier in the 20th century Swanepoel (1953) raised concern about vanishing wetlands leading to habitat loss and loss of populations of *Metisella meninx*. According to the second South African Red Data Book of butterflies (Henning, Terblanche & Ball, 2009) the proposed global red list status of *Metisella meninx* has been Vulnerable. During a recent large scale atlassing project the *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas* (Mecenero *et al.*, 2013) it was found that more *Metisella meninx* populations are present than thought before. Based on this valid new information, the conservation status of *Metisella meninx* is now regarded as Rare (Habitat specialist) (Mecenero *et al.*, 2013). Though *Metisella meninx* is more widespread and less threatened than perceived before, it should be regarded as a localised rare habitat specialist of conservation priority, which is dependent on wetlands with suitable patches of grass at wetlands (Terblanche In prep.). Another important factor to keep in mind for the conservation of *Metisella meninx* is that based on very recent discoveries of new taxa in the group the present *Metisella meninx* is species complex consisting of at least three taxa (Terblanche In prep., Terblanche & Henning In prep.). The ideal habitat of *Metisella meninx* is treeless marshy areas where *Leersia hexandra* (rice grass) is abundant (Terblanche In prep.). The larval host plant of *Metisella meninx* is wild rice grass, *Leersia hexandra* (G.A. Henning &

Roos, 2001). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

Platylesches dolomitica (Hilltop Hopper)

Platylesches dolomitica is listed as Rare (Low density) by Mecenero *et al.* (2013). Historically the conservation status of *Platylesches dolomitica* was proposed to be Vulnerable (Henning, Terblanche & Ball 2009). However this butterfly which is easily overlooked and has a wider distribution than perceived before. *Platylesches dolomitica* has a patchy distribution and is found on rocky ledges where *Parinari capensis* occurs, between 1300 m and 1800m (Mecenero *et al.* 2013, Dobson Pers comm.). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

5.4.2 Fruit chafer beetles

Table 4.20 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoninae) that are of known high conservation priority in the North West Province. No *Ichneustoma stobbiai* or *Trichocephala brincki* were found during the surveys. There appears to be no suitable habitat for *Ichneustoma stobbiai* or *Trichocephala brincki* at the site. There appears to be no threat to any of the fruit chafer beetles of particular high conservation priority if the site were developed.

5.4.3 Scorpions

Table 4.21 lists the rock scorpion species (Scorpiones: Ischnuridae) that are of known high conservation priority in the North West Province. None of these rock scorpions have been found at the site and the habitat does not appear to be optimal.

5.5 Ecological Sensitivity at the site

Ecological sensitivity at most of the, which include a lot of hitherto cleared areas adjacent residential developments and tar road, is low. Stream crossings with their riparian zones and buffer zones and also the rocky hill at the site have a medium-high sensitivity. Southern slopes of the rocky hill at the site is of high ecological sensitivity.

