APPENDIX I2

TERRESTRIAL ECOLOGICAL IMPACT ASSESSMENT

PROPOSED MOKOLO AND CROCODILE RIVER (WEST) WATER AUGMENTATION PROJECT (PHASE 2A) (MCWAP-2A): WATER TRANSFER INFRASTRUCTURE

Terrestrial Ecological Impact Assessment Report

December 2018

DEA Reference No.: 14/12/16/3/3/2/1100

Final

Prepared for: Department of Water and Sanitation

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Title and Approval Page

Project Name:	Proposed Mokolo and Crocodile River (West) Water Augmentation Project (Phase 2A) (MCWAP-2A): Water Transfer Infrastructure
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Applicant:	Department of Water and Sanitation

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Executive Summary

Introduction and Background

Major developments are planned for the Waterberg coalfields that are located in the Lephalale area. As a direct result of the aforementioned developments, the demand for water in the Lephalale area is expected to significantly increase into the future.

Due to the limited availability of water in the Lephalale area, the Department of Water and Sanitation (DWS) conducted a feasibility study (completed in 2010) of the Mokolo Crocodile River (West) Water Augmentation Project to establish how the future water demands could be met. The phases of the proposed project include the following:

- Mokolo Crocodile River (West) Water Augmentation Project Phase 1: Augment the supply from Mokolo Dam to supply in the growing water use requirement for the interim period until a transfer pipeline from the Crocodile River West can be implemented. The solution must over the long term optimally utilise the full yield from Mokolo Dam and will be operated as a system together with Mokolo Crocodile River (West) Water Augmentation Project Phase 2A. Phase 1 is operational since June 2015.
- **Mokolo Crocodile River (West) Water Augmentation Project Phase 2A**: Transfer water from the Crocodile River (West) to the Steenbokpan and Lephalale areas, including the implementation of the River Management System in the Crocodile River (West) and its tributaries. Phase 2A is the focus of this Environmental Impact Assessment.

The overall Mokolo Crocodile River (West) Water Augmentation Project Phase 2A consists of the following components:

- **Water Transfer Infrastructure - transfer of water from Crocodile River (West) to Lephalale;**
- Borrow Pits - sourcing of construction material; and
- River Management System - manage abstractions from, and the river flow in, the Crocodile River (West) between Hartbeespoort Dam and Vlieëpoort Weir, the Moretele River from Klipvoor Dam to the confluence with the Crocodile River (West), the stretch of Elands River from Vaalkop Dam to Crocodile confluence, and also the required flow past Vlieëpoort.

This Report specifically deals with the Water Transfer Infrastructure component. The major scheme components for the proposed Water Transfer Infrastructure include the following:

- Vlieëpoort Abstraction Weir on the Crocodile River (West);

- Low-lift Pumping Station;
- Low-lift Rising Main (2 pipes);
- Sedimentation Works;
- Balancing Reservoir;
- High-lift Pumping Station;
- High-lift Rising Main to Break Pressure Reservoir;
- Break Pressure Reservoir;
- Gravity Pipeline from Break Pressure Reservoir to Operational Reservoir;
- Operational Reservoir;
- Gravity pipeline from Operational Reservoir to Medupi Tee-off via Steenbokpan; and
- Ancillary infrastructure (gauging weirs, River Management System, access roads, accommodation, offices, workshops and security measures).

Nemai Consulting (Pty) Ltd was appointed by DWS and the Trans Caledon Tunnel Authority (TCTA) (implementing agent) to conduct the Environmental Impact Assessment (EIA) for MCWAP Phase 2A (MCWAP-2A). A Terrestrial Ecological Assessment was undertaken as part of the EIA Process in order to assess the impacts that the proposed development will have on the receiving environment. The objective of this study was to identify sensitive species and their habitats along the proposed development routes. The current ecological status and conservation priority of vegetation on the sites were assessed. Potential faunal habitats were also investigated in the study area and all mammals, reptiles and amphibians known to occur along the routes or seen were recorded. Red Data species (both fauna and flora) that are known to occur on site were investigated.

Study Area

The project is located within the western part of the Limpopo Province. The footprint of MCWAP-2A WTI traverses the Thabazimbi Local Municipality (LM) and Lephalale LM, which fall within the Waterberg District Municipality (DM).

The proposed pipeline route commences from the Vlieëpoort Mountains at the weir site on the Crocodile River, in the south-western point of the project area. From there it runs in a predominantly northern direction along existing roads, farm boundaries and a railway line, until it reaches its destination near Steenbokpan (Alternative D3). Thabazimbi is situated approximately 10 km to the north-east of the Vlieëpoort weir site and Lephalale is situated approximately 30 km to the east of the Alternative D1 pipeline route's terminal point. The project infrastructure is mostly located on privately-owned properties that are primarily used for agricultural practices and game-farming.

Regional Vegetation

The proposed MCWAP-2A WTI (refer to this report as Study area) falls within the within the Savanna biome. However, a very small section of Central Route, Alternative E, Balancing

Dams and Desilting Works fall within an Azonal vegetation. The Savanna Biome is the largest Biome in South Africa and occupies over one third of the whole area. It is characterized by a grassy ground layer and distinct upper layer of woody plants. The study area is classified as falling within the following vegetation types: Subtropical Alluvial Vegetation (Azonal vegetation), Dwaalboom Thornveld (Savanna biome), Western Sandy Bushveld (Savanna biome), Waterberg Mountain Bushveld (Savanna biome) and Limpopo Sweet Bushveld (Savanna biome). The greater part of the Central Route and the entire Alternative C fall within the Western Sandy Bushveld. Alternative routes A1 and A2 fall within the Dwaalboom Thornveld. Only sections of Alternative route E traverse the Subtropical Alluvial Vegetation. Balancing Dams, Desilting Works and Low-lift Pump Station fall within the Waterberg Mountain Bushveld.

Terrestrial Threatened Ecosystems

According to the data sourced from South African National Biodiversity Institute (SANBI), no terrestrial threatened ecosystems were recorded in the project area, with the closest to the site being the Springbokvlakte Thornveld.

Limpopo Conservation Plan

Critical Biodiversity Areas (CBAs) are areas that are important for conserving biodiversity while Ecological Support Areas (ESAs) are areas that are important to ensure the long term persistence of species or functioning of other important ecosystems. Degradation of CBAs or ESAs could potentially result in the loss of important biodiversity features and/or their supporting ecosystems. The map of CBAs includes five categories: Critical Biodiversity Area 1, Critical Biodiversity Area 2, Ecological Support Area 1, Ecological Support Area 2, No Natural Remaining (NNR), Other Natural Area (ONA) and Protected Area (PA). The proposed MCWAP-2A WTI falls within CBA 1, CBA 2, ESA 1, ESA 2, NNR and ONA. The project footprint in relation to the Limpopo Conservation Plan is as follows:

- CBA 1 - Vlieëpoort abstraction weir, Bierspruit gauging weir, low-lift pump station, Operation Reservoir (OR), sections of low-lift rising main and Central Route, as well as sections of Alternatives A1, C, D2, D3 and E;
- CBA 2 - balancing dam, desilting works, Break Pressure Reservoir (BPR) (Central Route), new Paul Hugo gauging weir, Construction camps, sections of low-lift rising main and Central Route, as well as sections of Alternatives A1, A2, C, D1, D2, D3 and E;
- ESA 1 - sections of the Central Route and sections of Alternatives C and D2, as well as the Sand River gauging weir;
- ESA 2 - balancing dam, sections of low-lift rising main and Central Route, as well as sections of Alternatives C, D3 and E;

- Other Natural Area - sections of Central Route as well as Alternatives A1, A2, C, D1, D2, D3 and D4.
- No Natural Remaining - balancing dam, high-lift pump station, sections of Central Route as well as sections of Alternatives A1, A2, D2 and D3.

Protected Areas

The nearest protected areas, with a formal status in terms of the National Environmental Management Protected Areas Act (Act No. 57 of 2003), to the project footprint include the following:

- Marakele National Park – located approximately 3.5 km to the east of the Central Route;
- Atherstone Nature Reserve – located approximately 40 km to the west of Alternative A1;
- Hans Strijdom Nature Reserve – located approximately 30 km to the east of the Central Route; and
- D'nyala Nature Reserve – located approximately 31 km to the east of Alternative D4.

The Waterberg Biosphere, which is located to the east of the project area, represents a considerable area of Savanna biome and contains a high level of biological diversity. It stretches from Marakele National Park in the south-west to Wonderkop Nature Reserve in the north-east with Vaalwater as the gateway town. According to UNESCO (2009), Biosphere reserves are areas of terrestrial and coastal marine ecosystems which are internationally recognized under UNESCO's Man and the Biosphere (MAB) Programme. Biosphere Reserves are protected areas and they promote and demonstrate a balanced relationship between people and nature. Sections of the Central Route as well as Alternative C encroach into the transition zone of the biosphere, which is a flexible area of co-operation, which may contain a variety of agricultural activities, settlements and other uses and in which local communities, management agencies, scientists, non-governmental organizations, cultural groups, economic interests and other stakeholders work together to manage and sustainably develop the area's resources.

Methodology

Survey methodology included a comprehensive desktop review, utilising available provincial ecological data, relevant literature, Geographic Information System (GIS) databases, topographical maps and aerial photography. This was then supplemented through a ground-truthing phase, where pertinent areas associated with the various route alternatives were visited during field surveys undertaken during 23 to 26 April 2018. The survey focused on flora (vegetation) and fauna (mammals, avifauna, reptiles and amphibians). Several Orange Listed floral and Red Data faunal species pertaining to the survey routes were identified

during the desktop review. Habitat suitability was assessed through the ground-truthing phase of the surveys.

Results and Discussion - Flora

During the field survey, no threatened plant species were observed within the project area; however, only one (1) species of conservation concern (Orange Listed Plants) (listed as *Declining)* was found, namely *Vachellia erioloba (= Acacia erioloba)* (known as Camel Thorn). These plant species were recorded along the Central, A2 and D2 routes.

In terms of the National Forests Act (Act No. 84 of 1998), certain tree species can be identified and declared as protected. Protected trees occurring in the study area are *Vachellia (Acacia) erioloba* (Camel Thorn), *Adansonia digitata* (Baobab)*, Boscia albitrunca* (Shepherd's tree)*, Combretum imberbe* (Leadwood) and *Sclerocarya birrea* subsp*. africana* (Marula)*.* According to section 51(1) of the National Forests Act (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 of Department of Agriculture, Forestry and Fisheries (DAFF). There is only one plant species which falls within "*protected plants*" in terms of Limpopo Environmental Management Act (LEMA) (Act No. 7 of 2003) Schedule 12, namely *Spirostachys africana* (Tamboti). A permit from the Limpopo Department of Economic Development, Environment and Tourism (LEDET) is required before construction commences in order to cut, disturb, destroy or remove these trees noted within the project area.

The major concerns on site are alien invasives, weeds and potential invasives. All areas affected by construction should be rehabilitated upon completion of the construction phase of the development to its pre-construction state where possible, in agreement with the Environmental Control Officer (ECO). Mitigation measures provided will ensure that any available ecological linkages between sensitive areas are not affected negatively. Mitigation measures included within this report are feasible and will be easy to achieve. Several of the mitigation measures included here have been implemented successfully on several different construction sites.

Results and Discussion - Fauna

The greater area was historically commonly used for cattle grazing. Game farms are now more common, with an associated high faunal biodiversity. Local occurrences of mammal species are more closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. The riverine areas and ridges in the area are regarded as significant in terms of the habitat that they provide to fauna. Riparian zones also serve as important corridors to allow for animal migration. The bats recorded from the caves situated in the Mooivallei area are

reported to be *Rhinolophus darlingi* and *Miniopterus schreibersii.* According to Jacobs *et al*. (2016), *Rhinolophus darling* is now classified as '*Least Concern'* whereas *Miniopterus schreibersii* is no longer listed. According to Macewan *et al.* (2016), *M. schreibersii* assessment is not included for the region because it previously included *M. natalensis* (Least Concern) (which was considered a subspecies but is not listed on its own) (Dr Harriet Davies-Mostert pers.comm, June 2018). However, Chapter 10 of the Limpopo Environmental Management Act (LEMA) (Act No. 7 of 2003) deals with preservation of caves and caves-formation and according to Section 70 (2 a):

> "*No person may deposit, dump or drain and refuse, waste, substance or thing, whether solid, liquid, gaseous or explosive, into a cave or near a cave or near a cave entrance, or cause or allow it to enter or percolate into a cave*"

According to Monadjem *et al*. (2010), most of the cave dwelling bat species in South Africa are insectivorous and feed on nocturnal insects. According to Galago Environmental (2010), it is recommended that a blasting expert and geologist also assess the potential impact of blasting on the cave. The geotechnical investigations need to be taken into consideration during the design phase and the line can be shifted within the 100m corridor in order to avoid the cave and also to minimize impacts. According to Mr Egan from LEDET, the proposed "development would have to consider their impact on subterranean chambers and as a buffer around a cave entrance wouldn't really address this as many caves are extensive"

The proposed route should preferably follow existing roads and railways. This will have a minimal effect on the natural vegetation on the study routes. The banks of the Crocodile River where the weir will be constructed are steep with reeds that grow in most areas followed by riparian vegetation that varies in density from place to place and three of the Red Data species will be directly affected by the availability of water downstream from the proposed weir in the Crocodile River, namely Greater Painted-snipe, Yellow-billed Stork and Black Stork. It is therefore recommend that the abstraction of water from the river must therefore ensure that enough water is released for the ecological Reserve to ensure the continued existence of these bird species.

A separate Wildlife Impact Assessment Study has been undertaken to assess the impact of the proposed development on wildlife.

The main potential impact of the proposed development on reptile species is probable to be habitat loss or degradation. Nevertheless, in the long-term, effects on reptile species are probable to be comparatively low as the extent of habitat loss would be low. Habitat destruction should be limited to the absolute minimum throughout the survey area. In order to protect Southern African Python on site, should this species be encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity. This remedial action requires the engagement of a herpetologist and or ecologist to

oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). However, if this species if found during winter period, when it is in hibernation, then a permit from LEDET would be required in order to catch and release it to a safer environment

Some sections within the project area offer suitable habitat for Giant Bullfrog and African Bullfrog to occur in the study area. The conservation of these species and of any amphibians in general will be met by the protected area network as well as the designation of priority habitats *i.e.,* pans or quaternary catchments, with associated restrictions on land use.

Environmental Impact Assessment

All impacts were found to be significantly reduced through the implementation of mitigation measures. Impacts were noted to be rated between “medium to low” prior to mitigation, and as “low” after mitigation.

Terrestrial Sensitivity

A map of the sensitivity and conservation value of the different parts of the proposed route alternatives was developed showing the distribution of areas in different sensitiviity classes (very low, low, medium and high) relative to the proposed routes. It is possible from this map to identify areas where there are possible conflicts between the alignment of the routes and areas of high sensitivity.

Analysis of Alternatives

An attractive feature of the Central route as the preferred option is that for the most it follows public amenities (powerlines, roads and the railway line), which would avoid interference during the construction and operational phases with ecotourism activities on private properties. The Central route incorporates habitat units that would support a variety of both faunal and floral species biodiversity to a greater or lesser extent and the impacts on biodiversity and habitat conservation can be successfully mitigated with the sincere efforts of the contractor and construction teams. Pipelines do not result in large-scale clearing and suitable mitigation measures can be implemented to reduce the identified impacts.

Conclusion and Recommendations

It is recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Red Data Listed species and also to propose mitigation measures to limit the impacts imposed by the proposed development activities on site. The walk-down survey should preferably be undertaken during summer season in order to have a higher probability of detecting species of special concern. This is relevant in the areas that have been labelled as ecologically sensitive. In order to conserve the faunal species community structures within the region, habitat destruction should be limited to an absolute minimum as intact habitat would result in

higher faunal and floral species diversity. It is therefore critical that operations are limited to the required footprint only. It is recommended that the larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes.

The Central Route either runs along servitudes of tar roads, gravel roads, farm roads, railway lines, or power lines and most of the areas directly linked to these servitudes are disturbed to a certain degree. It was therefore found that the proposed pipeline will not have a significant impact on the flora and fauna in the area, given that the servitude width be kept to a minimum and that the mitigation measures proposed above be implemented. After the conclusion of this Terrestrial Ecological Assessment, it is the opinion of the ecologist that the proposed development be considered favourable provided that the sensitivity map be considered during the planning and construction phases of the proposed development activities to aid in the conservation of ecology within the study area. Once the proposed development has been constructed, rehabilitation process needs to take place and should ensure that alien plant emergence and erosion do not occur.

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1 INTRODUCTION AND BACKGROUND

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The overall Mokolo Crocodile River (West) Water Augmentation Project Phase 2A consists of the following components:

- **Water Transfer Infrastructure - transfer of water from Crocodile River (West) to Lephalale;**
- Borrow Pits - sourcing of construction material; and
- River Management System - manage abstractions from, and the river flow in, the Crocodile River (West) between Hartbeespoort Dam and Vlieëpoort Weir, the Moretele River from Klipvoor Dam to the confluence with the Crocodile River (West), the stretch of Elands River from Vaalkop Dam to Crocodile confluence, and also the required flow past Vlieëpoort.

This Report specifically deals with the Water Transfer Infrastructure component. The major scheme components for the proposed Water Transfer Infrastructure include the following:

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- Gravity pipeline from Operational Reservoir to Medupi Tee-off via Steenbokpan; and
- Ancillary infrastructure (gauging weirs, River Management System, access roads, accommodation, offices, workshops and security measures).

Nemai Consulting (Pty) Ltd was appointed by DWS and the Trans Caledon Tunnel Authority (TCTA) (implementing agent) to conduct the Environmental Impact Assessment (EIA) for MCWAP Phase 2A (MCWAP-2A). A Terrestrial Ecological Assessment was undertaken as part of the EIA Process in order to assess the impacts that the proposed development will have on the receiving environment. The objective of this study was to identify sensitive species and their habitats along the proposed development routes. The current ecological status and conservation priority of vegetation on the sites were assessed. Potential faunal habitats were also investigated in the study area and all mammals, reptiles and amphibians known to occur along the routes or seen were recorded. Red Data species (both fauna and flora) that are known to occur on site were investigated.

1.1 Objectives of the survey

In order to achieve the requirements of this study, the following objectives are to be noted:

- To apply relevant literature to determine the diversity and eco-status of the plants, mammals, avifauna, reptiles, amphibians and invertebrates along the proposed route alternatives;
- To carry out field survey to gain an understanding of the diversity of taxa and eco-status of ecosystems which these species inhabit, as well as the presence of unique habitats that might require further investigation or protection;
- To assess the current conservation status of plant and animal species along the study area;
- To comment on ecological sensitive species/areas;
- To assess the possible impact of the proposed project on these taxa and/or habitats;

- To list the species on site and to recommend necessary actions in case of occurrence of endangered, vulnerable or rare species or any species of conservation importance; and
- To provide management recommendations to mitigate negative and enhance positive impacts within the project area.

NOTE: See a separate Wildlife Impact Assessment report conducted by Ben Orban from NABRO Ecological Analysts CC. The need for the Wildlife Impact Assessment stems from the potential impacts particularly during the construction stage of the proposed project, which may include but are not limited to the following:

- Sensitive game species (including exotic game) could be adversely affected through construction-related activities (noise, dust, light pollution, illegal poaching and habitat loss); and
- Temporary relocation of game, if required, with associated arrangements to minimise impacts to affected game.