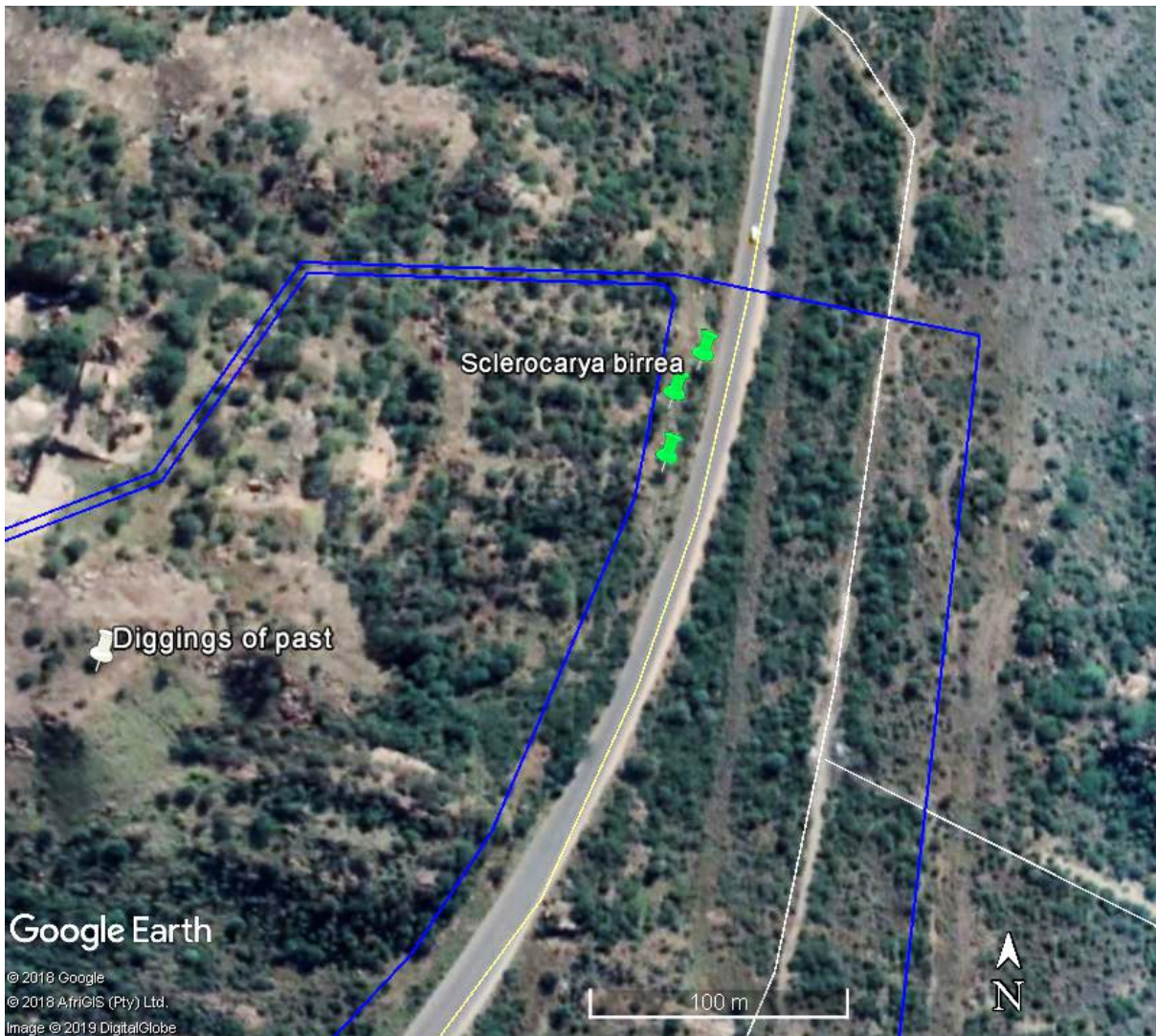


Figure 2 Indication of positions of Protected *Sclerocarya birrea* trees and the proposed footprint. Proposed footprint in blue and green markers indicating *Sclerocarya birrea* (Marula).