1.2 Declaration

I, Avhafarei Phamphe, declare that I –

- act as an independent specialist consultant in the fields of Biodiversity (Fauna and Flora) for the Terrestrial Ecological Impact Assessment Report for the MCWAP-2A: Water Transfer Infrastructure Project;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

Avhafarei Phamphe

Flora and Fauna Specialist

Nemai Consulting (PTY) Ltd

2 RELEVANT LEGISLATION AND GUIDELINES

The following legislation are relevant to this project:

- The Constitution, 1996 (Act No. 108 of 1996) – Section 24;
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- National Forests Act, 1998 (Act No. 84 of 1998);
- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- Limpopo Environmental Management Act, 2003 (Act No. 7 of 2003),
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Threatened or Protected Species regulations;
- Limpopo Conservation Plan v.2. technical report (2013);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) - Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014 and
- Limpopo Environmental Outlook Report, 2016.

3 STUDY AREA

The project is located within the western part of the Limpopo Province. The footprint of the proposed Water Transfer Infrastructure traverses the Thabazimbi Local Municipality and Lephalale Local Municipality, which fall within the Waterberg District Municipality (**Figures 1** and **2**).

The proposed pipeline route commences from the Vlieëpoort Mountains at the weir site in the Crocodile River, in the south-western point of the project area. From there it runs in a predominantly northern direction along existing roads, farm boundaries and a railway line, until it reached its destination near Steenbokpan. Thabazimbi is situated approximately 10 km to the north-east of the Vlieëpoort weir site and Lephalale is situated approximately 30 km to the east of the Alternative D1 pipeline route's terminal point. The project infrastructure is mostly located on privately-owned properties that are primarily used for agricultural practices and game-farming.

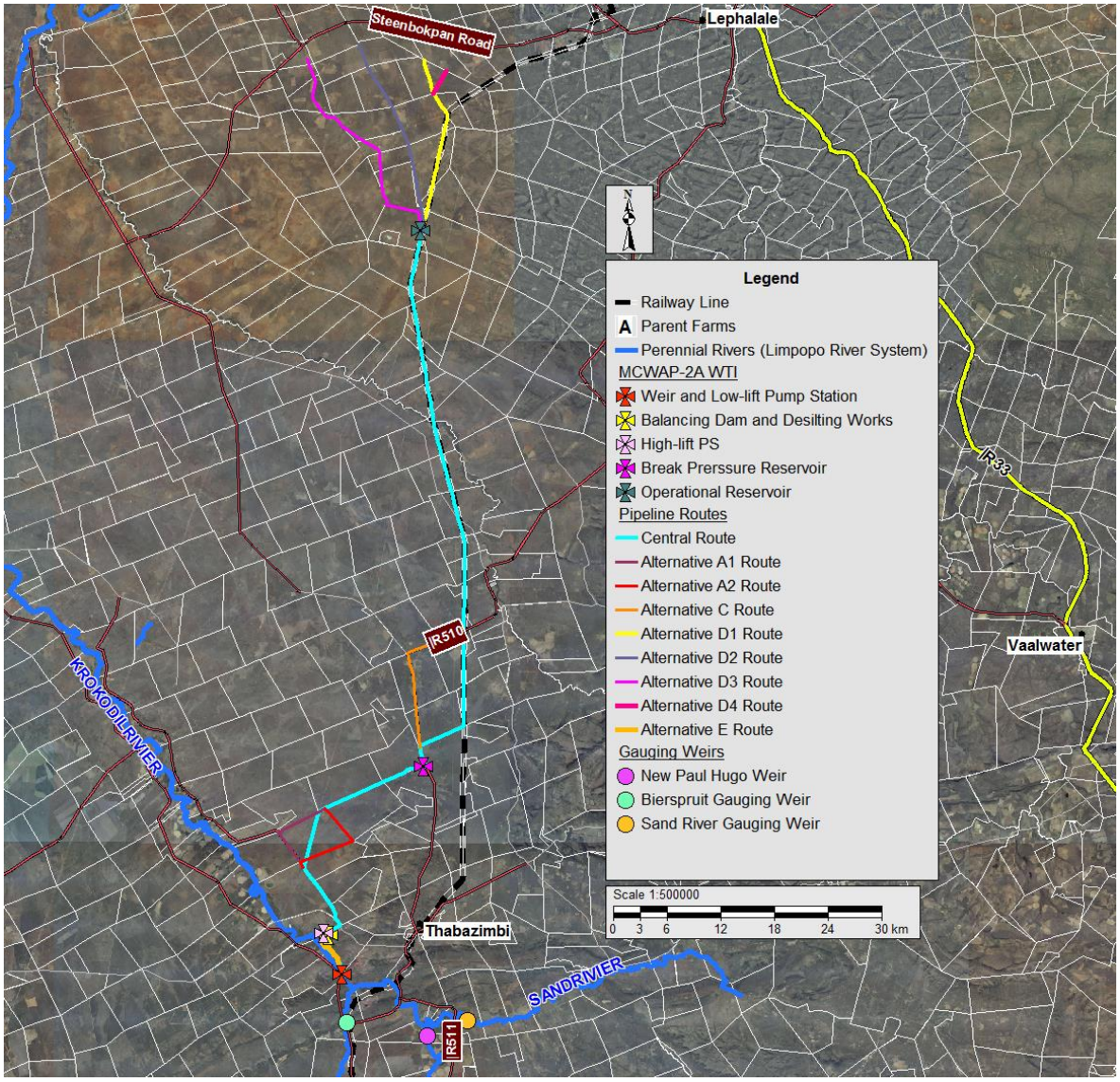

Figure 1. Orthophotograph of MCWAP-2A WTI

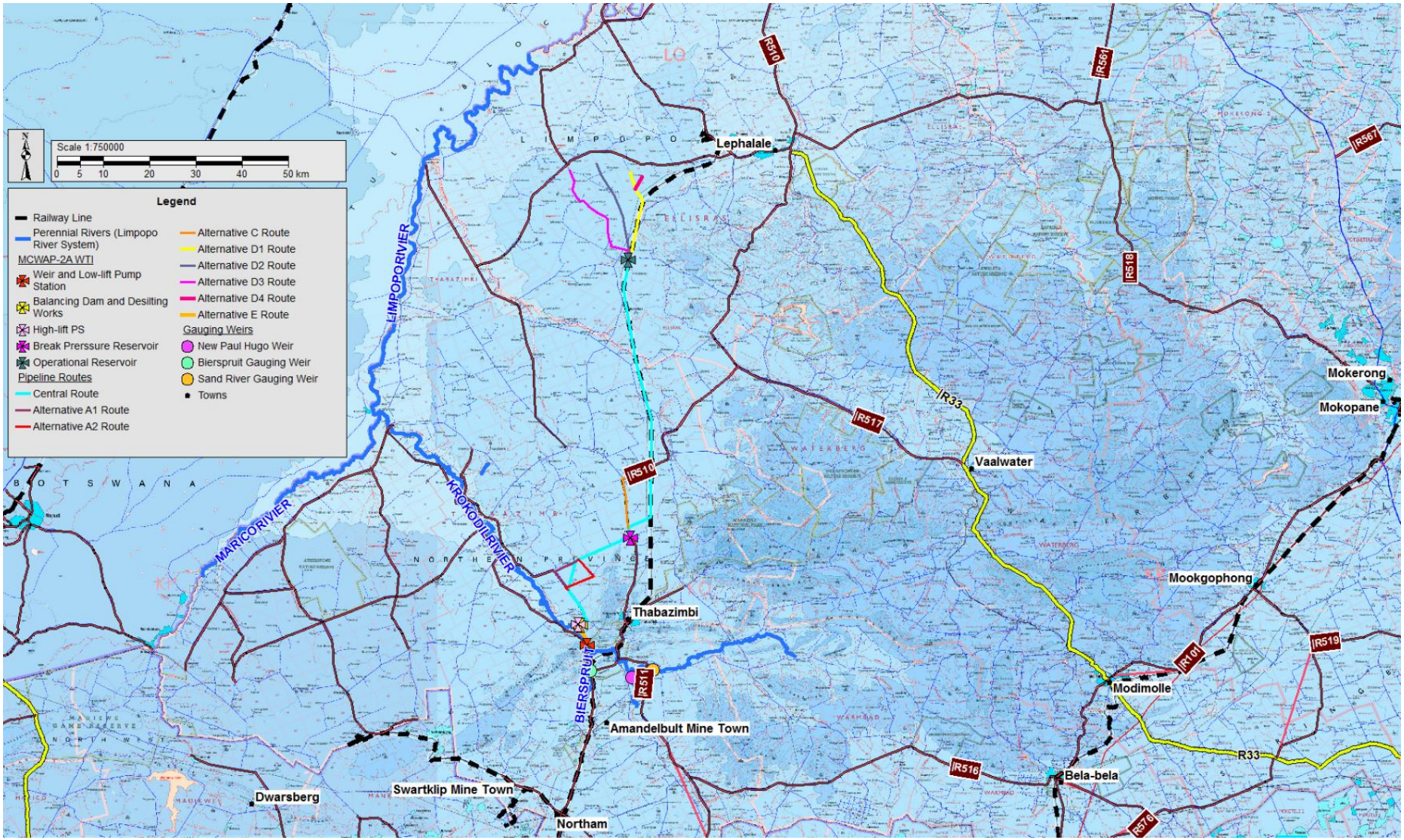

Figure 2. Locality map of the study area

4 LIMITATIONS AND GAPS

The constraints or limitations to the survey included:

- Given the magnitude of the project and the various extent of ervens and portions of farms in the area, some farms/areas were not easily accessible. However, detailed walk down surveys once the final routes have been selected will be required;
- A separate Wildlife Impact Assessment report was conducted by Ben Orban from NABRO Ecological Analysts CC for this EIA Process.
- Fauna species directly or indirectly observed during the site visits were supplemented with those that are likely to occur in the area based on their distribution and habitat preferences; and
- Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and Nemai Consulting can thus not accept responsibility for conclusions and mitigation measures made in good faith based on information gathered or databases consulted at the time of the investigation. Detailed walk-down surveys once the routes are finalised will be required in order to reduce impacts identified in this report.

5 REGIONAL VEGETATION

The proposed MCWAP-2A WTI falls within the Savanna biome (SANBI, 2012) (**Figure 3**). However, a very small section of Central Route, Alternative E, Balancing Dams and Desilting Works fall within an Azonal vegetation. The Savanna Biome is the largest Biome in South Africa and occupies over one third of the whole area (Driver *et al*. 2004). It is characterized by a grassy ground layer and distinct upper layer of woody plants (Low and Rebelo, 1996). The study area is classified as falling within the following vegetation types: Subtropical Alluvial Vegetation (Azonal vegetation), Dwaalboom Thornveld (Savanna biome), Western Sandy Bushveld (Savanna biome), Waterberg Mountain Bushveld (Savanna biome) and Limpopo Sweet Bushveld (Savanna biome) (SANBI, 2012) (**Figure 4**). The greater part of the Central Route and the entire Alternative C fall within the Western Sandy Bushveld. Alternative routes A1 and A2 fall within the Dwaalboom Thornveld. Only sections of Alternative route E traverse the Subtropical Alluvial Vegetation. Balancing Dams, Desilting Works and Low-lift Pump Station fall within the Waterberg Mountain Bushveld.

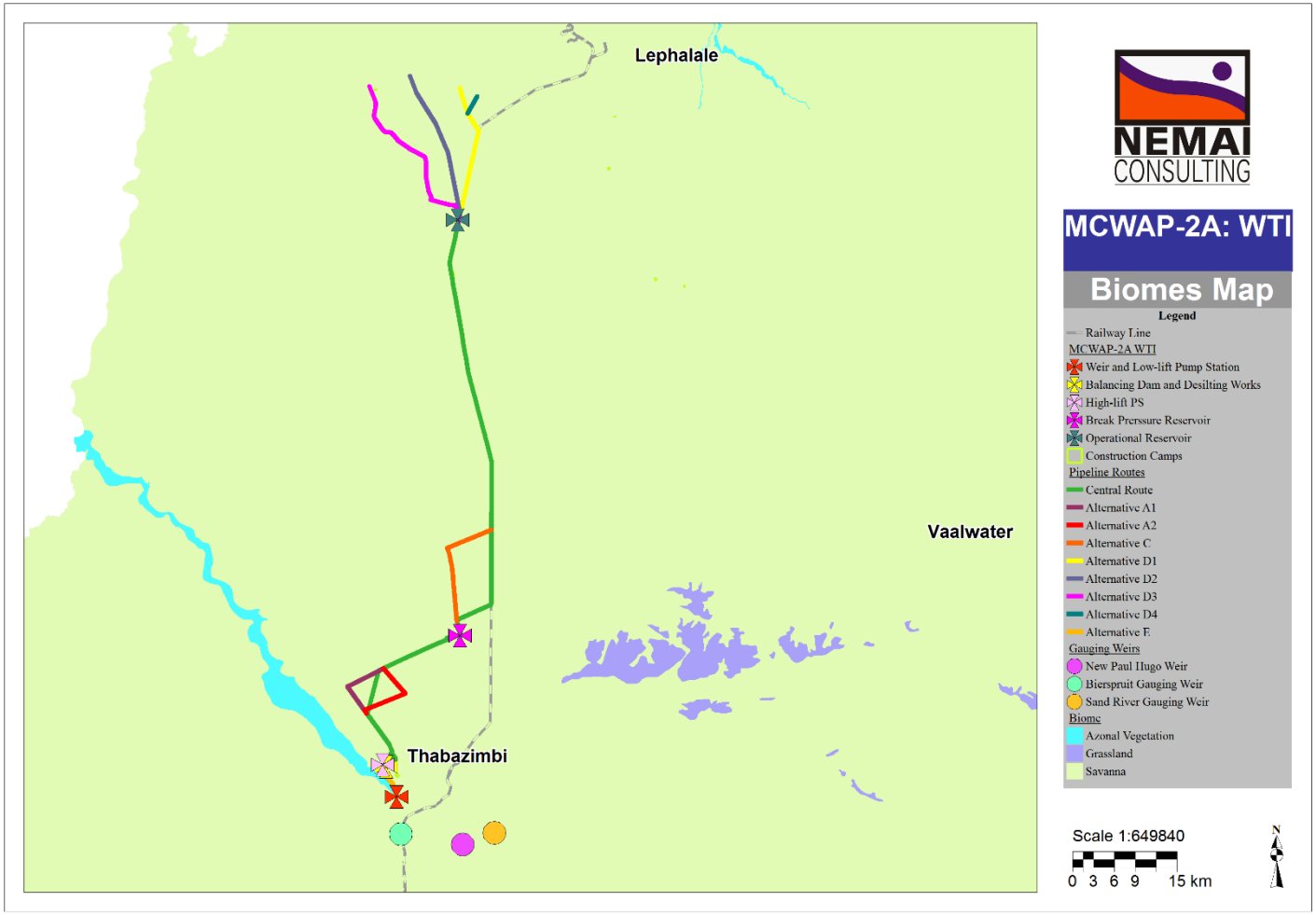

Figure 3. Biomes in relation to the project area

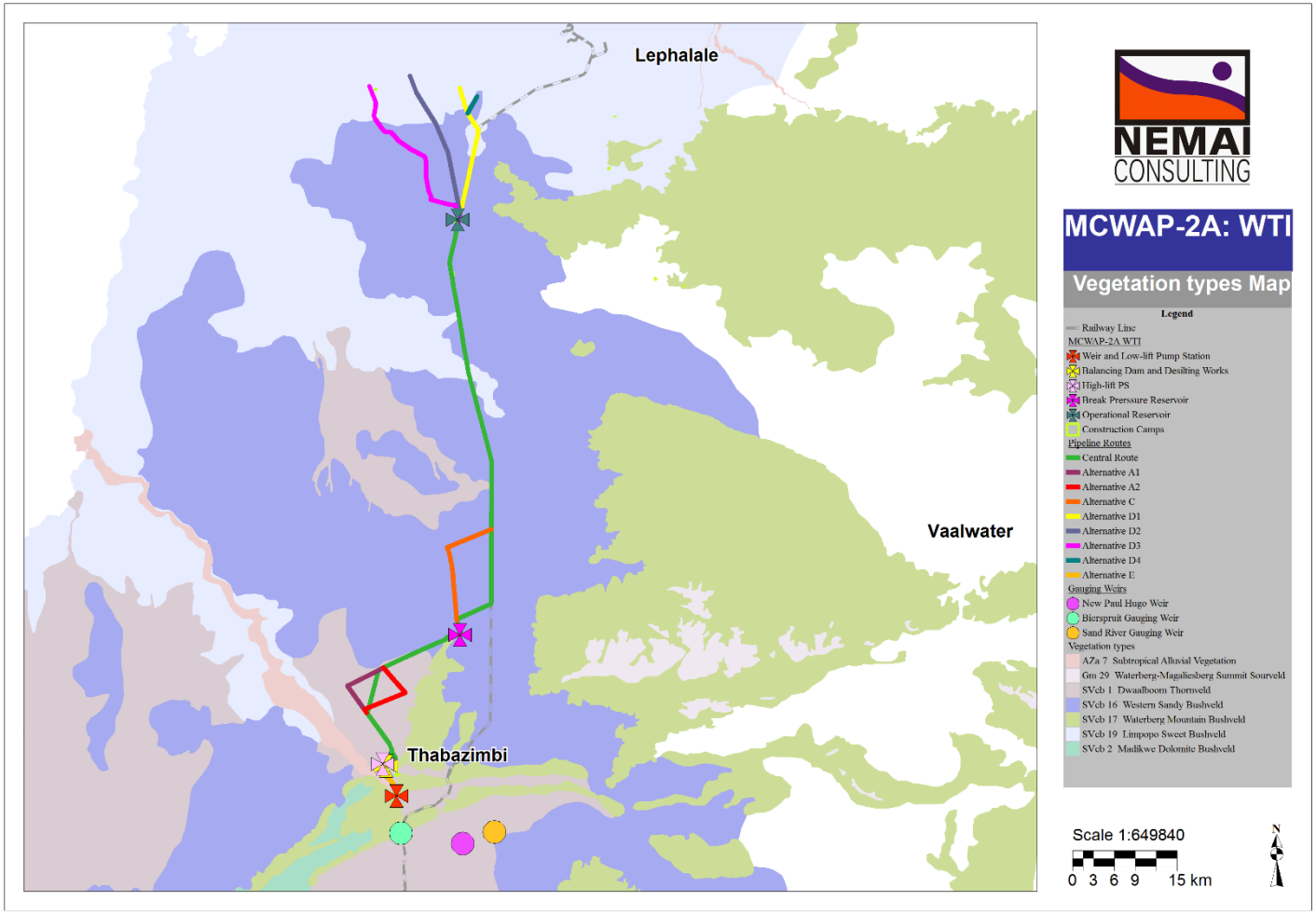

Figure 4. Vegetation types in relation to the project area

The description of the vegetation types follows below:

5.1 Limpopo Sweet Bushveld

The Limpopo Sweet Bushveld is found in Limpopo Province. It extends from the lower reaches of the Crocodile and Marico Rivers around Makoppa and Derdepoort, respectively, down the Limpopo River Valley including Lephalale and into the tropics past Tom Burke to the Usutu border post and Taaiboschgroet area in the north. The unit also occurs on the Botswana side of the border (Mucina and Rutherford, 2006).

This vegetation type is listed as **Least threatened** with a national conservation target of 19%. Less than 1% is statutorily conserved and limited to reserves straddling the south-eastern limits of the unit, for example the D'Nyala Nature Reserve. Very little of this vegetation type is conserved in other reserves. About 5% is transformed, mainly by cultivation (Mucina and Rutherford, 2006).

5.2 Western Sandy Bushveld

Western Sandy Bushveld vegetation type is found in Limpopo and North-West Provinces. It occurs on flats and undulating plains from Assen northwards past Thabazimbi and remaining west of the Waterberg Mountains towards Steenbokpan in the north. Some patches occur between the Crocodile and Marico Rivers to the west (Mucina and Rutherford, 2006).

This vegetation type is listed as **Least threatened** with a national conservation target of 19%. About 6% is statutorily conserved, just over half of which in the Marakele National Park. About 4% is transformed, mainly by cultivation (Mucina and Rutherford, 2006).