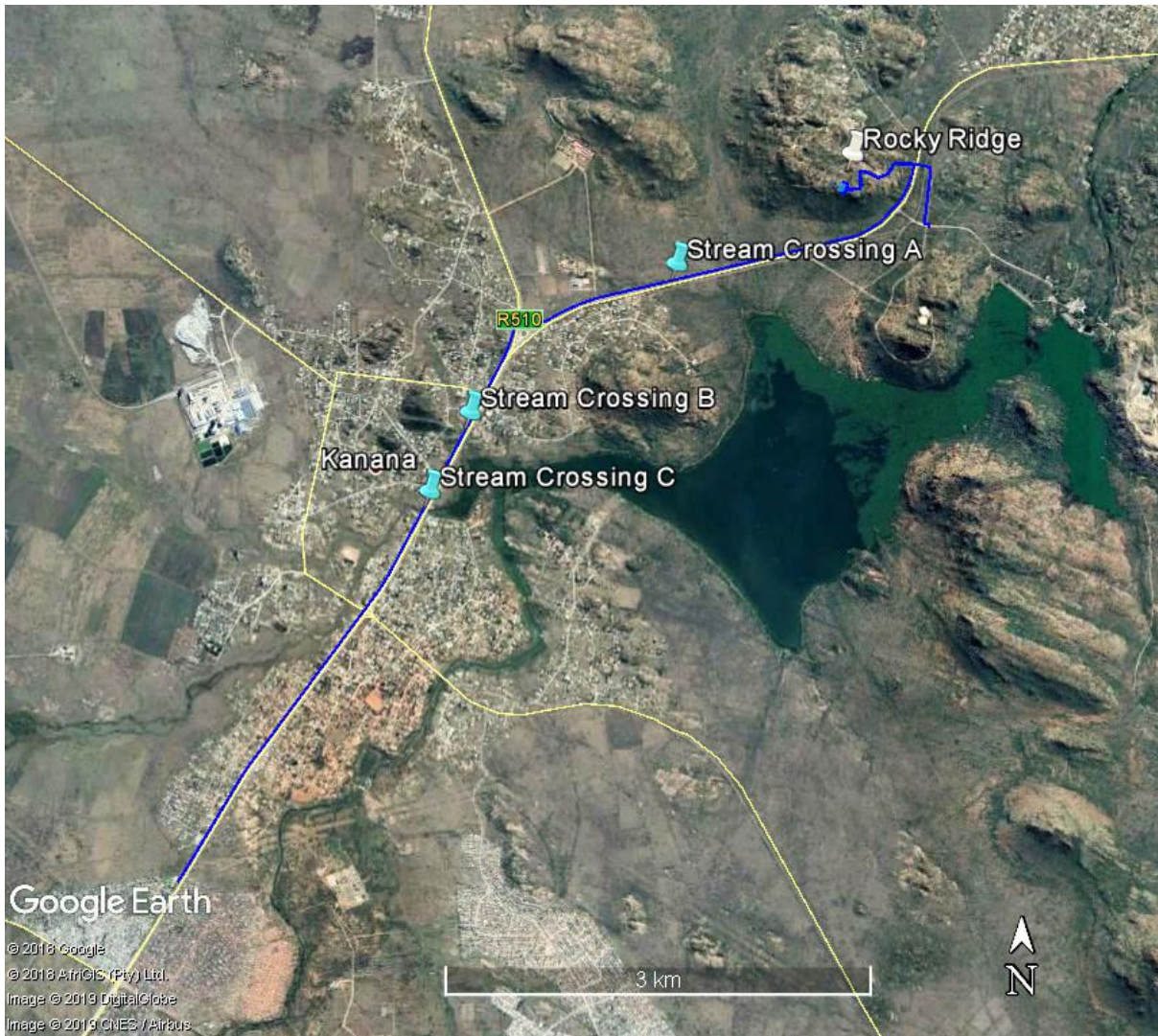


Figure 3 Indication of stream crossings and rocky ridge at site. Most of the site is on flat and ecologically disturbed terrain. Ecological sensitivity at most of the, which include a lot of hitherto cleared areas adjacent residential developments and tar road, is low. Stream crossings with their riparian zones and buffer zones and also the rocky hill at the site have a medium-high sensitivity. Southern slopes of the rocky hill at the site is of high ecological sensitivity.

6 RISKS, IMPACTS AND MITIGATION

Background:

Habitats of threatened plants are in danger most often due to urban developments such as is the case for the Gauteng Province (Pfab & Victor, 2002). Habitat conservation is the key to the conservation of invertebrates such as threatened butterflies (Deutschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Furthermore, corridors and linkages may play a significant role in insect conservation (Pryke & Samways, 2003, Samways, 2005).

Urbanisation is a major additional influence on the loss of natural areas (Rutherford & Westfall 1994). In the South Africa the pressure to develop areas are high since its infrastructure allows for improvement of human well-being. Urban nature conservation issues in South Africa are overshadowed by the goal to improve human well-being, which focuses on aspects such as poverty, equity, redistribution of wealth and wealth creation (Cilliers, Müller & Drewes 2004). Nevertheless, the conservation of habitats is the key to invertebrate conservation, especially for those threatened species that are very habitat specific. This is also true for any detailed planning of corridors and buffer zones for invertebrates. Though proper management plans for habitats are not in place, setting aside special ecosystems is in line with the recent Biodiversity Act (2004) of the Republic of South Africa.

Corridors are important to link ecosystems of high conservation priority. Such corridors or linkages are there to improve the chances of survival of otherwise isolated populations (Samways, 2005). How wide should corridors be? The answer to this question depends on the conservation goal and the focal species (Samways, 2005). For an African butterfly assemblage this is about 250m when the corridor is for movement as well as being a habitat source (Pryke and Samways 2003). Hill (1995) found a figure of 200m for dung beetles in

tropical Australian forest. In the agricultural context, and at least for some common insects, even small corridors can play a valuable role (Samways, 2005). Much more research remains to be done to find refined answers to the width of grassland corridors in South Africa. The width of corridors will also depend on the type of development, for instance the effects of the shade of multiple story buildings will be quite different from that of small houses.

To summarise: In practice, as far as developments are concerned, the key would be to prioritise and plan according to sensitive species and special ecosystems.

In the case of this study:

Flat terrestrial terrain at the site consists of areas at or in the immediate vicinity of residential areas and further north at the site overgrazed and visibly degraded savanna where *Vachellia tortilis* subsp. *heteracantha* (Umbrella Thorn) is the most conspicuous thorn tree. At the urban areas and near the tar road at the site, hitherto cleared areas are characterised by indigenous pioneer plant species and many alien invasive weed species.

A rocky hill is present at the northern end of the site. Rocky ridges are absent at most of the site. Vegetation at the northern and northeastern side of rocky hill at site has been modified owing to excavations of the past. Vegetation at southern side of rocky hill is in near pristine condition and contains a diversity of indigenous plant species.

Three watercourses cross the site, from north to south Stream Crossing A, Stream Crossing B and Stream Crossing C. These are aquatic systems classified as non-perennial rivers (active channel with riparian zones). Vegetation at the stream crossings is visibly modified or ecologically degraded.

The active channels (streambeds) and their riparian zones are important networks of considerable conservation importance in an increasingly urbanised area. Rocky hill at northern part of the site is also corridor of considerable conservation importance.

No Threatened or Near Threatened plant or animal species appear to be resident at the site. One protected tree species *Sclerocarya birrea* (Marula) occurs at the study area **but is not present at the narrow strip allocated for the development.** In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in

any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

The following potential risks, impacts and mitigation measures apply to the proposed development:

6.1 Identification of potential impacts and risks

The potential impacts identified are:

Construction Phase

- Potential impact 1: Loss of habitat owing to the removal of vegetation at the proposed development.
- Potential impact 2: Loss of sensitive species (Threatened, Near-Threatened, Rare, Declining or Protected species) during the construction phase.
- Potential impact 3: Loss of connectivity and conservation corridor networks in the landscape.
- Potential impact 4: Contamination of soil during construction in particular by hydrocarbon spills.
- Potential impact 5: Killing of vertebrate fauna during the construction phase.

Operational Phase

- Potential impact 6: An increased infestation of exotic or alien invasive plant species owing to disturbance.

6.2 Potential impacts and risks during the construction phase

Classes of impacts for this study: Very High, High, Moderate, Low, Very Low

Aspect/Activity	Clearance of vegetation at part of the site for the development
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed development. This will entail the partial destruction of habitat of low and medium-high ecological sensitivity.
Status	Negative
Mitigation required	Impacts should be restricted to the narrow strip allocated for the development. Footprint at the rocky hill crosses hitherto disturbed areas and limits any disturbance to higher ecological sensitive areas to a minimum. The hydrological setting at stream crossings, especially the gradient and top soil should be restored approach the original setting.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Low
RISK	Following the mitigation measures and type of development (a narrow strip) a low risk of impact is expected.

Aspect/Activity	Removal of sensitive species
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Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Presence of Threatened or Near-Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates at the site appear to be unlikely. Protected (but not threatened) tree species <i>Sclerocarya birrea</i> (Marula) is present in close vicinity of the proposed footprint. .
Status	Negative.
Mitigation required	Position of footprint avoids any damage to <i>Sclerocarya birrea</i> (Marula) trees at the site. / A permit at the relevant authorities should be applied for in case of any damage or removal of individual trees of <i>Sclerocarya birrea</i> (Marula) trees, if the development is approved.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISK	If permit application procedure or avoidance of protected trees is followed, the risk of significant impact is low.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	While there is little scope for most of the site to be part of a corridor of particular conservation importance, the narrow active channels and riparian zones at Stream Crossing A, Stream Crossing B and Stream Crossing C should be viewed as important parts of conservation corridors in the larger area.
Status	Negative
Mitigation required	The hydrological setting at stream crossings, especially the gradient and top soil should be restored approach the original setting. Rehabilitation of vegetation at Stream Crossings should be implemented.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Low
RISK	Following mitigation and the nature of the development (a narrow strip) a low impact risk is expected.

Aspect/Activity	Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils.
Status	Negative
Mitigation required	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	A low risk is expected following mitigation.

Aspect/Activity	Possible disturbance, trapping, hunting and killing of vertebrates during construction phase
Type of Impact (i.e. Impact Status)	Direct

Potential Impact	During the construction phase animal species could be disturbed, trapped, hunted or killed.
Status	Negative
Mitigation required	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	Following mitigation a low risk is anticipated.