5.3 Dwaalboom Thornveld

Dwaalboom Thornveld vegetation type is found in Limpopo and North-West Provinces. It flats north of the Dwarsberge and associated ridges mainly west of the Crocodile River in the Dwaalboom area but including a patch around Sentrum. South of the ridges, it extends eastwards from the Nietverdiend area, north of the Pilanesberg to the Northam area (Mucina and Rutherford, 2006).

This vegetation type is listed as **Least threatened** with a national conservation target of 19%. Some 6% is statutorily conserved, mostly within the Madikwe Game Reserve in the west. About 14% is transformed mainly by cultivation. Main use is extensive cattle grazing (Mucina and Rutherford, 2006).

5.4 Waterberg Mountain Bushveld

Waterberg Mountain Bushveld vegetation type is found in Limpopo Province. It occurs in Waterberg Mountains, including the foothills, escarpment and tablelands south of the line

between Lephalale and Marken, north of Bela-Bela and west of Mokopane and with outliers in the southwest such as the Boshofsberge and Vlieëpoortberge near Thabazimbi (Mucina and Rutherford, 2006).

This vegetation type is listed as **Least threatened** with a national conservation target of 24%. About 9% is statutorily conserved mainly in the Marakele National Park and Moepel Nature Reserve. More than 3% is transformed, mainly by cultivation (Mucina and Rutherford, 2006).

5.5 Subtropical Alluvial Vegetation

Subtropical Alluvial vegetation unit is found in Limpopo, Mpumalanga and KwaZulu-Natal Provinces and in Swaziland. It occurs in broad river alluvia and around some river-fed pans in the subtropical regions of eastern South Africa, in particular in the Lowveld, Central Bushveld and in northern KwaZulu-Natal. The most important alluvia include the Limpopo, Luvubu, Olifants, Sabie, Crocodile, Phongolo, Usutu and Mkuze Rivers. This unit is fully embedded within the Savanna Biome. The altitude ranges from 0–1 000 m (Mucina and Rutherford, 2006).

The conservation status of this vegetation type is **Least threatened** with a national conservation target of target of 31%. Large patches of this vegetation type are statutorily conserved in the Kruger and Mapungubwe National Parks, Vemre and D'nyala Nature Reserves, Ndumo Game Reserve and Greater St Lucia Wetland Park as well as in a number of private reserves fringing the western borders of the Kruger National Park and the Limpopo River. Much of the area has been transformed for cultivation, urban development and road building. Alien woody species commonly occurring in this vegetation type include *Melia azedarach*, *Chromolaena discolor* etc (Mucina and Rutherford, 2006).

6 TERRESTRIAL THREATENED ECOSYSTEMS

The South African National Biodiversity Institute (SANBI), in conjunction with the Department of Environmental Affairs (DEA), released a draft report in 2009 entitled "Threatened Ecosystems in South Africa: Descriptions and Maps", to provide background information on the above List of Threatened Ecosystems (SANBI, 2009). The purpose of this report was to present a detailed description of each of South Africa's ecosystems and to determine their status using a credible and practical set of criteria. The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat;
- Ecosystem degradation and loss of integrity;
- Limited extent and imminent threat;

- Threatened plant species associations;
- Threatened animal species associations; and
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan.

In terms of section 52(1) (a), of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011 (Government Notice 1002) (Driver et al. 2004). The list classified all threatened or protected ecosystems in South Africa in terms of four categories; Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Protected. The purpose of categorising these ecosystems is to prioritise conservation areas in order to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that Threatened Ecosystems make up 9.5% of South Africa, with critically endangered and endangered ecosystems accounting for 2.7%, and vulnerable ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive conservation and planning tools, such as Biodiversity Sector Plans, municipal Strategic Environmental Assessments (SEAs) and Environmental Management Frameworks (EMFs), EIAs and other environmental applications (Mucina *et al*. 2006).

According to the data sourced from South African National Biodiversity Institute (SANBI), no terrestrial threatened ecosystems were recorded in the project area, with the closest to the site being the Springbokvlakte Thornveld (Vulnerable) (**Figure 5**).

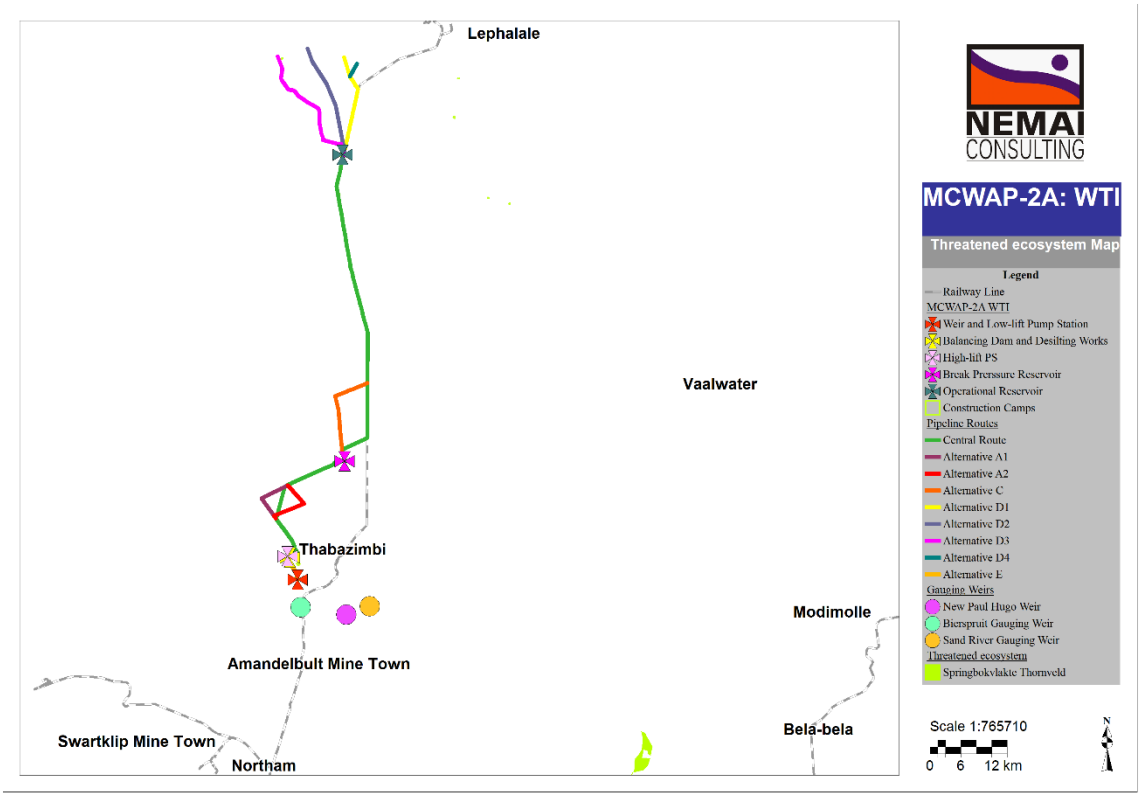

Figure 5. Terrestrial threatened ecosystem in relation to the project area

7 LIMPOPO CONSERVATION PLAN

Critical Biodiversity Areas (CBAs) within the bioregion are the portfolio of sites that are required to meet the region's biodiversity targets, and need to be maintained in the appropriate condition for their category (Desmet *et al*, 2013). An objective of the CBA map is to identify a network of areas, which if managed according to the land use guidelines would meet the pattern targets for all important biodiversity features, while at the same time ensuring the areas necessary for supporting necessary ecological processes remain functional.

The systematic conservation planning process resulted in 40% of the Limpopo Province being identified as CBAs (CBA1 22% and CBA2 18%). Ecological Support Areas (ESAs) cover a further 22% of the province, of which 16% are intact natural areas (ESA 1) and 7% are degraded or areas with no natural remaining which are nevertheless required as they potentially retain some value for supporting ecological processes (ESA 2) (Desmet *et al*, 2013).

A map indicating the Limpopo C-Plan categories in relation to the project footprint is shown in **Figure 6**. The general description of CBA map categories and associated land management objectives are listed in **Table 1**.

The project footprint in relation to the Limpopo Conservation Plan is as follows:

- CBA 1 - Vlieëpoort abstraction weir, Bierspruit gauging weir, low-lift pump station, Operation Reservoir (OR), sections of low-lift rising main and Central Route, as well as sections of Alternatives A1, C, D2, D3 and E;
- CBA 2 - balancing dam, desilting works, Break Pressure Reservoir (BPR) (Central Route), new Paul Hugo gauging weir, Construction camps, sections of low-lift rising main and Central Route, as well as sections of Alternatives A1, A2, C, D1, D2, D3 and E;
- ESA 1 - sections of the Central Route and sections of Alternatives C and D2, as well as the Sand River gauging weir;
- ESA 2 - balancing dam, sections of low-lift rising main and Central Route, as well as sections of Alternatives C, D3 and E;
- Other Natural Area - sections of Central Route as well as Alternatives A1, A2, C, D1, D2. D3 and D4.
- No Natural Remaining - balancing dam, high-lift pump station, sections of Central Route as well as sections of Alternatives A1, A2, D2 and D3.

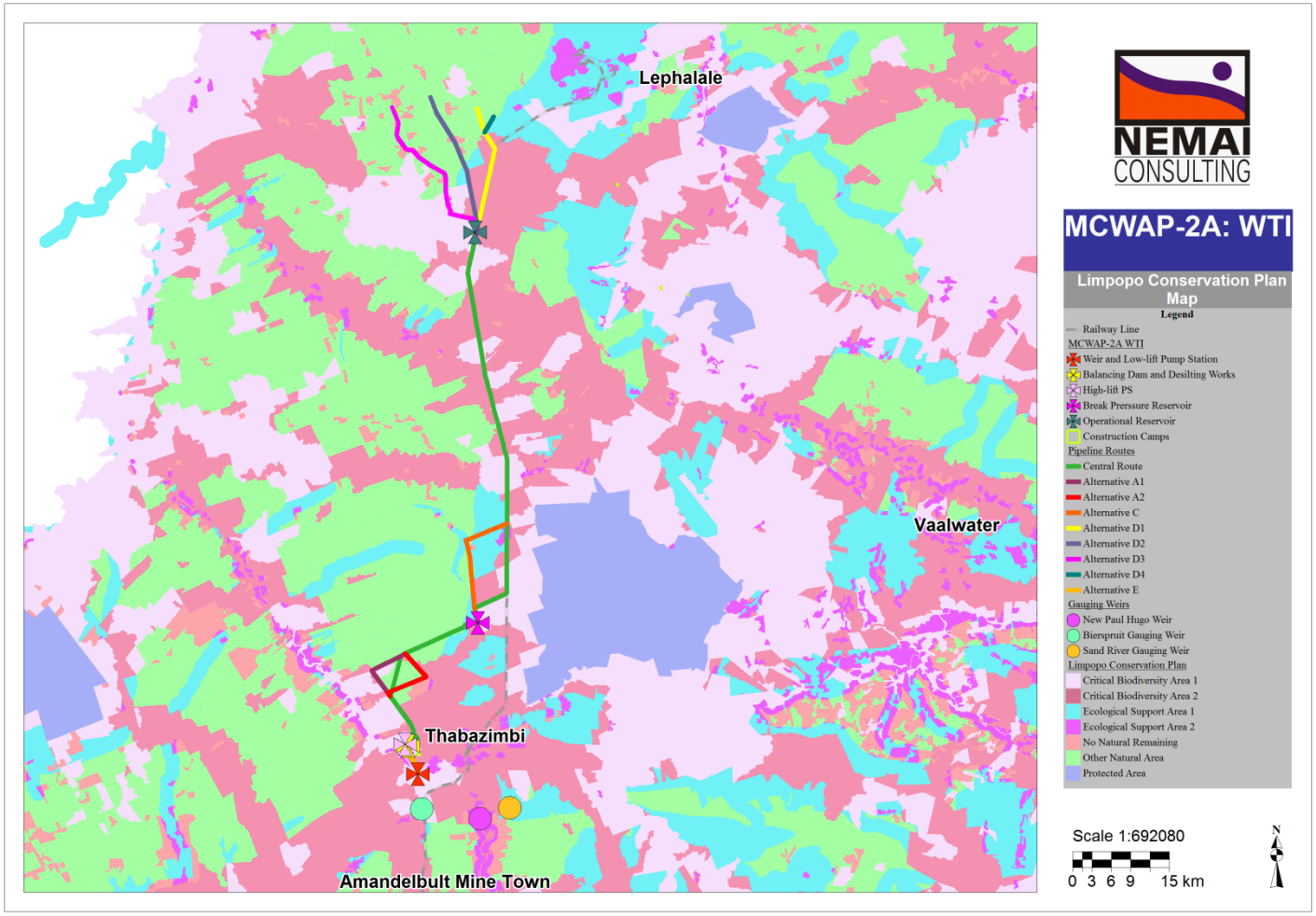

Figure 6. CBA and ESA in relation to the project area

Table 1. General description of CBA Map categories and associated land management objectives

CBA Map Category	Description	Land Management Objective	Land Management Recommendations	Compatible Land-Use	Incompatible Land-Use
Protected Areas	Formal Protected Areas and Protected Areas pending declaration under NEMPAA.	Maintain in a natural state with limited or no biodiversity loss. Rehabilitate degraded areas to a natural or near natural state, and manage for no further degradation. Development subject to Protected Area objectives and zoning in a NEMPAA compliant and approved management plan.	Maintain or obtain formal conservation protection.	Conservation and associated activities (e.g. ecotourism operations), and required support infrastructure.	All other land-uses.
Critical Biodiversity Areas (1)	Irreplaceable Sites. Areas required to meet biodiversity pattern and/or ecological processes targets. No alternative sites are available to meet targets.	Maintain in a natural state with limited or no biodiversity loss. Rehabilitate degraded areas to a natural or near natural state, and manage for no further degradation.	Obtain formal conservation protection where possible. Implement appropriate zoning to avoid net loss of intact habitat or intensification of land use.	Conservation and associated activities. Extensive game farming and eco--- tourism operations with strict control on environmental impacts and carrying capacities, where the overall there is a net biodiversity gain. Extensive Livestock Production with strict control on environmental impacts and carrying capacities. Required support infrastructure for the above activities. Urban Open Space Systems	Urban land-uses including Residential (including golf estates, rural residential, resorts), Business, Mining & Industrial; Infrastructure (roads, power lines, pipelines). Intensive Animal Production (all types including dairy farming associated with confinement, imported foodstuffs, and improved/irrigated pastures). Arable Agriculture (forestry, dry land & irrigated cropping). Small holdings
Critical Biodiversity Area (2)	Best Design Selected Sites. Areas selected to meet biodiversity pattern and/or ecological process targets.	Maintain in a natural state with limited or no biodiversity loss. Maintain current agricultural activities. Ensure that land use	Avoid conversion of agricultural land to more intensive land uses, which may have a	Current agricultural practices including arable agriculture, intensive and extensive animal production, as well as game and	Urban land-uses including Residential (including golf estates, rural

CBA Map Category	Description	Land Management Objective	Land Management Recommendations	Compatible Land-Use	Incompatible Land-Use
	Alternative sites may be available to meet targets.	is not intensified and that activities are managed to minimize impact on threatened species.	negative impact on threatened species or ecological processes.	ecotourism operations, so long as these are managed in a way to ensure populations of threatened species are maintained and the ecological processes which support them are not impacted. Any activities compatible with CBA1.	residential, resorts), Business, Mining & Industrial; Infrastructure (roads, power lines, pipelines). More intensive agricultural production than currently undertaken on site. Note: Certain elements of these activities could be allowed subject to detailed impact assessment to ensure that developments were designed to CBA2. Alternative areas may need to be identified to ensure the CBA network still meets the required targets.
Ecological Support Areas (1)	Natural, near natural and degraded areas supporting CBAs by maintaining ecological processes.	Maintain ecosystem functionality and connectivity allowing for limited loss of biodiversity pattern.	Implement appropriate zoning and land management guidelines to avoid impacting ecological processes. Avoid intensification of land use. Avoid fragmentation of natural landscape.	Conservation and associated activities. Extensive game farming and eco-tourism operations. Extensive Livestock Production. Urban Open Space Systems. Low density rural residential, smallholdings or resorts where development design and overall development densities allow maintenance of ecological functioning.	Urban land-uses including Residential (including golf estates), Business, Mining & Industrial; Infrastructure (roads, power lines, pipelines). Intensive Animal Production (all types including dairy farming associated with confinement, imported foodstuffs, and improved/irrigated pastures). Arable

CBA Map Category	Description	Land Management Objective	Land Management Recommendations	Compatible Land-Use	Incompatible Land-Use
					Agriculture (forestry, dry land & irrigated cropping). Note: Certain elements of these activities could be allowed subject to detailed impact assessment to ensure that developments were designed to maintain overall ecological functioning of ESAs.
Ecological Support Areas (2)	Areas with no natural habitat that is important for supporting ecological processes.	Avoid additional/ new impacts on ecological processes.	Maintain current land-use. Avoid intensification of land use, which may result in additional impact on ecological processes.	Existing activities (e.g. arable agriculture) should be maintained, but where possible a transition to less intensive land uses or ecological restoration should be favoured.	Any land use or activity that results in additional impacts on ecological functioning mostly associated with the intensification of land use in these areas (e.g. Change of floodplain from arable agriculture to an urban land use or from recreational fields and parks to urban).
Other Natural Areas	Natural and intact but not required to meet targets, or identified as CBA or ESA	No management objectives, land management recommendations or land-use guidelines are prescribed. These areas are nevertheless subject to all applicable town and regional planning guidelines and policy. Where possible existing Not Natural areas should be favoured for development before "Other natural areas" as before "Other natural areas" may later be required either due to the identification of previously unknown important biodiversity features on these sites, or alternatively where the loss of CBA has resulted in the need to identify alternative sites.			
No natural habitat remaining	Areas with no significant direct biodiversity value. Not Natural or degraded natural areas that are not required as ESA, including intensive agriculture, urban, industry; and human				

CBA Map Category	Description	Land Management Objective	Land Management Recommendations	Compatible Land-Use	Incompatible Land-Use
	infrastructure.				

8 PROTECTED AREAS

The nearest protected areas, with a formal status in terms of the National Environmental Management Protected Areas Act (Act No. 57 of 2003), to the project footprint include the following (**Figure 7**):

- Marakele National Park – located approximately 3.5 km to the east of the Central Route;
- Atherstone Nature Reserve – located approximately 40 km to the west of Alternative A1;
- Hans Strijdom Nature Reserve – located approximately 30 km to the east of the Central Route; and
- D'nyala Nature Reserve – located approximately 31 km to the east of Alternative D4.
- The Ben Alberts Nature Reserve lies immediately southeast of the Vlieëpoort weir site. The reserve belongs to Kumba Iron Ore, Thabazimbi mine (currently undergoing closure).