6.3 Potential impacts during the operational phase

Aspect/Activity	An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa) or alien invasive Australian <i>Acacia</i> species (Australian Wattles) that should not be allowed to establish. Once established these combatting these alien invasive plant species may become very expensive in the long term.
Status	Negative
Mitigation required	Continued monitoring and eradication of alien invasive plant species are imperative. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa) and alien invasive Australian <i>Acacia</i> species (Australian wattles) that should not be allowed to establish. A rehabilitation plan should be implemented to allow for vegetation at the site to recover.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	Following mitigation, a low risk is anticipated.

6.4 Risk and impact assessment summary for the construction phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Part of site	Long-Term	Substantial	Very likely	Low	Low	Keep disturbance to less sensitive area. Avoid watercourse and buffer zone. Avoid artificial waterbody Dam 2 and buffer zone.	High	Moderate	High
Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near-threatened species)	Negative	Site	Long-Term	Very low (No species anticipated)	Unlikely	Not applicable	Not applicable	Avoidance of footprint crossing Protected tree species /Permit application for protected tree species	Moderate	Low	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	The hydrological setting at stream crossings, especially the gradient and top soil should be restored approach the original setting. Rehabilitation of vegetation at Stream Crossings should be implemented.	High	Low	High

Contamination of soil by spilling pollutants on soil which could infiltrate the soil	Soil contamination	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Rubble and waste removal. Measures that avoid hydrocarbon (petroleum) spills to get into contact with the soil.	Moderate	Low	High
Disturbance or killing of vertebrates	Disturbance or killing of species	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.	Moderate	Low	High

6.5 Risk/ Impact assessment summary for the operational phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Monitoring and eradication of alien invasive plant species. Implementation of rehabilitation plan.	Moderate	Low	High

6.5 Summary of risks and impacts

Large parts of the site consist of hitherto cleared areas or visibly modified areas at and adjacent residential areas and a tar road on flat terrain. A rocky hill is present at the northern end of the site. Proposed footprint has been positioned to run through vegetation at the northern and northeastern side of rocky hill at site that has been modified owing to excavations of the past. Proposed footprint avoids diverse indigenous vegetation at the southern side of the rocky hill. Three watercourses cross the site, from north to south Stream Crossing A, Stream Crossing B and Stream Crossing C. These are aquatic systems classified as non-perennial rivers (active channel with riparian zones). Vegetation at the stream crossings is visibly modified or ecologically degraded. Important mitigation measures are for alien invasive plant species not to establish in high quantities and also for a rehabilitation plan to restore some cover of indigenous vegetation at these Stream Crossings.

No Threatened or Near Threatened plant or animal species appear to be present at the site. One Protected tree species, *Sclerocarya birrea* (Marula) of which any impacts are avoided by the proposed footprint, is found at the site.

Owing to the nature of the proposed development which is a narrow strip, the fact that most of the site is already impacted in various ways, the distinct measures to avoid sensitive areas a low risk of impact is anticipated if mitigation measures are applied.

7 CONCLUSION

- Large parts of the site consist of hitherto cleared areas or visibly modified areas at and adjacent residential areas and a tar road on flat terrain.
- A rocky hill is present at the northern end of the site. Proposed footprint has been positioned to run through vegetation at the northern and northeastern side of rocky hill at site that has been modified owing to excavations of the past. Proposed footprint avoids diverse indigenous vegetation at the southern side of the rocky hill.
- Three watercourses cross the site, from north to south Stream Crossing A, Stream Crossing B and Stream Crossing C. These are aquatic systems classified as non-perennial rivers (active channel with riparian zones). Vegetation at the stream crossings is visibly modified or ecologically degraded. Important mitigation measures are for alien invasive plant species not to establish in high quantities and also for a rehabilitation plan to restore some cover of indigenous vegetation at these Stream Crossings.
- Site is part of the Crocodile (West) and Marico Water Management Area (WMA 3). The site is not part of a Freshwater Ecosystem Priority Area (FEPA) or wetland cluster (Nel, Driver, Strydom, Maherry, Petersen, Hill, Roux, Nienaber, Van Deventer, Swartz, & Smith-Adao, 2011; Nel, Murray, Maherry, Petersen, Roux, Driver, Hill, Van Deventer, Funke, Swartz, Smith-Adao, Mbona, Downsborough & Nienaber, 2011).
- Vegetation type Marikana Thornveld (SVcb 6) (Mucina & Rutherford 2006) is listed as a Threatened ecosystem, Vulnerable, by the National List of Threatened Ecosystems (2011). Owing to developments and mining in surrounding areas, numerous disturbances of this vegetation at the proposed footprint, the scope for restoration and conservation of this isolated patch of the vegetation type at the narrow strip proposed for development, is little.
- Rocky hill at the site is part of a Critical Biodiversity Area 2 (CBA 2). Critical Biodiversity Areas, together with protected areas, ensures that a viable representative sample of all ecosystem types and species can persist. From an environmental management perspective these Critical Biodiversity Areas must stay in largely natural condition (SANBI, 2017).