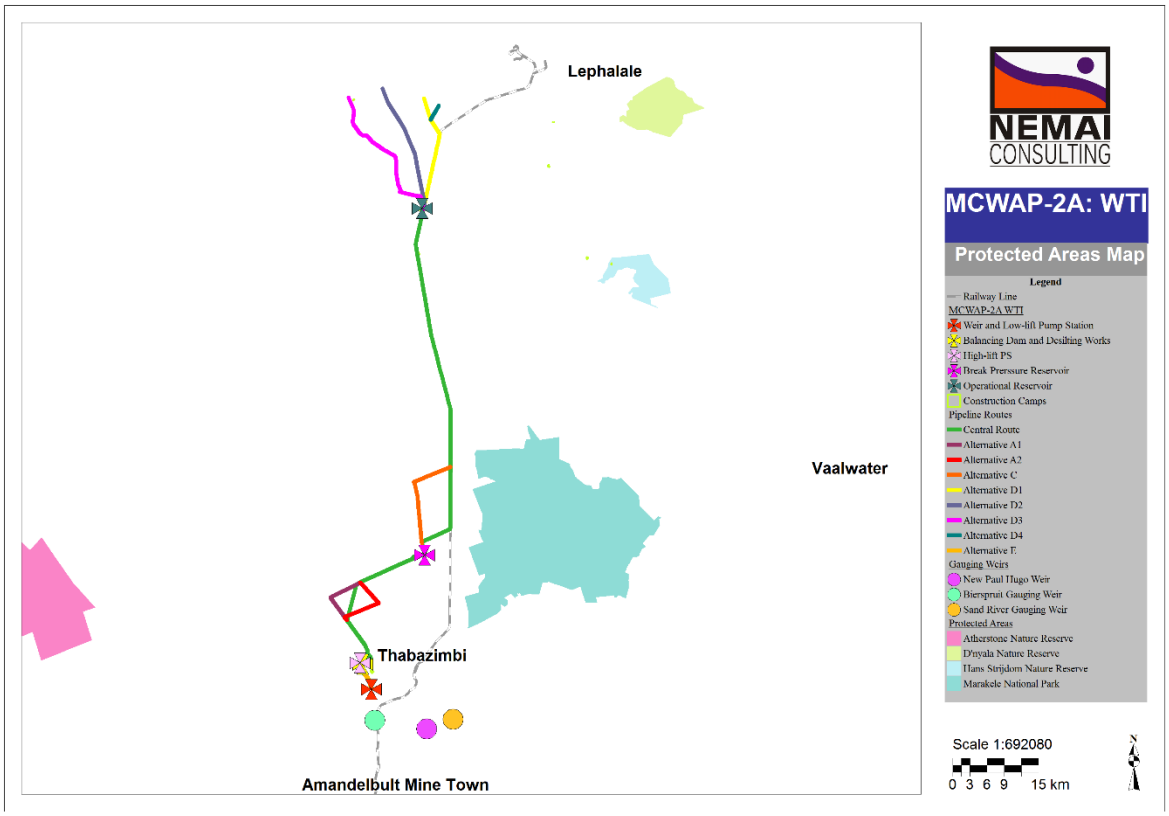

Figure 7. Protected Areas in relation to the project area

The Waterberg Biosphere, which is located to the east of the project area (**Figure 8**), represents a considerable area of Savanna biome and contains a high level of biological diversity. It stretches from Marakele National Park in the south-west to Wonderkop Nature Reserve in the north-east with Vaalwater as the gateway town. According to UNESCO (2009), Biosphere reserves are areas of terrestrial and coastal marine ecosystems which are internationally recognized under UNESCO's Man and the Biosphere (MAB) Programme. Biosphere Reserves are protected areas and they promote and demonstrate a balanced relationship between people and nature. Sections of the Central Route as well as Alternative C encroach into the transition zone of the biosphere, which is a flexible area of co-operation, which may contain a variety of agricultural activities, settlements and other uses and in which local communities, management agencies, scientists, non-governmental organizations, cultural groups, economic interests and other stakeholders work together to manage and sustainably develop the area's resources (Waterberg DM, 2013).

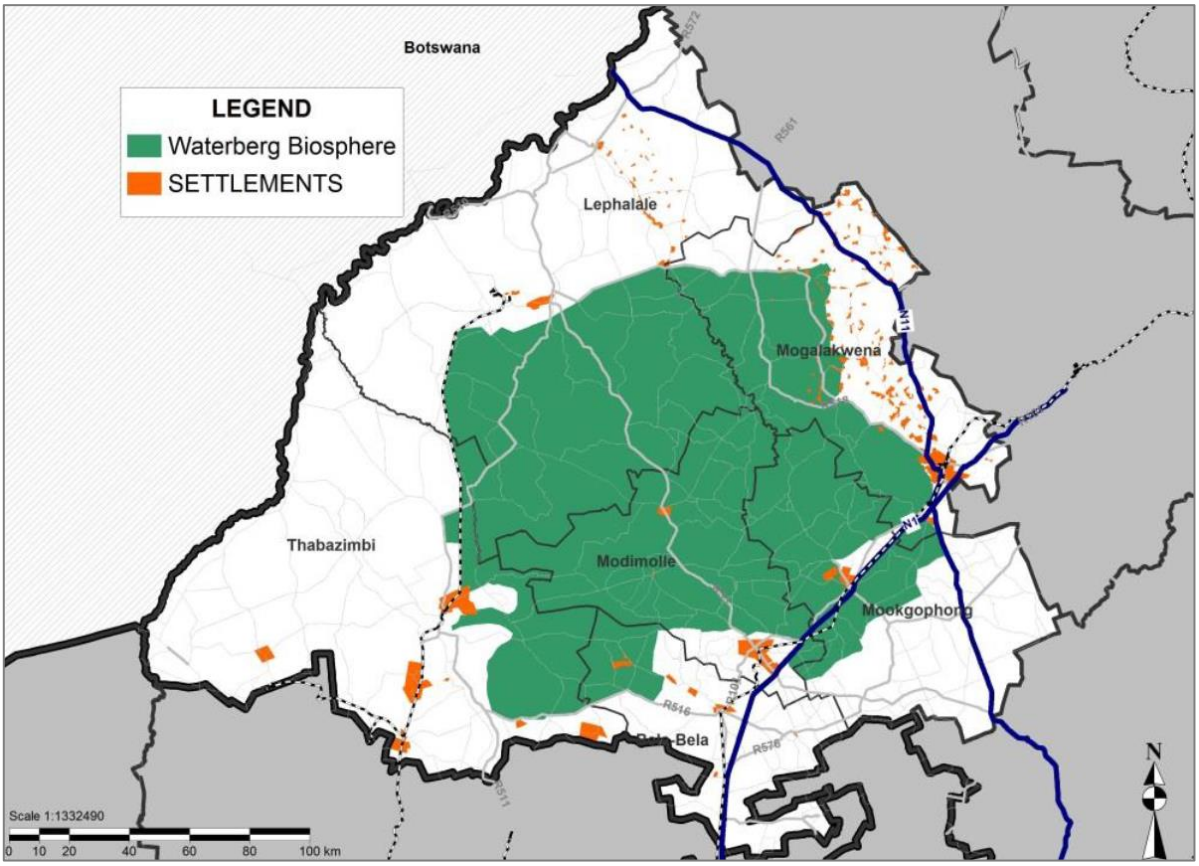

Figure 8. Waterberg Biosphere (Waterberg DM, 2013).

9 METHODOLOGY

The report follows the initial assessments conducted by Galago Environmental in 2010 for the same project (new routes and infrastructures have since been added).

9.1 Flora

The flora assessment consisted of two complementary approaches:

- A desktop analysis, which included a literature review, local knowledge, topographical maps, and Google Earth imagery; and
- Late wet season survey was undertaken from 23-26 April 2018, which fall within an optimal time of the season to find sensitive plant and animal species of high conservation priority. Weather conditions during the surveys were favourable for recording both fauna and flora.

Satellite imagery of the area (Google Earth) was studied in order to acquire a three dimensional impression of the topography and land use and also to identify potential "hot-spots" or specialized habitats such as natural habitats, rocky outcrops, wetlands and rivers on or near the study area.

The Pretoria Computerised Information System (PRECIS) list of Red Data plants recorded in the 2327CB, 2327CD, 2427AB, 2427AD, 2427AC and 2427CB quarter degree grid squares were consulted to verify the record of occurrence of the plant species seen in the vicinity of the study area. The site sampled is only a very small portion of the whole grid and so habitats suitable for certain species in the PRECIS list may not be present at the areas sampled. The vegetation map published in SANBI (2012) was consulted to identify vegetation units that are found in the study area. The desktop component of the study of the habitats of the Red-Data-listed plants was conducted before the site visits.

The habitats along the study area were inspected in a random zigzag fashion, paying particular attention to areas that at first sight appeared to be sensitive. All general observations were noted such as grasses, herbs (forbs), shrubs and trees. The habitats suitable for Red Data listed species known to occur in the quarter degree grid square were examined intensively for the presence of such species. Attention was also paid to the occurrence of medicinal, alien and declared weed species. Field guides such as van Wyk *et al.* (1997), Pooley (1998), van Oudshoorn (1999) and Manning (2009) were utilised during the field work.

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

Invasive species are controlled by the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) - Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. The AIS Regulations list four (4) different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa.

Invasive plant species are divided into four categories, namely:

- Category 1a: Invasive species which must be combatted and eradicated. Any form of trade or planting is strictly prohibited.
- Category 1b: Invasive species which must be controlled and wherever possible, removed and destroyed. Any form or trade or planting is strictly prohibited.
- Category 2: Invasive species, or species deemed to be potentially invasive, in which a permit is required to carry out a restricted activity. Category 2 species include commercially important species such as pine, wattle and gum trees.
- Category 3: Invasive species which may remain in prescribed areas or provinces. Further planting, propagation or trade, is however prohibited.

According to van Oudtshoorn (1999), a grass species reacts to grazing in one of two ways: it can either become more or less abundant. **Table 2** describes the classification of grasses.

Table 2. Classification of grasses (van Oudtshoorn, 1999)

Class	Description	Examples
Decreasers	Grasses that are abundant in good veld, but that decrease in number when the veld is overgrazed or undergrazed.	*Themeda triandra, Digitaria eriantha*
Increaser 1	Grasses that are abundant in underutilised veld. These grasses are usually unpalatable, robust climax species that grow without any defoliation	*Hyperthelia dissoluta, Trachypogon spicatus*
Increaser 2	Grasses that are abundant in overgrazed veld. These grasses increase due to the disturbing effect of overgrazing and include mostly pioneer and subclimax species	*Aristida adscensionis, Eragrostis rigidor*
Increaser 3	Grasses that are commonly found in overgrazed veld. These are usually unpalatable, dense climax grasses	*Sporobolus africanus, Elionurus muticus*
Invaders	All plants that are not indigenous to an area. These plants are mostly pioneer plants and are difficult to eradicate	*Arundo donax*

9.2 Mammals

Mammal site visits were conducted in April 2018, and during these visits, the observed and presence of mammals associated with the recognized habitat types of the study routes were recorded during the day. Animal Demography Unit virtual museum was consulted before the site visits for a list of species that could potentially be found along the proposed route alternatives and these species were thoroughly investigated within their suitable habitats. No night surveys were undertaken. Adjoining properties were also scanned for important faunal habitats. During the site visits, mammals were identified by spoor, burrow and visual

sightings through random transect walks. Locals were also interviewed to provide species lists on their properties.

9.3 Reptiles

The reptile assessment was conducted during the day. During the field visits, the observed and derived presence of reptiles associated with the recognised habitat types of the study site were recorded. This was done with due regard to the known distributions of Southern African reptiles. Reptiles were identified by sightings during random transect walks. Possible burrows or other reptile retreats were inspected for any inhabitants. Locals were also interviewed to provide species lists on their properties.

9.4 Amphibians

According to Carruthers (2001), amphibians are extremely sensitive to habitat transformation and degradation. The identification technique which was used for this study was frog's call. According to Carruthers (2001), a frog's call is a reliable means of identifying species. Frog calls were compared with pre-recorded calls from du Preez and Carruthers (2009)'s CD and identified from this comparison. According to Waddle (2006), physical searching should take place during both day and night, while acoustic surveying took place primarily at night between the hours of 18:00 and 21:00. Samplings were conducted on the moist to semi-aquatic areas. During this surveys; fieldwork was augmented with species lists compiled from personal records; data from the South African Frog Atlas Project (SAFAP) (1999-2003) and published data. Suitable habitats such as ephemeral wetlands where amphibian species of conservation such as Bullfrogs occur were also investigated.

9.5 Invertebrates

A desktop survey was initially undertaken to determine if any Red Data Listed (RDL) invertebrate species had historical records in association with the project area, as well as immediate surrounding areas. A "walk about" throughout the proposed development site was undertaken to assess the potential of the habitats of supporting various RDL invertebrate species. Rock turning was also employed on areas of the subject property where rocky outcrops were located. The invertebrate assessment conducted was a general assessment with the purpose of identifying burrows of the Baboon spiders in the study area and no active searching of Red Data invertebrates was done during the field studies.

10 RESULTS AND DISCUSSION

10.1 Flora

10.1.1 Desktop study results

The study area is located within 2327CB, 2327CD, 2427AB, 2427AC, 2427AD and 2427CB quarter degree squares in terms of the 1:50 000 grid of South Africa. SANBI uses this grid

system as a point of reference to determine any Red Data plant species or any species of conservation importance occurring in South Africa. **Table 3** provides details on the Red Data plant species which have been recorded in grid cells 2427AD and 2427CB (No Red Data plant species were recorded in grid cells 2327CB and 2327CD). The definitions of the conservation status are provided in **Table 4**. Due to the fact that threatened species have historically been noted in the area, it is imperative that, before the construction activities take place, detailed searches for these rare/threatened and protected species are made during the appropriate time of year when plants are likely to be more noticeable.

Table 3. Threatened plant species recorded in grid cells 2427AD and 2427CB

Family	Species	Threat status	Growth forms
Scrophulariaceae	*Freylinia tropica* S.Moore	Rare	Shrub
Scrophulariaceae	*Jamesbrittenia bergae* P.Lemmer	VU	Dwarf shrub
Zamiaceae	*Encephalartos eugene-maraisii* I.Verd.	EN	Shrub, tree

Note: EN=Endangered, VU=Vulnerable

Table 4. Definitions of Red Data status (Raimondo *et al.* 1999)

Symbol	Status	Description
EN	Endangered	A taxon is Endangered when the best available evidence indicates that it meets any of the five International Union for Conservation of Nature (IUCN) criteria for Endangered, and is therefore facing an extremely high risk of extinction in the wild.
VU	Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the five IUCN criteria for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.
N/A	Rare	A taxon is rare when it does not meet any of the four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to the five IUCN criteria.

10.1.2 Plant species recorded in the project area.

The study area is situated within agricultural areas such as cotton fields (**Figure 9),** railway line (**Figure 10**), game-farming (**Figure 11**), cultivated commercial fields (**Figure 12**), and also through existing infrastructures (including roads (**Figure 13),** fences and powerlines (**Figure 14**). The species recorded during the site visits confirmed the study area's location within the Savanna Biome of South Africa. All of the species recorded in the study area are listed in **Table 5** and the species of conservation importance recorded are indicated in **bold**.

Figure 9. Cotton fields in Mooivalei farm

Figure 10. Railway line

Figure 11. Game farm

Figure 12. Commercial fields in Mooivalei

Figure 13. Roads

Figure 14. Powerlines servitude in the Farm Paarl 124KQ

Table 5. Plant species recorded within the study area

Scientific Name	Common Name	Ecological status	Weirs			Vlieëpoort abstraction weir and Low-lift pump station	Low-lift rising main and Alternative route E	Balancing dam, Desilting works, Sediment Storage Compartments and High-lift pump station	Pipeline (rising main, gravity main and delivery line)								
			Bierspruit Gauging Weir	Sand River Gauging Weir	New Paul Hugo Gauging Weir				Central Route	A1	A2	C	D3	D2	D1 & D3	BPR	OR
Abutilon angulatum var. *angulatum*	Elephant's ear		✓			✓	✓										
Abutilon austro-africanum						✓	✓										
***Vachellia erioloba* (= *Acacia erioloba*)**	**Camel thorn**	**Declining/Protected**							✓		✓			✓			
Vachellia (Acacia) karroo	Sweet thorn		✓	✓	✓				✓							✓	
(Senegalia) Acacia galpinii	Monkey thorn						✓		✓	✓	✓						
Senegalia (*Acacia*) *nigrescens)*	Knob thorn		✓			✓	✓		✓				✓	✓	✓		
Senegalia burkei	Black Monkey Thorn								✓				✓		✓		
Vachellia nilotica	Gum arabic tree								✓				✓	✓	✓		
Acacia (Vachellia) tortilis subsp*. heteracantha*	Umbrella thorn								✓								
Achyranthes aspera var. *aspera*	Burweed					✓	✓		✓								
Adansonia digitata	**Baobab**	**Protected tree**											✓				
Albizia versicolor	Poison Pod Albizia	Medicinal							✓								
Aloe chabaudii	Dwala Aloe	Medicinal							✓								
Alternanthera pungens	Khakhiweed	Weed						✓	✓			✓	✓	✓	✓	✓	
Amaranthus hybridus	Smooth pigweed																
Ammocharis coranica	Karoo Lily								✓								
Aristida congesta subsp. *congesta*	Buffalo Grass		✓	✓	✓				✓			✓			✓		
Asparagus laricinus	Bergkatbos		✓														
Bauhinia petersiana subsp. *macrantha*	Kalahari bauhinia												✓	✓	✓		
Bidens pilosa	Common Black-jack	Weed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Brachylaena dicolor	Coast silver oak	Medicinal							✓								
Boscia albitrunca	**Shepherd's tree**	**Protected tree**							✓								
Celtis africana	White stinkwood						✓										
Cenchrus ciliaris	Foxtail buffalo grass							✓									
Cereus jamacaru	Queen of the night	Category 1b											✓	✓	✓		
Cirsium vulgare	Scotch Thistle	Category 1b	✓						✓								
Chenopodium album	Common lambsquarters	Weed	✓			✓	✓	✓	✓								
Commelina africana	Yellow commelina	Medicinal	✓			✓	✓	✓									
Combretum apiculatum	Red Bush willow								✓	✓	✓			✓			
Combretum erythrophyllum	River bushwillow		✓	✓	✓												

Scientific Name	Common Name	Ecological status	Weirs			Vlieëpoort abstraction weir and Low-lift pump station	Low-lift rising main and Alternative route E	Balancing dam, Desilting works, Sediment Storage Compartments and High-lift pump station	Pipeline (rising main, gravity main and delivery line)								
			Bierspruit Gauging Weir	Sand River Gauging Weir	New Paul Hugo Gauging Weir				Central Route	A1	A2	C	D3	D2	D1 & D3	BPR	OR
Combretum molle	Velvet bush-willow		✓			✓			✓								
Combretum imberbe	**Leadwood**	**Protected tree**				✓	✓					✓	✓				
Combretum hereroense	Russet bushwillow						✓		✓		✓						
Combretum zeyheri	Large-fruited bushwillow								✓							✓	
Cotton								✓									
Erigeron (Conyza) bonariensis		Weed						✓	✓								
Cynodon dactylon	Couch Grass	Increaser 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Datura stramonium	Jimson weed	Category 1b	✓						✓								
Datura ferox	Long Spined Thorn Apple	Category 1b							✓								
Datura sp						✓	✓		✓		✓						
Dichrostachys cinerea	Sicklebush					✓	✓		✓	✓	✓					✓	✓
Digitaria eriantha	Common Finger Grass	Decreaser	✓			✓	✓		✓								✓
Diospyros lyciodes	Blue bush						✓		✓								
Dombeya rotundifolia	Wild pear							✓									✓
Ehretia rigida	Puzzle bush						✓	✓	✓								
Elephantorrhiza elephantina	Elephant's root						✓	✓	✓								
Euphorbia tirucalli	Rubber-hedge euphorbia	Medicinal									✓						
Eragrostis pallens	Broom love grass								✓								
Eragrostis superba	Saw-tooth love grass								✓								
Eragrostis trichophora	Atherstone's Grass								✓								
Gardenia volkensii	Bushveld gardenia								✓								
Gomphocarpus fruticosus	Milkweed	Medicinal							✓								
Grewia flava	Brandy bush	Medicinal							✓			✓	✓	✓	✓		✓
Gymnosporia buxifolia	Spike-thorn								✓			✓		✓			✓
Hibiscus trionum	Flower-of-an-hour							✓									
Hyparrhenia hirta	Common Thatching Grass	Increaser 1					✓	✓	✓								
Ipomoea obscura	Wild petunia		✓				✓		✓								
Kalanchoe paniculata	Hasie-oor								✓				✓	✓	✓		
Kleinia (Senecio) longiflora	Sjambokbos								✓				✓				
Lantana rugosa	Bird's brandy								✓								
Lannea discolor	Live-long, tree grape	Medicinal							✓								
Lippia javanica	Lemon Bush	Medicinal	✓						✓								

Scientific Name	Common Name	Ecological status	Weirs			Vlieëpoort abstraction weir and Low-lift pump station	Low-lift rising main and Alternative route E	Balancing dam, Desilting works, Sediment Storage Compartments and High-lift pump station	Pipeline (rising main, gravity main and delivery line)								
			Bierspruit Gauging Weir	Sand River Gauging Weir	New Paul Hugo Gauging Weir				Central Route	A1	A2	C	D3	D2	D1 & D3	BPR	OR
Melia azedarach	/Syringa	Category 1b					✓	✓									
Melinis repens	Natal Red Top	Increaser 2	✓				✓	✓	✓			✓	✓				
Ochna pulchra	Peeling plane								✓								
Peltophorum africanum	Weeping Wattle						✓				✓						
Phragmites australis	Common reed	Decreaser	✓		✓	✓											
Pogonarthria squarrosa	Herringbone Grass	Increaser 2							✓								
Pterocarpus rotundifolius	Round-leaved bloodwood								✓	✓	✓						
Ricinus communis	Caster-oil plant	Category 1b						✓									
Sclerocarya birrea* subsp. *caffra	**Marula**	**Protected tree**					✓	✓	✓		✓	✓				✓	✓
Schmidtia pappophoroides	Sand Quick Grass								✓				✓		✓		
Searsia lancea	Karee								✓								
Searsia pyroides	Common wild currant					✓	✓		✓							✓	
Senegalia mellifera subsp. *detinens (Acacia mellifera)*	Black thorn								✓								
Sorghum bicolor	Sorghum					✓	✓										
Spirostachys africana	**Tamboti**	**LEMA Protected**				✓	✓								✓		
Sporobolus africanus	Ratstail Dropseed	Increaser 3				✓	✓								✓		
Sporobolus pyramidalis	Catstail dropseed					✓	✓										
Tagetes minuta	Tall Khaki Weed	Weed	✓		✓		✓	✓	✓							✓	
Tarchonanthus camphoratus	Camphor bush								✓	✓	✓						
Terminalia sericea	Silver terminalia								✓			✓	✓	✓	✓		✓
Tragus berteronianus	Carrot-seed grass																
Typha capensis	Bulrush		✓					✓									
Verbena bonariensis	Tall Verbena	Weed	✓														
Xanthium strumarium	Rough cocklebur	Category 1b							✓	✓	✓						
Ximenia americana	Yellow plum		✓	✓	✓				✓							✓	
Zea mays	Corn or maize								✓				✓				
Ziziphus mucronata	Buffalo thorn		✓	✓	✓		✓										

10.1.3 Protected Trees

In terms of the National Forests Act (Act No. 84 of 1998), certain tree species can be identified and declared as protected. Protected trees occurring in the study area are *Vachellia (Acacia) erioloba* (Camel Thorn) (**Figure 15**), *Adansonia digitata* (Baobab) (**Figure 16**), *Boscia albitrunca* (Shepherd's tree) (**Figure 17**), *Combretum imberbe* (Leadwood) (**Figure 18**) and *Sclerocarya birrea* subsp. *africana* (Marula) (**Figure 19**). According to section 51(1) of the National Forests Act (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 of Department of Agriculture, Forestry and Fisheries (DAFF). There is only one plant species which falls within "*protected plants*" in terms of Limpopo Environmental Management Act (LEMA) (Act No. 7 of 2003) Schedule 12, namely *Spirostachys africana* (Tamboti) (**Figure 20**). A permit from the Limpopo Department of Economic Development, Environment and Tourism (LEDET) is required before construction commences in order to cut, disturb, destroy or remove these trees noted within the project area. *Adansonia digitata* (Babobab) near Kremetart pan on Alternative D3 can be avoided by placing the pipeline route between the gravel (farm) road and the pan. The distribution of these protected tree species along the study area are indicated in **Figures 21, 22, 23 24** and **25** below.

Figure 15. *Vachellia (Acacia) erioloba* (Camel Thorn) recorded along the Central, A2 and D2 routes

Figure 16. *Adansonia digitata* (*Baobab*) recorded along the Route D3

Figure 17. *Boscia albitrunca* (Shepherd's tree) recorded along the railway line (Central route)

Figure 18. *Combretum imberbe* (Leadwood) recorded within the study area

Figure 19. *Sclerocarya birrea* subsp*. africana (Marula)* recorded within the study area

Figure 20. *Spirostachys africana* (Tamboti) recorded along the D2 route

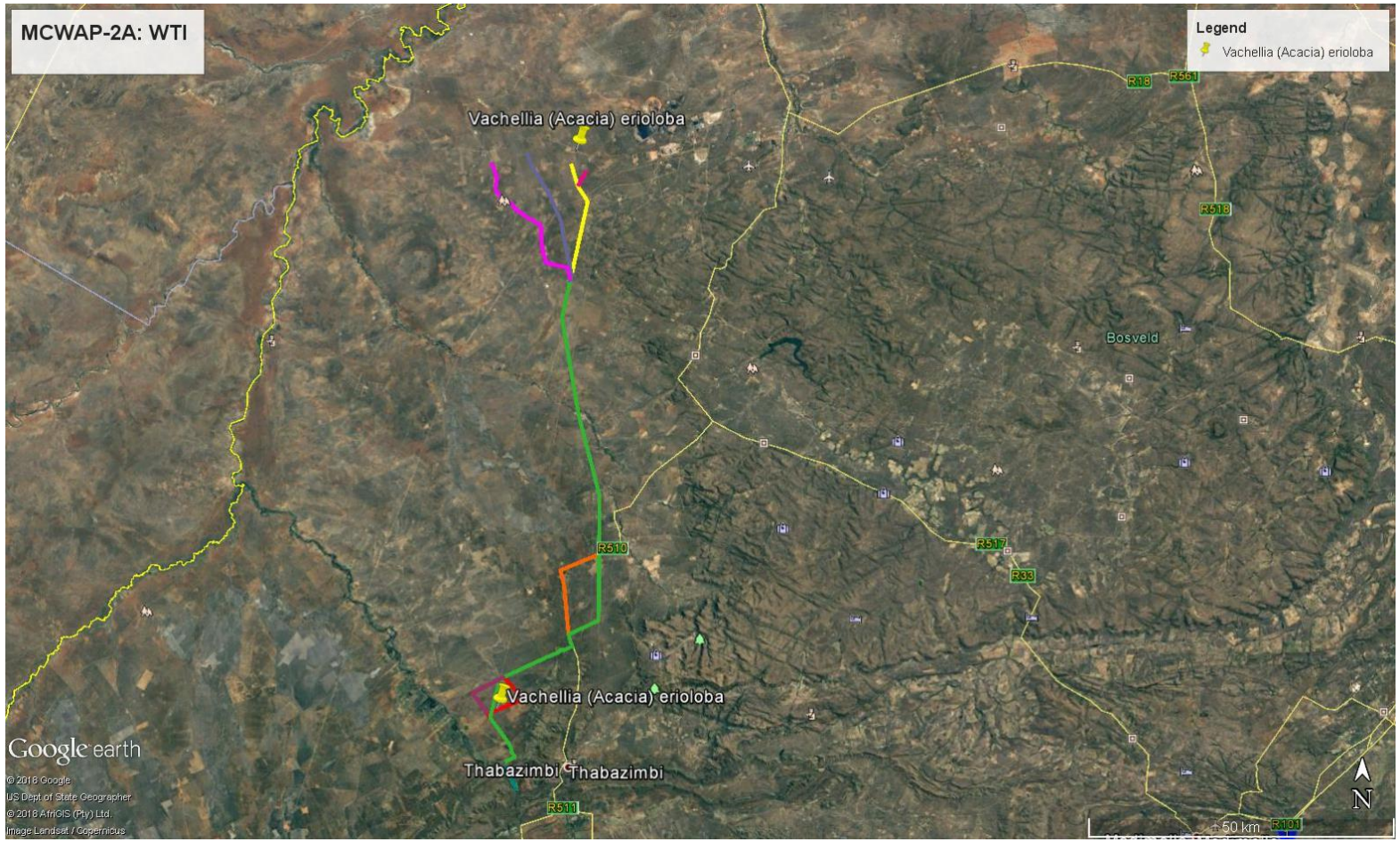

Figure 21. Distribution of *Vachellia (Acacia) erioloba* recorded within the project area

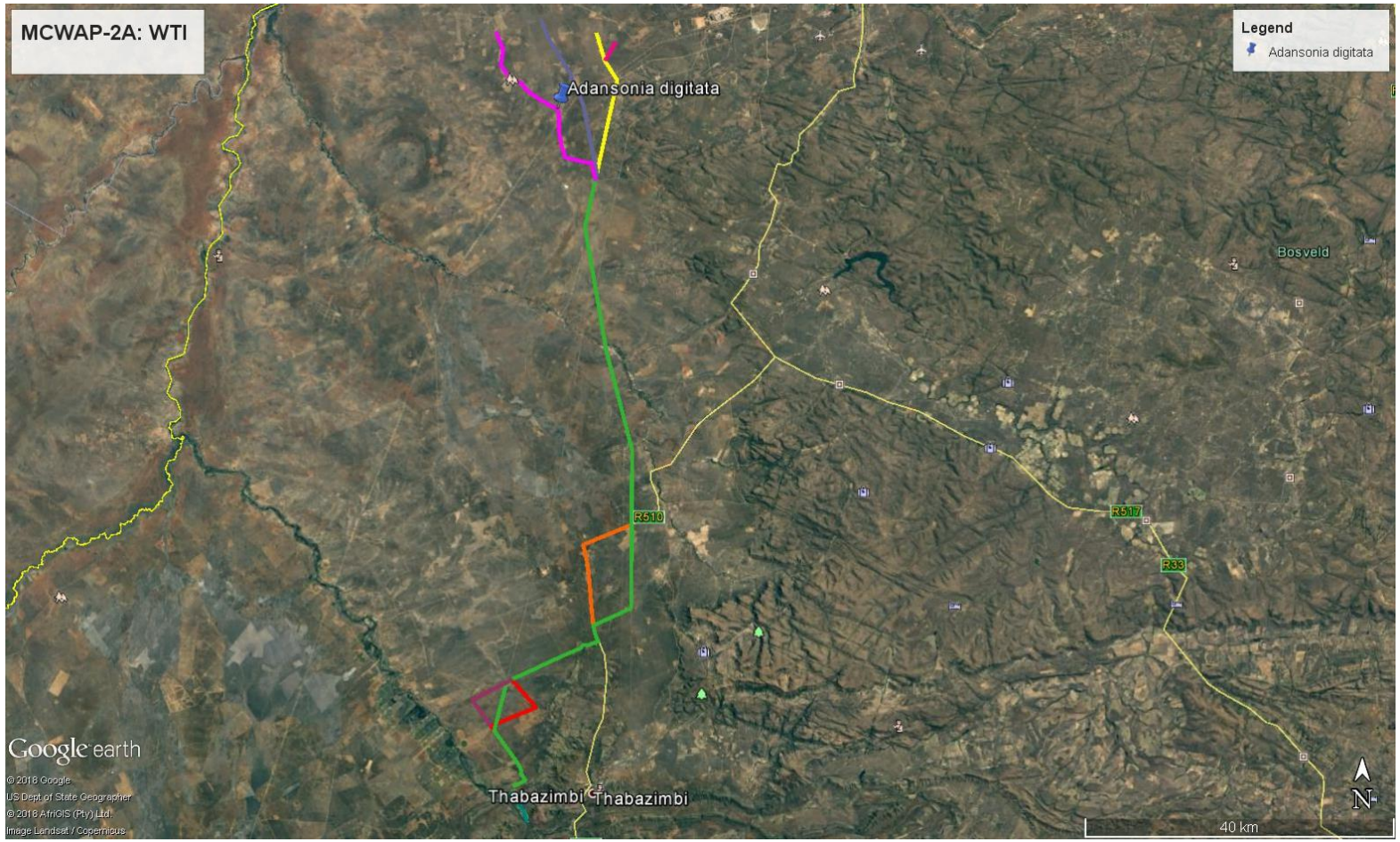

Figure 22. Distribution of *Adansonia digitata* (Baobab) recorded within the project area

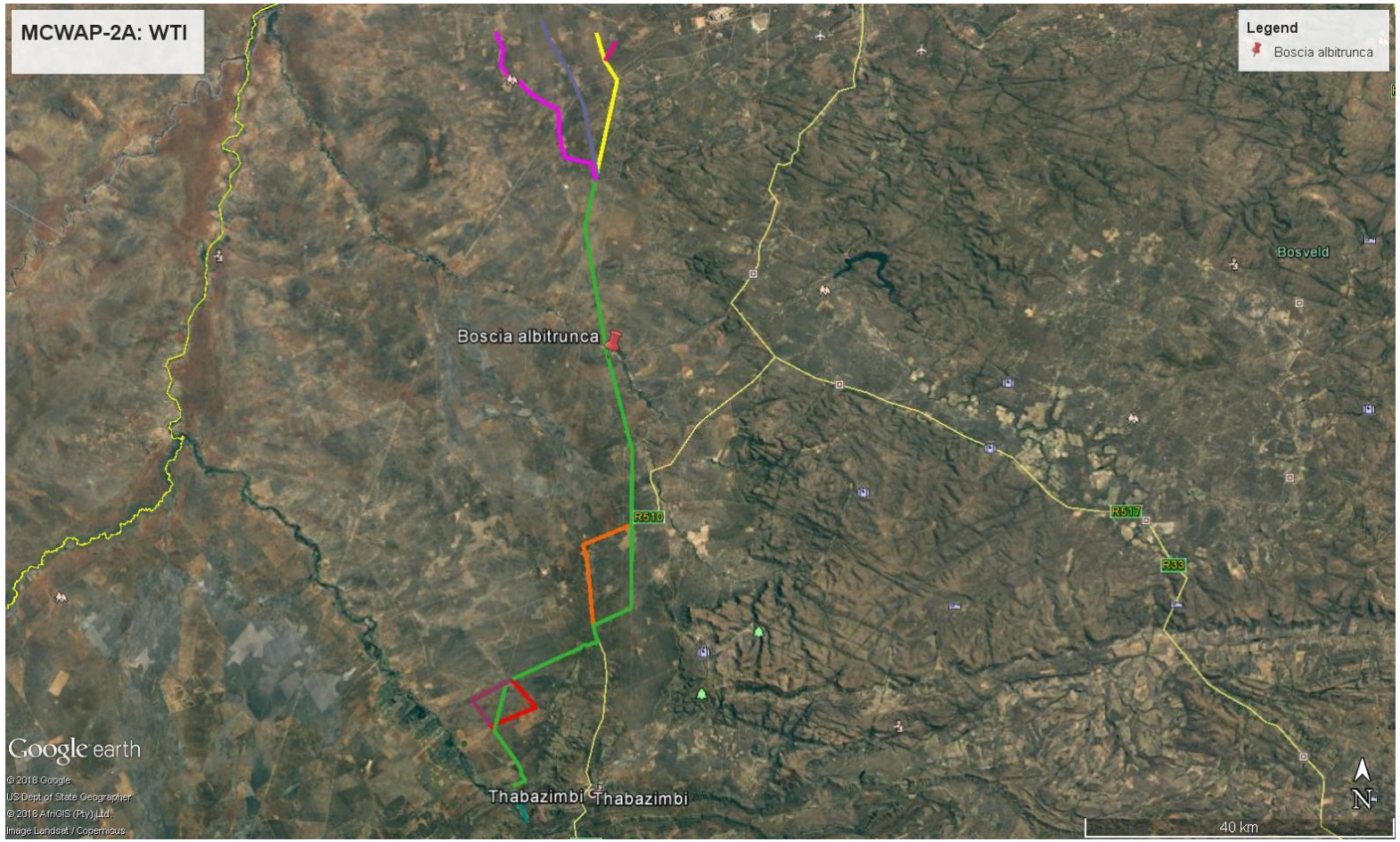

Figure 23. Distribution of *Boscia albitrunca* (Shepherd's tree) recorded within the project area

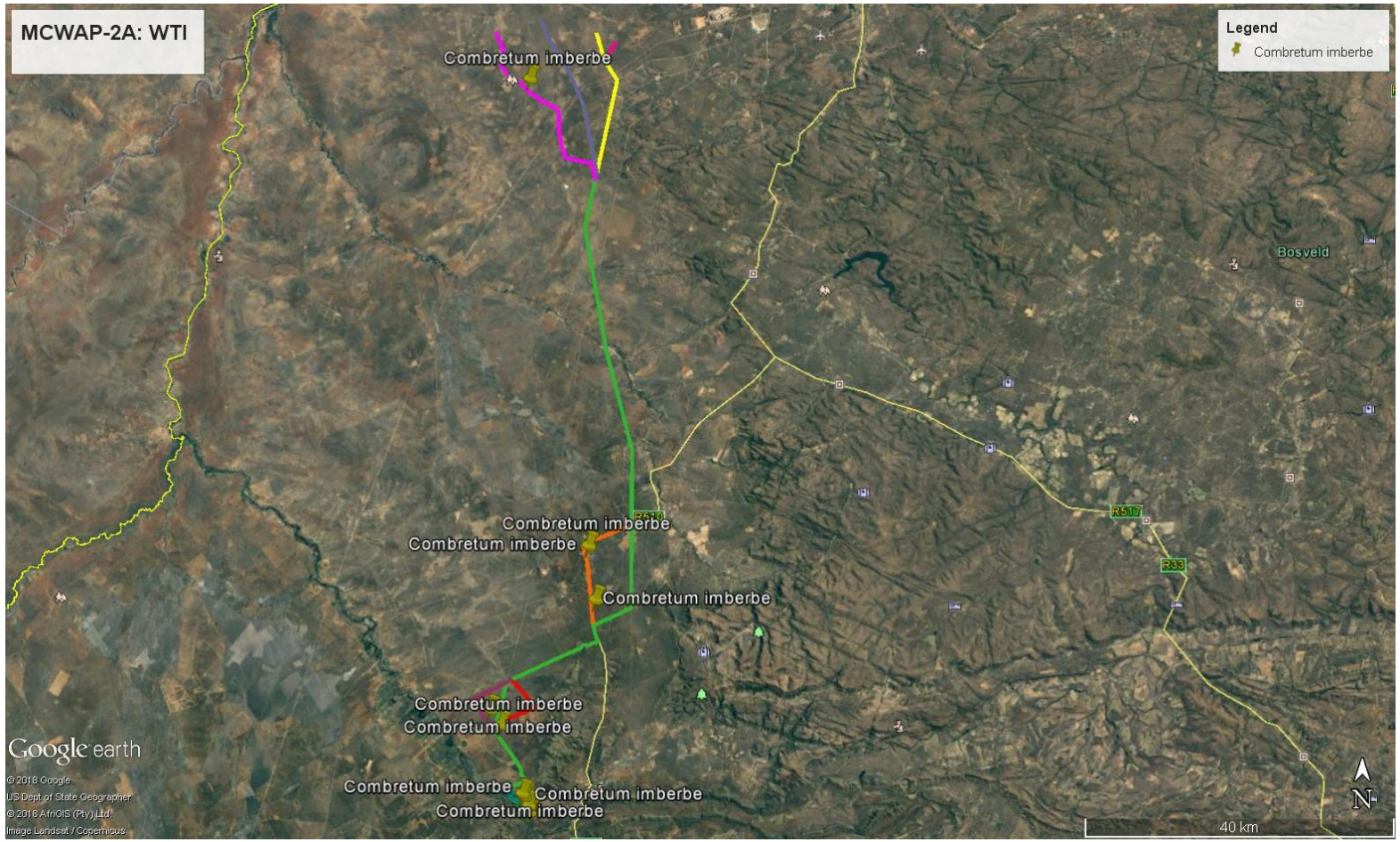

Figure 24. Distribution of *Combretum imberbe* (Leadwood) recorded within the project area