- No Threatened or Near Threatened plant or animal species appear to be present at the site. One Protected tree species, *Sclerocarya birrea* (Marula) of which any impacts are avoided by the proposed footprint, is found at the site.
- Owing to the nature of the proposed development which is a narrow strip, the conspicuous disturbances, modifications and transformations at the site, the distinct measures to avoid sensitive areas a low risk of impact is anticipated if mitigation measures are applied.

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ANNEXURE 1

List of plant species recorded at the study area including the sites.

Sources: Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998), Van Wyk & Van Wyk (1997), Crouch, Klopper, Burrows & Burrows (2011), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Ginkel *et al.* (2011), Van Jaarsveld (2006), Van Wyk & Smith (2003).

Note: Recent research reinforced and confirmed the recognition of two genera *Vachellia* and *Senegalia* for hitherto *Acacia* in South Africa hence the names *Vachellia* and *Senegalia* for hitherto *Acacia* species (see Kyalangalilwa *et al.*, 2013).

**Plant species are listed alphabetically under main taxonomic groups.
Species marked with an asterisk * are exotic.**

TAXON	COMMON NAMES	FAMILY
ANGIOSPERMS: MONOCOTYLEDONS		
<i>Albucca setosa</i>	Small White Albucca	HYACINTHACEAE
<i>Aristida adscensionis</i>	Annual Three-awn	POACEAE
<i>Aristida bipartita</i>	Rolling Grass	POACEAE
<i>Aristida congesta</i>	Tassel Three-awn	POACEAE
<i>Asparagus laricinus</i>		ASPARAGACEAE

<i>Bothriochloa insculpta</i>	Pinhole Grass	POACEAE
<i>Brachiaria eruciformis</i>	Sweet Signal Grass	POACEAE
<i>Cenchrus ciliaris</i>		POACEAE
<i>Chloris virgata</i>	Feathertop Chloris	POACEAE
<i>Commelina africana</i>		COMMELINACEAE
<i>Cynodon dactylon</i>	Couch Grass	POACEAE
<i>Dichanthium annulatum</i>	Vlei Finger Grass	POACEAE
<i>Digitaria eriantha</i>	Common Finger Grass	POACEAE
<i>Eleusine coracana</i>	Goose Grass	POACEAE
<i>Elionurus muticus</i>	Wire Grass	POACEAE
<i>Eragrostis chloromelas</i>	Curly Leaf	POACEAE
<i>Eragrostis lehmanniana</i>	Lehmann's Love Grass	POACEAE
<i>Eragrostis plana</i>	Tough Love Grass	POACEAE
<i>Eragrostis superba</i>	Saw-tooth Love Grass	POACEAE
<i>Heteropogon contortus</i>	Spear Grass	POACEAE
<i>Juncus effusus</i>	Soft Rush	JUNCACEAE
<i>Leptochloa fusca</i>		POACEAE
<i>Melinis repens</i>	Natal Red-Top	POACEAE
<i>Panicum coloratum</i>	Small Buffalo Grass	POACEAE
<i>Panicum maximum</i>	White Buffalo Grass	POACEAE
<i>Paspalum dilatatum</i>	Dallis Grass	POACEAE
<i>Paspalum scrobiculatum</i>		POACEAE
* <i>Pennisetum clandestinum</i>	Kikuyu Grass	POACEAE
* <i>Pennisetum setaceum</i>	Fountain Grass	POACEAE
<i>Phragmites australis</i>	Common Reed	POACEAE
<i>Setaria verticillata</i>	Bur Bristle Grass	POACEAE
<i>Sorghum versicolor</i>	Black-seeded Sorghum	POACEAE
<i>Tragus berteronianus</i>	Carrot-seed Grass	POACEAE
<i>Typha capensis</i>	Bulrush	TYPHACEAE
<i>Urochloa panicoides</i>	Garden Urochloa	POACEAE
<i>Urochloa trichopus</i>		POACEAE
ANGIOSPERMS:		

DICOTYLEDONS		
* <i>Alternanthera pungens</i>	Paper Thorn	AMARANTHACEAE
* <i>Argemone ochroleuca</i>	White-flowered Mexican Poppy	PAPAVERACEAE
* <i>Bidens pilosa</i>		ASTERACEAE
* <i>Chenopodium album</i>	White Goosefoot	CHENOPODIACEAE
<i>Convolvulus saggitatus</i>	Wild Bindweed	CONVOLVULACEAE
<i>Corchorus asplenifolius</i>		TILIACEAE
<i>Croton gratissimus</i>	Lavender Feverberry	EUPHORBIACEAE
* <i>Datura stramonium</i>		SOLANACEAE
<i>Dichrostachys cinerea</i>	Sicklebush	FABACEAE
<i>Dombeya rotundifolia</i>	Wildpear	PENTAPETACEAE
<i>Eichhornia crassipes</i>	Water Hyacinth	PONTEDERIACEAE
<i>Felicia muricata</i>		ASTERACEAE
* <i>Flaveria bidentis</i>	Smelter's Bush	ASTERACEAE
<i>Gazania krebsiana</i> subsp. <i>krebsiana</i>	Butter Flower	ASTERACEAE
<i>Geigeria burkei</i>		ASTERACEAE
* <i>Gomphrena celosioides</i>	Bachelor's Button	AMARANTHACEAE
<i>Gomphocarpus fruticosus</i>		APOCYNACEAE
<i>Grewia flavescens</i>	Sandpaper Raisin	SPARRMANNIACEAE
<i>Gymnosporia buxifolia</i>	Spikethorn	CELASTRACEAE
<i>Hibiscus cannabinus</i>		MALVACEAE
<i>Hibiscus trionum</i>		MALVACEAE
* <i>Lantana camara</i>		VERBENACEAE
<i>Lantana rugosa</i>		VERBENACEAE
* <i>Ludwigia adscendens</i> subsp. <i>diffusa</i>	Willowherb	ONAGRACEAE
* <i>Malva parviflora</i>	Small Mallow	MALVACEAE
* <i>Melia azedarach</i>	Syringa	MELIACEAE
* <i>Opuntia ficus-indica</i>	Sweet Prickly Pear	CACTACEAE
* <i>Oxalis corniculata</i>	Creeping Sorrel	OXALIDACEAE
<i>Persicaria</i> species		POLYGONACEAE
<i>Pollichia campestris</i>	Waxberry	ILLECEBRACEAE
<i>Pouzolzia mixta</i>	Soap-nettle	URTICACEAE

<i>Scabiosa columbaria</i>		DIPSACACEAE
* <i>Schkuhria pinnata</i>	Dwarf Marigold	ASTERACEAE
<i>Searsia lancea</i>	Karee	ANACARDIACEAE
<i>Searsia leptodictya</i>	Mountain Karee	ANACARDIACEAE
<i>Senegalia mellifera</i> subsp. <i>detinens</i>	Black Thorn	FABACEAE
<i>Sesamum triphyllum</i>		PEDALIACEAE
* <i>Sesbania bispinosa</i>	Spiny Sesbania	FABACEAE
<i>Sida cordifolia</i>		
* <i>Tagetes minuta</i>	Khaki Weed	ASTERACEAE
<i>Thesium</i> sp.		SANTALACEAE
<i>Tribulus terrestris</i>	Devil's Thorn	ZYGOPHYLLACEAE
<i>Vachellia karroo</i>	Sweet Thorn	FABACEAE
<i>Vachellia tenuispina</i>		FABACEAE
<i>Vachellia tortilis</i> subsp. <i>heteracantha</i>	Umbrella Thorn	FABACEAE
* <i>Xanthium spinosum</i>	Spiny Cocklebur	ASTERACEAE
<i>Ziziphus mucronata</i>	Buffalo-thorn	RHAMNACEAE
<i>Ziziphus zeyheriana</i>	Dwarf Buffalo-thorn	RHAMNACEAE