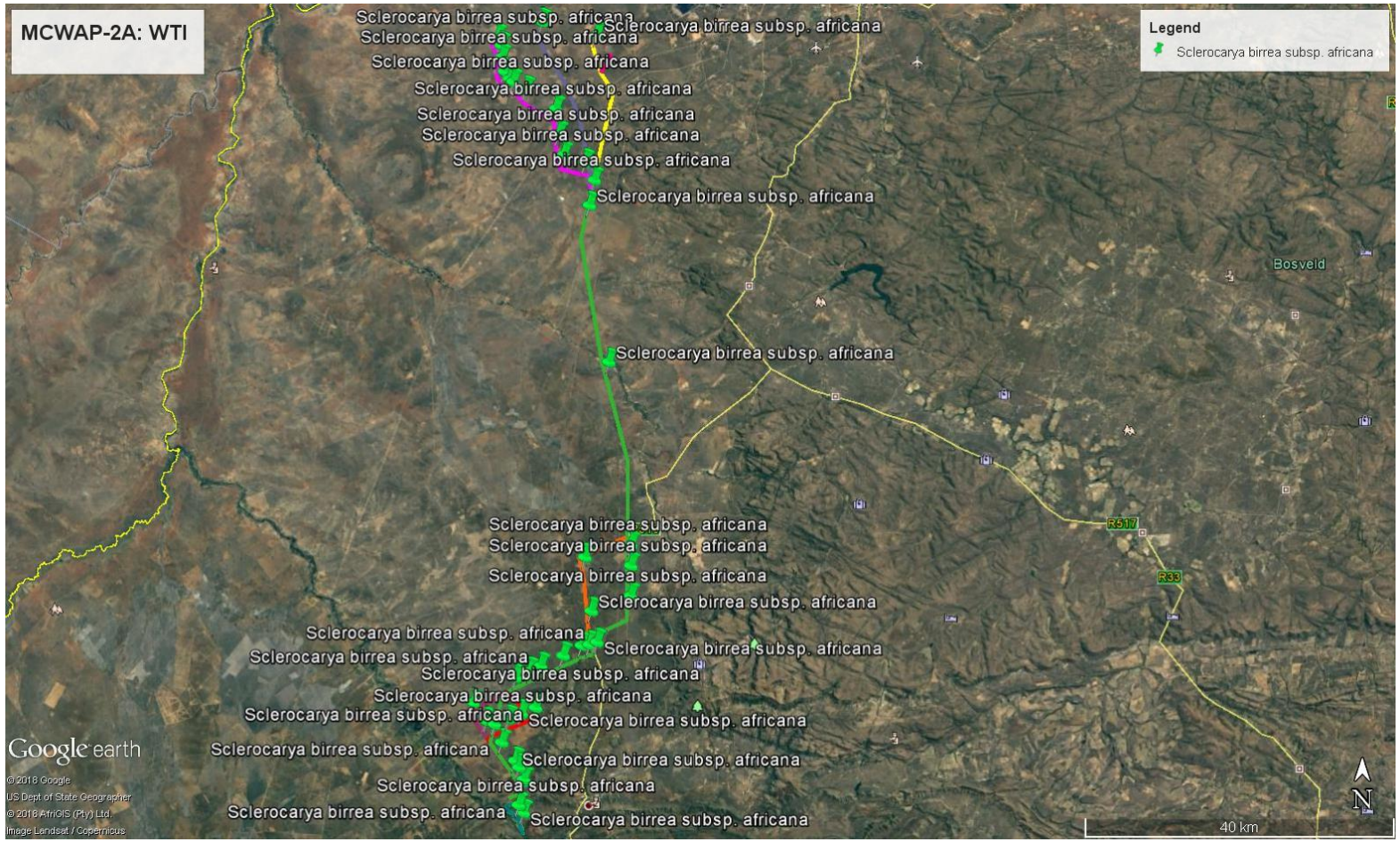

Figure 25. Distribution of *Sclerocarya birrea subsp. africana* (Marula) recorded within the project area

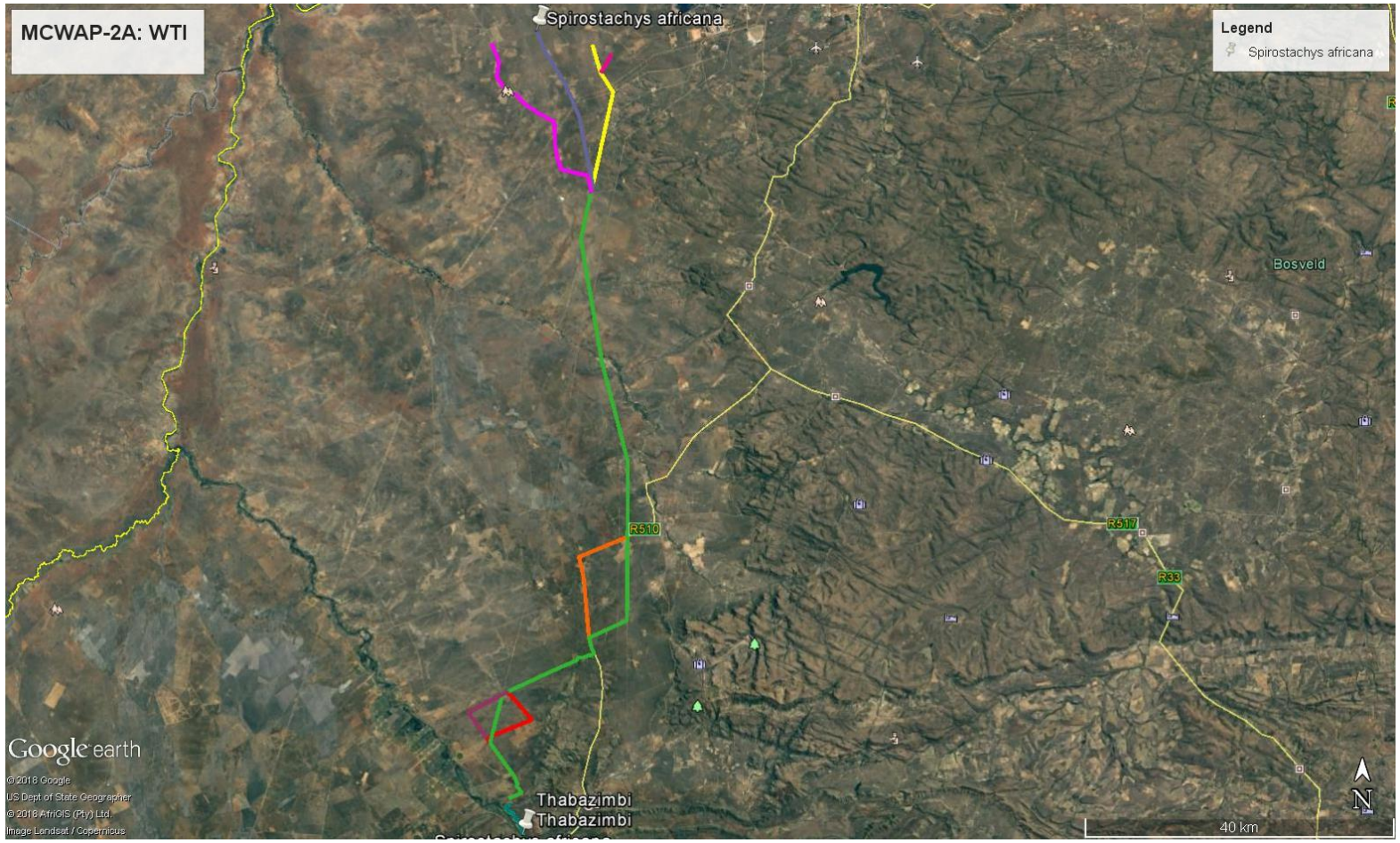

Figure 26. Distribution of *Spirostachys africana* (Tamboti) recorded along the project area

10.1.4 Alien invasive species recorded within the project area

Alien invader plants are species that are of exotic, non-native or of foreign origin that typically invade undeveloped or disturbed areas. Invaders are a threat to our ecosystem because by nature they grow fast, reproduce quickly and have high dispersal ability (Henderson, 2001). This means that invader plants and seeds spread rapidly and compete for the growing space of our own indigenous plants. If these invader plants out-compete indigenous plants there is a shift in the species composition of the area and the changing our plant communities causes a decline in species richness and biodiversity (Henderson, 2001). Many factors allow alien invasive plants to succeed, particularly the absence of their natural enemies. This makes it difficult to control invasive plants without bringing in natural enemies and eliminating the high competition they have over the indigenous vegetation (Bromilow, 2010). Alien invasive plant species within different alternative routes were observed to occur in clumps, scattered distributions or as single individuals on site. Invader and weed species must be controlled to prevent further infestation and it is recommended that all individuals of invader species (Especially Category 1) must be removed and eradicated (Henderson, 2001). Riparian vegetation, human habitation, railway line, roads and foot paths are all associated with alien invasive plant species and species which were dominated within the project area were *Ricinus communis* (**Figure 27**), *Datura stramonium* (**Figure 28**) and *Xanthium strumarium* (**Figure 29**) (All Category 1b).

Figure 27. Alien plant *Ricinus communis* recorded along the project area

Figure 28. Alien plant *Datura stramonium* recorded on the project area

Figure 29. Alien plant *Xanthium strumarium* recorded along the project area

The Environmental Management Programme (EMPr) must ensure that the Applicant/Contractor implements suitable methods during the construction phase to limit the introduction and spread of alien invasive plant species.

10.1.5 Threatened plant species, species of conservation concern and medicinal plants recorded within the project area

According to the National Environmental Management Biodiversity Act 2004 (Act No. 10 of 2004 as amended), there is a dire need to conserve biodiversity in each province and as such, all natural and/or indigenous resources must be utilised sustainably. Within the study area, there are a number of plants that are used to provide medicinal products (**Table 5**). In some cases there is merit in protecting or translocating them before the proposed development commences. While many of these plants are indigenous or exotic weeds that have medicinal value (and for which no action is necessary with respect to conservation), their economic value means that they are considered to be in need of protection.

According to the South African Red Data list categories done by SANBI (**Figure 30**), **threatened species** are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered, Endangered or Vulnerable is a threatened species whereas **Species of conservation concern** are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD).

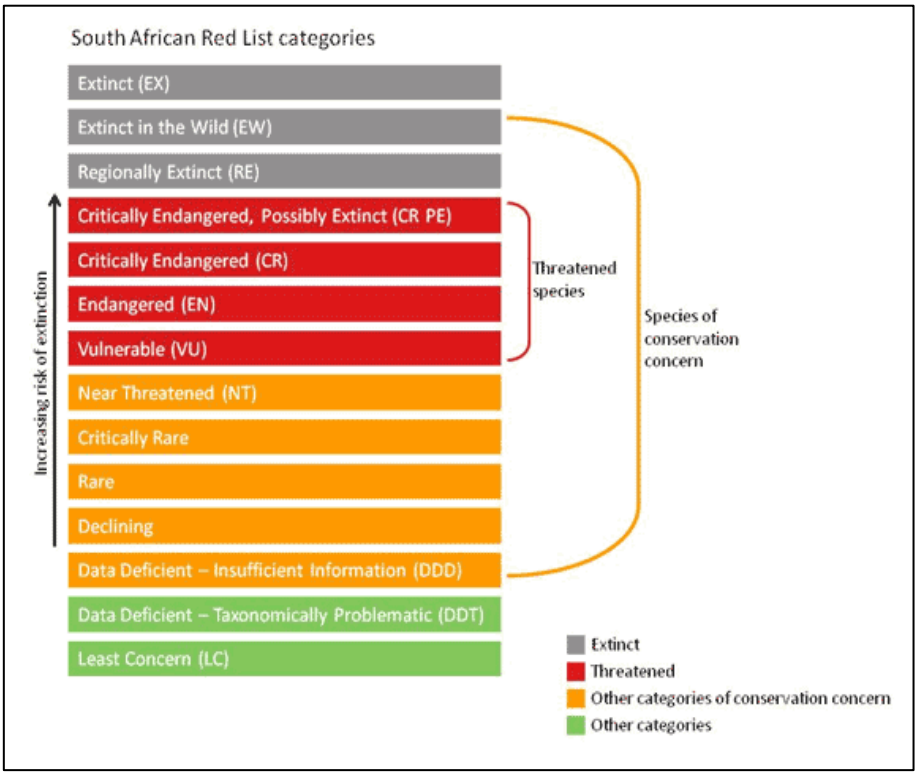

Figure 30. South African Red Data list categories (SANBI)

During the field survey, no threatened plant species were observed within the project area, however only one (1) species of conservation concern was noted, namely *Vachellia erioloba* (= *Acacia erioloba*) (Camel thorn). Raimondo *et al.* (2009) has listed this species as *Declining.*

Vachellia erioloba is widely distributed inland in the western half of the country, from the Northern Cape through to Limpopo Province. It also extends to Namibia, Botswana, Zimbabwe and to central Africa. It is a competitive species that can displace preferred vegetation. The timber is strong and is highly prized for firewood (Coates Palgrave, 2002).

It is therefore recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any plant species of conservation concern. This is relevant in the areas that have been labelled as ecologically sensitive.

10.1.6 Habitat available for species of conservation importance

Data sourced from SANBI indicates there are plant species on the Red Data List that are known to occur in or surrounding the project area. These species and their probability of occurrence are indicated in **Table 6**. The probability of occurrence is based on the suitable habit where the species is likely to occur.

Table 6. Red Listed plant species which are known to occur in the general vicinity of the project area, which could potentially be found along the project area

Species	Threat status	Suitable habitat	Probability of Occurrence
Freylinia tropica S.Moore	Rare	It occurs at a high altitude, in margins of evergreen forest, on river banks and beside streams. It can be found growing on exposed misty mountain slopes. Where it occurs, it is frequently a pioneer plant on cleared land.	High
Jamesbrittenia bergae P.Lemmer	Vulnerable	It grows naturally in fairly open exposed vegetation in heavy iron-rich soils. It is found in mixed bushveld, in crevices on ferricrete outcrops with a southern aspect.	High
Encephalartos eugene-maraisii I.Verd.	Endangered	This species is endemic to South Africa where it grows in the Waterberg and adjacent areas among low shrubs on rocky hills and steep slopes in open grassland and savanna	Medium

10.2 Fauna

The evaluation of faunal presence is based on the presence / absence of mammals, birds, reptiles and amphibians in the study area. The survey determined the current status of threatened animal species occurring, or likely to occur within the project area, describing the available and sensitive habitats. Faunal data was obtained during field survey assessments, which were carried out utilising vehicles and also on foot. The data was supplemented by previous surveys conducted in similar habitats, literature investigations, and historic data. Different habitats were explored to identify any sensitive or endangered species. Mammal nomenclature is referred to using Stuart and Stuart (1998), Skinner and Chimimba (2005), Friedman and Daly (2004), Child *et al.* (2016); bird names by Hockey *et al.* (2005), Taylor *et al*. (2015); reptile names by Branch (1988), Branch (2001), Bates *et al.* (2014); Amphibian names by Minter *et al.* (2004) and invertebrates by Leroy & Leroy. (2003).

10.2.1 Mammals

10.2.1.1 Desktop survey results

The Red Data mammal species that could potentially naturally occur in the project area are those which have been recorded in the grid cells 2327CB, 2327CD, 2427AB, 2427AD and 2427CB (Animal Demography Unit, 2018a) and are listed in **Table 7**.

Table 7. Red data Mammal species recorded in the grid cells 2327CB, 2327CD, 2427AB, 2427AD and 2427CB (Animal Demography Unit, 2018)

Family	Genus	Species	Subspecies	Common name	Red list category
Bovidae	*Hippotragus*	*equinus*		Roan Antelope	Vulnerable
Bovidae	*Hippotragus*	*niger*	niger	Sable Antelope	Vulnerable
Felidae	*Acinonyx*	*jubatus*		Cheetah	Vulnerable
Felidae	*Leptailurus*	*serval*		Serval	Near Threatened
Hyaenidae	*Hyaena*	*brunnea*		Brown Hyena	Near Threatened
Manidae	*Smutsia*	*temminckii*		Ground Pangolin	Vulnerable
Mustelidae	*Mellivora*	*capensis*		Honey Badger	Near Threatened
Vespertilionidae	*Myotis*	*tricolor*		Temminck's Myotis	Near Threatened
Hipposideridae	*Cloeotis*	*percivali*		Short-eared Trident Bat	Endangered

10.2.1.2 Mammals recorded within the study area

The greater area was historically commonly used for cattle grazing. Game farms are now more common, with an associated high faunal biodiversity. Various mammal species (e.g. buffalo) have been introduced through this practice. Numerous farms also keep exotic game species. Proper conservation measures on game farms also afford protection to other

species that naturally occur in the area, which include leopard, warthog, baboon and aardvark.

Known mammal distributions correlate well with biomes as defined by Acocks (1953), Low and Rebelo (1998), Knobel and Bredenkamp (2005) as well as Mucina and Rutherford (2006). However, the local occurrences of mammals are more closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (treeliving), rupiculous (rock-dwelling) and wetland-associated vegetation cover. The riverine areas and ridges in the area are regarded as significant in terms of the habitat that they provide to fauna. Riparian zones also serve as important corridors to allow for animal migration. Previous studies found a bat cave that is situated in the Mooivallei area (Galago Environmental CC, 2010) (**Figure 31**). The bats recorded from the caves are reported to be *Rhinolophus darlingi* and *Miniopterus schreibersii.* A fence to prevent sheep from falling into it is protecting the cave, and the owners acknowledge its value as a biological resource. According to Jacobs *et al*. (2016), *Rhinolophus darling* is now classified as '*Least Concern'* whereas *Miniopterus schreibersii* is no longer listed. According to Macewan *et al.* (2016), *M. schreibersii* assessment is not included for the region because it previously included *M. natalensis* (Least Concern) (which was considered a subspecies but is not listed on its own) (Dr Harriet Davies-Mostert pers.comm, June 2018). However, Chapter 10 of the Limpopo Environmental Management Act (LEMA) (Act No. 7 of 2003) deals with preservation of caves and caves-formation and according to Section 70 (2 a):

> "*No person may deposit, dump or drain any refuse, waste, substance or thing, whether solid, liquid, gaseous or explosive, into a cave or near a cave or near a cave entrance, or cause or allow it to enter or percolate into a cave*"

According to Monadjem *et al*. (2010), most of the cave dwelling bat species in South Africa are insectivorous and feed on nocturnal insects. According to Galago Environmental (2010), it is recommended that a blasting expert and geologist also assess the potential impact of blasting on the cave. The geotechnical investigations need to be taken into consideration during the design phase and the line can be shifted within the 100m corridor in order to avoid the cave and also to minimize impacts. According to Mr Egan from LEDET, the proposed "development would have to consider their impact on subterranean chambers as a buffer around a cave entrance wouldn't really address this as many caves are extensive"

Figure 31. Bat caves recorded in Mooivallei area

The detailed assessment of the mammal species which mostly occur in Game Ranches and protected areas is conducted by Ben Orban from NABRO Ecological Analysts CC (Wildlife Impact Assessment report).

Table 8 lists mammal species recorded during the field survey. **Figures 32** and **33** indicate mammal species observed on site. The list of species provided by the local farm owners are indicated in **BOLD.**

Figure 32. Zebra recorded in Mooivallei area

Figure 33. Female Impalas recorded near Sand River Gauging Weir

Table 8. Mammal species recorded within the study area

Scientific name	English name	Conservation Status
Lepus saxatilis	Scrub hare	Least concern
Sylvicapra grimmia	Grey/Common Duiker	Least concern
Cryptomys hottentotus	Common Mole-rat	Least concern
Hystrix africaeaustralis	Cape porcupine	Least concern
Gerbilliscus leucogaster	Bushveld Gerbil	Least concern
Paraxerus cepapi	Tree squirrel	Least concern
Xerus inauris	Cape Ground Squirrel	Least concern
Rattus rattus	House rat	Least concern
Papio hamadryas	Chacma baboon	Least concern
Cercopithecus pygerythrus	Vervet monkey	Least concern
Canis mesomelas	**Black-backed Jackal**	**Least concern**
Cynictis penicillata	Yellow mongoose	Least concern
Damaliscus pygargus phillipsi	Blesbok	Least concern
Equus quagga	Plains zebra	Least concern
Oryx gazella	Gemsbok	Least concern
Antidorcas marsupialis	Springbok	Least concern
Tragelaphus strepsiceros	Greater Kudu	Least concern
Aepyceros melampus	Impala	Least concern
Phacochoerus africanus	**Common Warthog**	**Least concern**
Connochaetes taurinus	Blue wildebeest	Least concern
Raphicerus campestris	**Steenbok**	**Least concern**
Giraffa camelopardalis	**Giraffe**	**Least concern**
Taurotragus oryx	**Common eland**	**Least concern**

10.2.1.3 Habitat available for mammal species of conservation importance

Data sourced from Animal Demographic Unit (ADU, 2018) indicates that there are Red Data mammal species which are known to occur in the general vicinity of the study area. **Table 9** below indicates the suitable habitat together with the probability of occurrence for each species that could potentially occur in the study area. The probability of occurrence is based on the presence of suitable habit where the species is likely to occur. According to Begg *et al.* (2016) and Monadjem *et al.* (2016), the Honey Badger (*Mellivora capensis*) and Temminck's Hairy Bat (*Myotis tricolor*) are now classified as *Least Concern* and have been excluded from the **Table 9**.

Table 9. Red Data Listed mammal species which could potentially occur within the project area, their suitable habitats and also the probability of occurrence (Child et al. (2016)

Common name	Red list category	Suitable habitat	Probability of occurrence
Roan Antelope	Endangered	They mostly inhabit lightly wooded savannah, open areas of medium sized grass, with easy access to surface water.	Medium
Sable Antelope	Vulnerable	Prefers open savannah woodlands or moist vleis, in which they select for medium height, good quality grass cover.	**FOUND**
Cheetah	Vulnerable	Cheetahs occur in the Savanna biome and are habitat generalists which can survive where sufficient food is available and threats are tolerable	Low
Serval	Near Threatened	Found in most types of grasslands, the serval is most common in moist habitats such as reed beds and marshes.	Low
Brown Hyena	Near Threatened	The Brown Hyaena is widespread across southern Africa and is found in the desert areas with annual rainfall less than 100 m, semi-desert, open scrub and open woodland savannah with a maximum rainfall up to about 700 mm. It shows an ability to survive close to urban areas. It requires some type of cover in which to lie up during the day. For this it favours rocky, mountainous areas with bush cover in the bushveld areas of South Africa.	Medium
Ground Pangolin	Vulnerable	It is found in various woodland and savannah habitats, preferring arid and mesic savannah and semi-arid environments at lower altitudes, often with thick undergrowth, where average annual rainfall ranges between 250 and 1,400 mm. They also occur in floodplain grassland, rocky slopes and sandveld up to 1,700 m, but are absent from Karroid regions, tropical and coastal forests, Highveld grassland and coastal regions.	Medium
Short-eared Trident Bat	Endangered	Occurs in savannah and woodland areas where there is sufficient cover in the form of caves and mine tunnels for day roosting	High

10.2.2 Avifauna

10.2.2.1 Desktop survey results

The Important Bird & Biodiversity Area (IBA) programme of southern Africa (Barnes, 1998) identified 124 IBAs in South Africa. IBAs are places of international significance for the conservation of birds and other biodiversity and are sites that together form part of a wider, integrated approach to the conservation and sustainable use of the natural environment. The Waterberg System IBA occurs approximately 3.5 km to the east of the Central Route and the Northern Turf Thornveld IBA is situated approximately 2 km to the south of the abstraction weir (**Figure 34**). The Paul Hugo and Bierspruit gauging weirs fall within the last mentioned IBA. The Northern Turf Thornveld IBA holds the core of the remaining resident South African population of Yellow-throated Sandgrouse (*Pterocles gutturalis*). The Sandgrouse inhabit short, open grasslands, fallow fields and recently burnt veld, especially on black clay soils near water. Other important birds in the IBA include Secretarybird *Sagittarius serpentarius*, Kori Bustard (*Ardeotis kori*), Lanner Falcon (*Falco biarmicus*) and Black-winged Pratincole (*Glareola nordmanni*). The only globally threatened species is found in this IBA is the Black-winged Pratincole; regionally threatened species are Yellow-throated Sandgrouse and Lanner Falcon. Common biome-restricted species found include Kurrichane Thrush (*Turdus libonyanus*), White-throated Robin-Chat (*Cossypha humeralis*), Burchell's Starling (*Lamprotornis australis*), White-bellied Sunbird (*Cinnyris talatala*) and the fairly common Kalahari Scrub Robin (*Erythropygia paean*) (Birdlife, 2018).

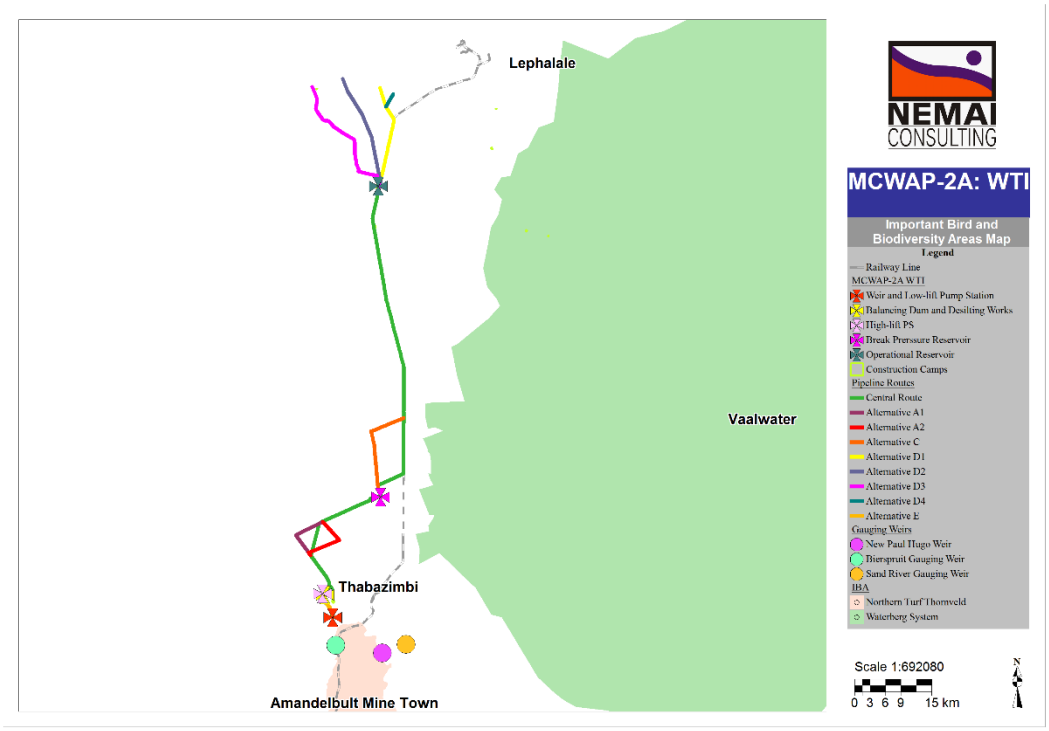

Figure 34.IBAs in relation to the project area

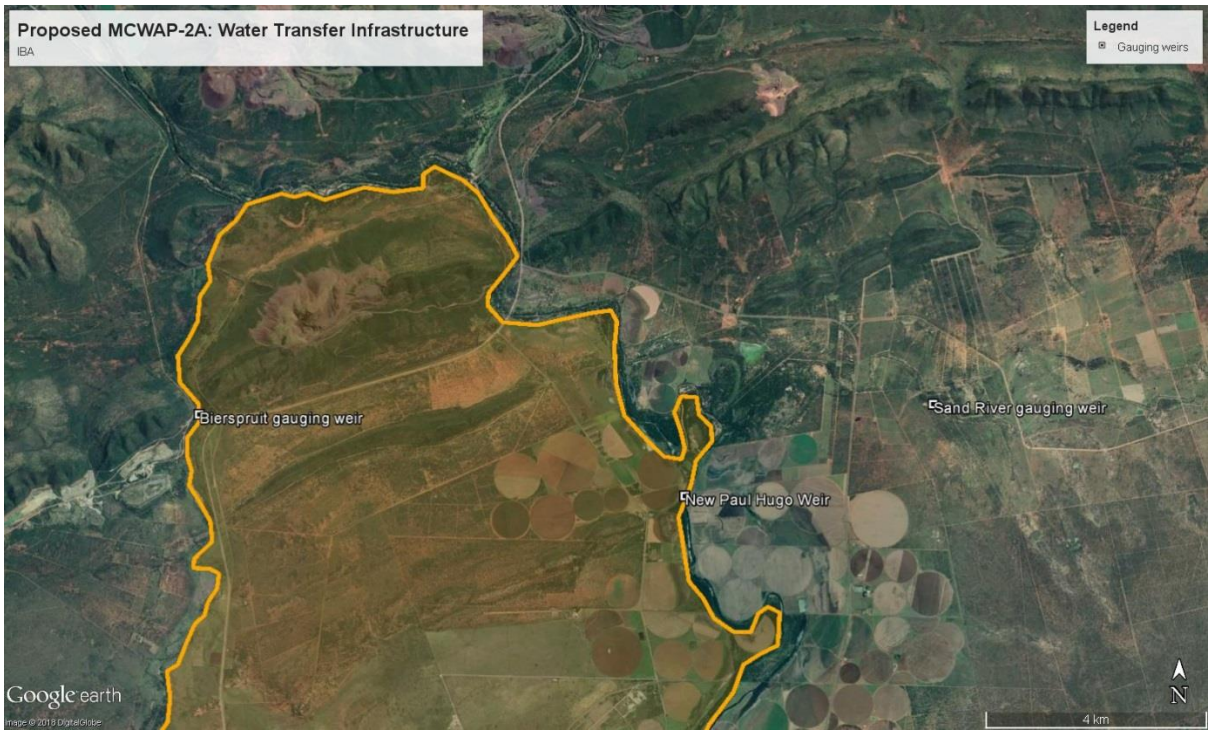

Figure 35. Paul Hugo and Bierspruit gauging weirs fall within the Northern Turf Thornveld IBA

Bird distribution data of the Southern African Bird Atlas Project (SABAP1 – Harrison *et al.*, 1997) obtained from the Avian Demography Unit of the University of Cape Town was used in order to ascertain which Red Data bird species occur in the study area (see **Table 10**). The more recent SABAP2 data was also consulted online (http://sabap2.adu.org.za/coverage.php). The conservation status follows the recent publication by Eskom and Birdlife (Taylor *et al.* 2015).

Table 10. Red data bird species recorded in the grid cells 2327CB, 2327CD, 2427AB, 2427AD and 2427CB (ADU, 2018), which could potentially occur within the project area.

Common Name	Scientific Name	Conservation Status	2327CB	2327CD	2427AB	2427AD	2427CB
Kori Bustard	*Ardeotis kori*	Near Threatened	✓		✓	✓	✓
White-bellied Korhaan	*Eupodotis senegalensis*	Vulnerable				✓	
Yellow-throated Sandgrouse	*Pterocles gutturalis*	Near Threatened			✓		✓
Greater Painted-snipe	*Rostratula benghalensis*	Vulnerable					✓
Black-winged Pratincole	*Glareola nordmanni*	Near Threatened	✓				✓
White-backed Vulture	*Gyps africanus*	Endangered	✓	✓	✓		✓
Cape Vulture	*Gyps coprotheres*	Endangered	✓		✓		✓
Lappet-faced Vulture	*Aegypius tracheliotus*	Endangered	✓		✓		
Bateleur	*Terathopius ecaudatus*	Endangered	✓		✓		
African Marsh-Harrier	*Circus ranivorus*	Endangered					✓
Tawny Eagle	*Aquila rapax*	Endangered	✓	✓	✓		✓
Martial Eagle	*Polemaetus bellicosus*	Endangered			✓	✓	✓
Secretarybird	*Sagittarius serpentarius*	Vulnerable	✓	✓	✓	✓	✓
Lanner Falcon	*Falco biarmicus*	Vulnerable					✓
Yellow-billed Stork	*Mycteria ibis*	Endangered			✓		✓
Black Stork	*Ciconia nigra*	Vulnerable			✓		✓
Marabou Stork	*Leptoptilos crumeniferus*	Near Threatened			✓		✓

10.2.2.2 Bird species recorded within the study area

A numbers of bird species in South Africa have declined mainly due to massive habitat transformation and degradation as well as increased levels of human disturbances, extensive habitat transformation due to mining, industrial and commercial and agricultural activities. Human activities have transformed grasslands in South Africa to a point where few pristine examples exist (Low and Rebelo, 1996). Factors such as increased pasture management (overgrazing), decrease in grassland management due to frequent fires and land-use alteration (urbanisation) also contribute in the decline of species. More intensive surveys conducted over longer periods over several seasons are required in order to ascertain the current status of the above-mentioned threatened bird species on and surrounding the site. Many avifaunal species are adaptable as they are habitat generalists and can therefore accommodate a certain degree of habitat degradation and transformation (Harrison *et al*. 1997). Other species are extremely habitat specific and have to rely on certain habitat units for breeding, hunting or foraging and roosting. Habitat-specific species are sensitive to environmental change, with destruction of habitat being the leading cause of species decline worldwide (Barnes, 2000). Within the vegetation types found in the study area and immediate surrounding areas, five major bird habitat systems were identified. A short description of each habitat type follows below:

Rivers (Crocodile, Matlabas, Bierspruit and Sand) and associated riparian zones: The study area includes one of the significant sensitive faunal habitats – riparian vegetation (**Figure 35**), which could be suitable habitat for bird species that utilise this habitat type. Various species of water bird are mostly restricted to riverine habitat in southern Africa. Waterbirds will only utilize the non-perennial river system periodically for foraging. Areas with reeds, sedges or grassy tangles are suitable for Common Waxbills (*Estrilda astrilda),* Bishops and various warblers (Marais and Peacock, 2008). Water bodies also represent sensitive areas because they provide habitat for a wide variety of terrestrial and aquatic species, particularly avifauna.

Most common water dependent species such as Red-knobbed Coot *Fulica cristata*, Black-headed Heron *Ardea melanocephala*, African Darter *Anhinga rufa*, White-faced Duck *Dendrocygna viduata,* Yellow-billed Duck *Anas undulata*, Blacksmith Lapwing *Vanellus armatus*, African Sacred Ibis *Threskiornis aethiopicus* and Egyptian Goose *Alopochen aegyptiaca* may utilise the Crocodile River systems within the study areas quite extensively.

The Matlabas River is a smaller river system with more or less the same vegetation that grows on its banks. These rivers are sensitive for bird species that depend on them for food, water and breeding purposes. Bird species such as herons, crakes, moorhens, bishops, weavers, cisticolas and warblers will breed in the reeds growing on the banks of the river systems and will also feed on insects that live within the reeds and semi-aquatic vegetation. Fish living in the water of these rivers will also attract birds such as kingfishers, cormorants and darters. Frogs and crabs also occur and will attract bird species that feed on them such as Hadeda, herons, hamerkop and kingfishers (Galago Environmental, 2010). The reed

beds (**Figure 33**) will provide important potential breeding sites for many of the bishops and weavers that were observed.

The banks of the Crocodile River where the weir will be constructed are steep with reeds that grow in most areas followed by riparian vegetation that varies in density from place to place and three of the Red Data species will be directly affected by the availability of water downstream from the proposed weir in the Crocodile River, namely Greater Painted-snipe, Yellow-billed Stork and Black Stork (Galago Environmental, 2010). The riparian vegetation will favour species typically associated with a bushveld habitat and such birds include species such drongos, warblers, flycatchers, shrikes, sunbirds, waxbills, doves, cuckoos and woodpeckers. Many of these species make use of the thorny nature of these trees to build their nests. *Acacia* trees generally attract many insects and in turn attract a good diversity of typical “Bushveld” bird species.

Figure 36. Riparian vegetation

Figure 37. Reed beds provide important potential breeding sites for many of the bishops and weavers within the study area.

Woodland (savanna): The savanna biome contains a large variety of bird species but very few bird species are restricted to this biome. It is the most species-rich community in southern Africa (Barnes, 1998). The bird species within the woodland habitat include a great variety of arboreal passerines such as drongos, warblers, flycatchers, shrikes, sunbirds, waxbills and weavers as well as arboreal non-passerines such as doves, cuckoos and woodpeckers. Many of these species make use of the thorny nature of these trees to build their nests. *Acacia* trees generally attract many insects and in turn attract a good diversity of typical *Acacia* savanna bird species. The ground cover between the trees consists of mainly short to long grass interspersed with shrubs. Woodland areas (**Figure 38**) on site vary from relatively intact in places to a relatively poor state with significant bush encroachment partly due to sustained overgrazing and game farming. Plant species present are related to soil type, but usually include both broad-leafed and thorn trees. The woodland habitat forms the stronghold of Red Data raptors species such as Martial Eagle (*Polemaetus bellicosus)*, White-backed Vulture (*Gyps africanus)*, Cape Vulture (*Gyps coprotheres)*, Lappet-faced Vulture (*Torgos tracheliotis*) and Tawny Eagle (*Aquila rapax*) (Hockey *et al.* 2005; SABAP2, 2012).

Figure 38. Woodland vegetation

Pans

Several, mainly seasonal, pans are found in the region. Not only are these pans important for Red Data species but also for many Palaearctic waders which visit southern Africa during the summer months. The pans will attract several water bird species such as lapwings, ducks, herons and egrets for foraging, breeding and roosting purposes. They will feed on prey species such as frogs and their tadpoles and fish that aestivate and hibernate in the mud during times when the pans are dry as well as aquatic insects and plants. The pans are also an important source of water for many woodland bird species such as waxbills, buntings, sparrows, weavers and doves especially during hot and dry periods.

Agricultural areas

The project footprint significantly affects the pivots and fields on Portions 1 and 2 of the Farm Mooivalei 342 KQ, which is earmarked for the proposed balancing dam, desilting works, high-lift pump station and a section of the Central Route (Figure 105). Cultivated areas occur along the south-western part of the low-lift rising main. Other cultivated areas also occur along other sections of the pipeline routes. Agriculture is a major environmental problem for threatened bird species as well as species that depend on grassland for survival. The tilling of soil for cultivated fields is one of the most drastic and irrevocable alterations wrought on natural systems destroying the structure and species composition of the natural vegetation (Barnes, 1998). This disturbance is mainly permanent and thereby has a massive impact on the taxa that are dependent on that vegetation. This especially affects the grassland areas in

the region. Bird species that are able to exploit monoculture and cultivated crops, or by-products of cultivation such as bare ground, may benefit temporarily. Cultivated fields are utilised my many avifaunal species for foraging purposes. This habitat unit is however, seasonally attractive to various species such as storks and cranes, or raptors that prey on insects and rodents that feed on crops. The planting of crops increases rodent populations within the fields, which, in turn, increases the hunting potential for raptors and other opportunistic rodent-eating species.

Rocky outcrops

The rocky outcrops occur as scattered landmarks and provide for high spatial heterogeneities and niche space. These areas are earmarked by vertical cliffs that are often utilised by birds of prey for roosting or breeding habitat (e.g. Lanner Falcon *Falco biarmicus* and African Hawk-eagle *Aquila spilogaster*).

Fifty Eight (58) bird species (**Table 11**) were recorded during the field survey. Species recorded were common, widespread and typical of savanna environment. No Red Data bird species associated with the proposed development area were recorded during the field assessment. Bird species such as Black-chested snake eagle (**Figure 39**) was recorded along the railway live. Red-billed Oxpecker (**Figure 40**) were recorded in the Mooivalei farms. Common Ostrich (**Figure 41**) was recorded along the D3 alternative route. The list of species provided by the local land/farm owners are indicated in **BOLD.**

Table 11. Bird species recorded within the project area

Species number	Common name	Scientific name
1	Common Ostrich	*Struthio camelus*
63	Black-headed heron	*Ardea melanocephala*
71	Cattle Egret	*Bubulcus ibis*
81	Hamerkop	*Scopus umbretta*
94	Hadeda Ibis	*Bostrychia hagedash*
99	White-faced whistling duck	*Dendrocygna viduata*
102	Egyptian Goose	*Alopochen aegyptiaca*
116	Spur-winged Goose	*Plectropterus gambensis*
127	Black-shouldered Kite	*Elanus caeruleus*
133	**Steppe Eagle**	**Aquila nipalensis**
142	Brown Snake-Eagle	*Circaetus cinereus*
143	Black-chested snake eagle	*Circaetus pectoralis*
148	**African fish-eagle**	***Haliaeetus vocifer***
149	**Steppe Buzzard**	***Buteo vulpinus***
162	**Southern Pale Chanting Goshawk**	***Melierax canorus***
196	Natal Spurfowl	*Pternistis natalensis*
199	Swainson's spurfowl	*Pternistis swainsonii*
203	Helmeted Guineafowl	*Numida meleagris*
258	Blacksmith Lapwing (Plover)	*Vanellus armatus*
260	African Wattled Lapwing	Vanellus senegallus
297	Spotted Thick-knee (Dikkop)	Burhinus capensis
352	Red-eyed Dove	*Streptopelia semitorquata*

Species number	Common name	Scientific name
355	Laughing Dove	*Streptopelia senegalensis*
373	Grey go-away-bird (Lourie)	*Corythaixoides concolor*
381	Levaillant's cuckoo	*Clamator levaillantii*
382	Jacobin cuckoo	*Clamator jacobinus*
392	**Barn Owl**	***Tyto alba***
398	**Pearl-spotted Owlet**	***Glaucidium perlatum***
401	**Spotted Eagle-Owl**	***Bubo africanus***
415	White-rumped Swift	Apus caffer
417	Little Swift	*Apus affinis*
424	Speckled Mousebird	*Colius striatus*
435	Brown-hooded kingfisher	*Halcyon albiventris*
438	European Bee-eater	*Merops apiaster*
444	Little Bee-eater	*Merops pusillus*
447	Lilac breasted roller	*Coracias caudatus*
451	African Hoopoe	*Upupa africana*
458	Red-billed Hornbill	Tockus erythrorhynchus
459	Southern Yellow-Billed Hornbill	*Tockus leucomelas*
473	Crested Barbet	*Trachyphonus vaillantii*
518	Barn Swallow	Hirundo rustica
541	Fork-tailed Drongo	*Dicrurus adsimilis*
526	Greater Striped Swallow	Hirundo cucullata
568	Dark-Capped (Black-eyed) Bulbul	*Pycnonotus tricolor*
672	Rattling Cisticola	*Cisticola chiniana*
596	African (Common) Stonechat	*Saxicola torquatus*
664	Zitting Cisticola	Cisticola juncidis
732	Common Fiscal (Fiscal Shrike)	*Lanius collaris*
758	Common (Indian) Myna	*Acridotheres zeylonus*
761	Violet-backed (Plumcoloured) Starling	*Cinnyricinclus leucogaster*
764	Cape Glossy Starling	Lamprotornis nitens
772	Red-billed Oxpecker	*Buphagus erythrorhynchus*
801	House Sparrow	*Passer domesticus*
814	Southern Masked-Weaver	*Ploceus velatus*
824	Southern Red Bishop	*Euplectes orix*
826	Yellow-crowned Bishop	*Euplectes afer*
832	Long-tailed Widowbird	*Euplectes progne*
846	Common Waxbill	*Estrilda astrild*

Figure 39. Black-chested snake eagle was recorded along the railway live.

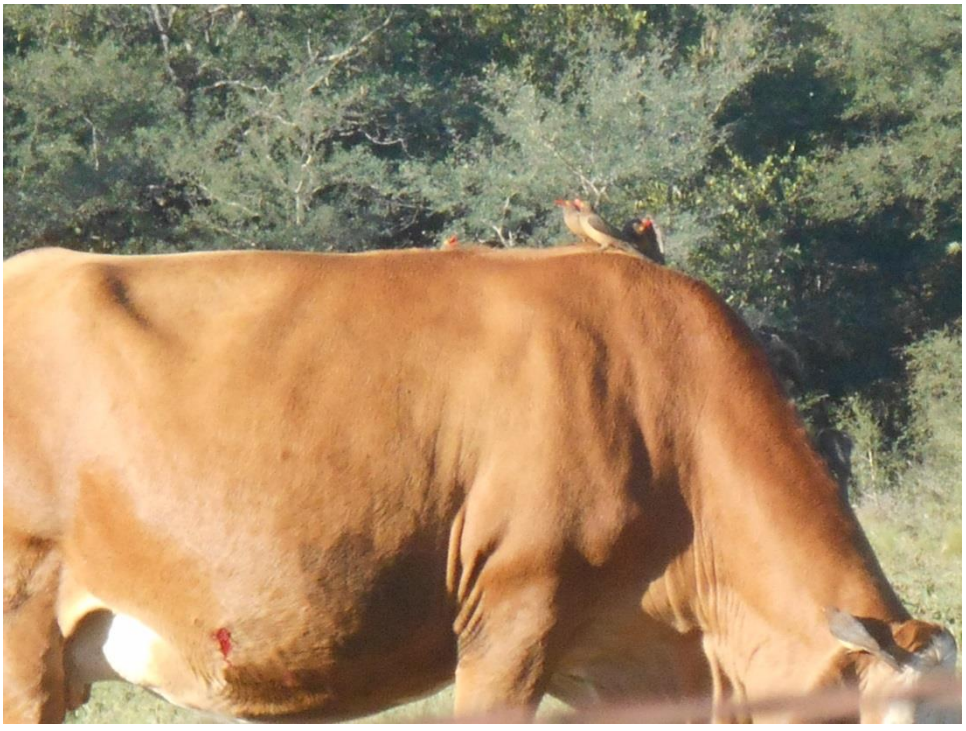

Figure 40. Red-billed Oxpecker were recorded within the Mooivalei farms.

Figure 41. Male Ostrich recorded along the D3 alternative route

10.2.2.3 Habitat requirements for Red Data bird species

Data sourced from SABAP 1**,** Harrison *et al*. (1997), Barnes (2000), SABAP 2 and Tarboton *et al.* (1987) indicated bird species on the Red Data List that are known to occur on grid cells 2327CB, 2327CD, 2427AB, 2427AD and 2427CB; as well as their probability of occurrence (indicated in **Table 12**). The probability of occurrence is based on the presence of suitable habit where the species is likely to occur. In this case few of the potential species are likely to occur at the site due to a lack of suitable microhabitats.

Bird species such as Eagles and Vultures need large foraging ranges and are only likely to move over the proposed pipeline routes on occasions. No tree nest building sites were observed in which these bird species breed. The impacts on these bird species is limited to construction phase and since these species forage over large ranges, these impacts will be minimal within the project area. The Pans near Steenbokpan could offer suitable foraging habitat for Red Data Listed (RDL) Storks but this however limited to periods when the pans are filled with water.

Table 12. Red data bird species recorded in the grid cells 2327CB, 2327CD, 2427AB, 2427AD and 2427CB (ADU, 2016), which could potentially occur within the project area.

Common Name	Scientific Name	Conservation Status	Suitable Habitat	Probability of occurrence
Kori Bustard	*Ardeotis kori*	Near Threatened	In southern Africa it is locally common in Namibia, Botswana, Zimbabwe and west-central South Africa. It generally prefers dry, open savanna, Nama karoo, dwarf shrublands, occasionally moving into grassland and dense, closed-canopy woodland.	High
White-bellied Korhaan	*Eupodotis senegalensis*	Vulnerable	It generally prefers fairly tall, dense sour or mixed grassland, either open or lightly wooded, occasionally moving into cultivated or burnt land.	Low
Yellow-throated Sandgrouse	*Pterocles gutturalis*	Near Threatened	It generally prefers short, open grassy plains with moist clay-like soils, especially on or near seasonal rivers, swamps or flood plains, also occupying fallow fields and cultivated land	Medium
Greater Painted-snipe	*Rostratula benghalensis*	Vulnerable	It generally prefers dams, pans and marshy river flood plains, or any waterside habitat with mud and vegetation.	Low
Black-winged Pratincole	*Glareola nordmanni*	Near Threatened	It generally prefers open seasonally wet grassland, edges of pans and cultivated land.	Medium-High
White-backed Vulture	*Gyps africanus*	Endangered	It generally prefers arid savanna with scattered trees, such as Mopane (*Colosphermum mopane*), largely avoiding forests, deserts, treeless grassland and shrubland	Low
Cape Vulture	*Gyps coprotheres*	Endangered	It can occupy a variety of habitat types, although it especially favours subsistence farming communal grazing areas, where there is plenty of livestock to feed on.	Medium-High
Lappet-faced Vulture	*Aegypius tracheliotus*	Endangered	It generally prefers arid and semi-arid open woodland, especially with *Acacia*, Shepherds-tree (*Boscia albitrunca*), Purple-pod cluster-leaf (*Terminalia prunioides*) and Mopane (*Colosphermum mopane*).	Medium
Bateleur	*Terathopius ecaudatus*	Endangered	It generally prefers savanna and woodland habitats, such as arid *Acacia* savanna and miombo (*Brachystegia*) woodland and Mopane (*Colosphermum mopane*) woodland, especially with long grass. It may also move into drainage-line woodland in semi-desert shrubland.	Low

Common Name	Scientific Name	Conservation Status	Suitable Habitat	Probability of occurrence
African Marsh-Harrier	*Circus ranivorus*	Endangered	It generally favours inland and coastal wetlands.	Low
Tawny Eagle	*Aquila rapax*	Endangered	It generally prefers lightly-wooded savanna, but it also occurs Nama Karoo and treeless grasslands, provided that there are pylons and alien trees to nest in.	High
Martial Eagle	*Polemaetus bellicosus*	Endangered	It is found in open plains and semi-desert country, but not frequenting forest, although it occasionally breeds in forests on the edge of open country.	Medium-High
Secretarybird	*Sagittarius serpentarius*	Vulnerable	Prefers open grassland with scattered trees, shrubland, open *Acacia* and *Combretum* savannah. Restricted to large conservation areas in the region. Avoids densely wooded areas, rocky hills and mountainous areas.	Medium
Lanner Falcon	*Falco biarmicus*	Vulnerable	The species can be found in *Eucalyptus* stands in southern Africa and even in urban areas, as long as there are open or lightly wooded areas nearby for hunting, though it tends to avoid heavily forested or very wet areas.	Low-Medium
Yellow-billed Stork	*Mycteria ibis*	Endangered	It generally prefers wetlands, such as pans, flood plains, marshes, streams, flooded grassland and small pools, occasionally moving into mudflats and estuaries.	Low-Medium
Black Stork	*Ciconia nigra*	Vulnerable	It can occupy almost any type of wetland, such as pans, rivers, flood plains, ponds, lagoons, dams, swamp forests, mangrove swamps, estuaries, tidal mudflats and patches of short grass close to water	High
Marabou Stork	*Leptoptilos crumeniferus*	Near Threatened	It generally prefers open semi-arid habitats and wetlands, such as pans, dams and rivers.	Medium

10.2.3 Reptiles

10.2.3.1 Desktop survey results

In general, the habitat types affected by the project area are suitable for relatively high species diversity. The reptiles mainly consists of widespread, common Bushveld species with slight variation due to the presence of sandy substrate, stony to rocky terrain, water bodies, bush and trees.

Based on Jacobsen (1989), the South African Reptile Conservation Assessment Survey (2006 – 2009) and Bates *et al.* (2014) the Southern African Python (*Python natalensis*) is the only Red Data reptile species which may occur on this project area.

10.2.3.2 Reptiles recorded within the project area

Areas such as rocky habitats, bush and trees, patches of grasslands and riparian vegetation within the project area are of high importance to reptiles. Reptiles are exceptionally hard to detect during field surveys. Riverine habitats are traditionally rich in reptile diversity and concentrations due to the habitat supporting a high number of prey species, such as frogs, birds and small mammals (Branch, 2001). The majority of reptile species are sensitive to severe habitat alteration and fragmentation. Species are also very often “expelled” into riparian zones due to transformation of lands for anthropogenic disturbances such as human settlements and agricultural purposes. Termite mounds were present within the project area and the old termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal species (Jacobsen, 2005). Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). No termite mounds were destroyed during the brief field survey. All overturned rock material was carefully replaced in its original position. **Table 13** indicates reptile species observed within the project area. The list of species provided by the local land owners are indicated by an Asterix (*****).

During the field surveys, a Leopard Tortoise (*Stigmochelys pardalis*) was sighted in the study area (**Figure 43**). Its habitat varies from montane grassland, fynbos, valley bushveld as well as arid and mesic savanna (Branch, 1988). The main potential impact of the proposed development on reptile species is probable to be habitat loss or degradation. Nevertheless, in the long-term, effects on reptile species are probable to be comparatively low as the extent of habitat loss would be low. Habitat destruction should be limited to the absolute minimum throughout the survey area.

Figure 42. A Leopard Tortoise recorded along the railway line route

Table 13. Reptile species recorded within the project area.

Genus	Species	Subspecies	Common name
Lamprophis	*capensis*		Brown House Snake*
Acanthocercus	*atricollis*		Southern Tree Agama (**Figure 34**)
Stigmochelis	*pardalis*		Leopard Tortoise
Lygodactylus	*capensis*	*capensis*	Common Dwarf Gecko
Dispholidus	*typus*		Boomslang
Thelotornis	*capensis*		Vine Snake
Dendroaspis	*polylepis*		Black Mamba*
Lygodactylus	*capensis*		Cape Dwarf Gecko
Pedioplanis	*lineoocellata*		Spotted Sand Lizard
Dasypeltis	*scabra*		Rhombic Egg-eater
Pedioplanis	*pulchella*		Common Sand Lizard
Gerrhosaurus	*flavigularis*		Yellow-throated Plated Lizard
Varanus	*niloticus*		Nile monitor*
Kinixys spekii	*spekii*		Speke's Hinged Tortoise*
Bitis	*arietans*	*arietans*	Puff Adder*
Python	*natalensis*		Southern African Python*
Psammophylax	*tritaeniatus*		Striped grass snake*
Telescopus	*semivariegatus*		Eastern Tiger Snake*
Naja	*mossambica*		Mozambique Spitting Cobra*
Naja	*annulifera*		Snouted Cobra*
Pseudaspis	*cana*		Mole snake

Figure 43. Southern Tree Agama recorded along the railway line route

10.2.3.3 Protected Species

These are indigenous species of high conservation value or national importance that require protection. Reptile species such as Southern African Python (*Python natalensis*) are known to occur in abundance, especially in the northern parts of the project area. This species is found in moist, rocky, well-wooded valleys, plantations or bush country, but seldom if ever stray far from permanent water (Broadley (1990). This species is listed as a *Protected Species* in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Threatened or Protected Species regulations. In order to protect Southern African Python on site, should this species be encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity. This remedial action requires the engagement of a herpetologist and or ecologist to oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). However, if this species if found during winter period, when it is in hibernation, then a permit from LEDET would be required in order to catch and release it to a safer environment.

10.2.4 Amphibians

Amphibians are an essential part of South Africa's exceptional biodiversity and are such worthy of both research and conservation effort. This is furthermore made relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but is still poorly understood (Wyman, 1990 & Wake, 1991). This decline seems to have worsened over the past years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data. Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried, 1989) and are worthy of both research and conservation effort.

10.2.4.1 Desktop survey results

Frogs and tadpoles are good species indicator on water quality, because they have permeable, exposed skins that readily absorb toxic substances. Tadpoles are aquatic and greatly exposed to aquatic pollutants (Blaustein, 2003). The presence of amphibians is also generally regarded as an indication of intact ecological functionality and therefore construction activities within these habitat units should be undertaken in an ecologically-sensitive manner.

According to Frog Atlas of Southern Africa (ADU, 2018), the Giant Bullfrog (*Pyxicephalus adspersus*) and African Bullfrog (*Pyxicephalus edulis*) are the only frog species of conservation concern which could potentially be found along the proposed development routes. It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez, 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*. 2004) to Least Concern in South Africa. The Giant Bullfrog has been chosen as a flagship species for the grassland eco-region (Cook, 2007).

10.2.4.2 Field work results

The Rivers (Crocodile, Matlabas, Bierspruit and Sand) (**Figure 45**) and associated riparian zones along the project area hold water on a permanent and temporary basis and are probably important breeding habitat for most of the frog species which occur at the study site. Only Six frog species were recorded along the study area (**Table 14**).

Figure 44. Watercourses along the project area

Table 14. Amphibian species recorded within the project area.

Genus	Species	Common name
Xenopus	*laevis*	Common Platanna
Amietophrynus	*gutturalis*	Guttural Toad
Breviceps	*adspersus*	Bushveld Rain Frog
Kassina	*senegalensis*	Bubbling Kassina
Bufo	*poweri*	Western Olive Toad
Cacosternum	*boettgeri*	Common Caco

10.2.4.3 Habitat requirements for Red Data amphibian species

The Giant Bullfrog (*Pyxicephelus adspersus*) is known to breed in seasonal shallow grassy pans, vleis and other rain filled depressions in open flat areas of grassland or savanna (Du Preez and Carruthers, 2009). Species such as African Bullfrog (*Pyxicephalus edulis*) is found in shallow temporary pans and marshy areas in open savanna woodland (du Preez and Carruthers, 2009). These habitat units are present within the project area. These species are, however, listed as a *Protected Species* in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Threatened or Protected Species regulations and therefore any impacts on a specimen of these species or that may negatively affect the survival of the species would require a permit. The conservation of the Bullfrogs and of amphibians in general will be met by the protected area network as well as the designation of priority habitats, *i.e.* pans or quaternary catchments, with associated restrictions on land use.

10.2.5 Invertebrates

Baboon spider species belonging to the genus *Ceratogyrus* has a particular presence in the Limpopo province. A brief desktop appraisal provided species list of the invertebrates known to occur in the region, recorded in grid cells 2327CB, 2327CD, 2427AB, 2427AC, 2427AD and 2427CB. Recorded individuals include:

- Green lynx spiders (*Peucetia* sp.)'
- Garden orb-web spiders (*Argiope* sp.)'
- Horned baboon spider (*Ceratogyrus darlingi*) and
- Golden brown baboon spider (*Idiothele nigrofulva*).

After searching no burrows were identified, although it should be noted that these species are notoriously difficult to detect. Many species of baboon spiders live in burrows in open ground. The burrows can be easily recognised by their round entrance and silk lining. Horned Baboon Spiders (*Ceratogyrus* spp – All species) are listed in the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of lists of Critically Endangered, Endangered, Vulnerable and **Protected species** and also under Schedule 10 (Invertebrates to which section 61(1)(a) AND (b) applies. It is therefore suggested that during the walk down survey, if any of these are found, a permit from LEDET will be required before relocation can take place. The Contractor must ensure that no baboon spiders are illegally collected or intentionally destroyed throughout all stages of the project. Care should be taken when removing stumps, logs or rock material and any scorpions encountered on the site should be left alone and allowed free access away from the activity or safely removed from the area.

11 TERRSTRIAL ECOLOGICAL SENSITIVITY ANALYSIS

The ecological function describes the intactness of the structure and function of the vegetation communities which in turn support faunal communities. It also refers to the degree of ecological connectivity between the identified vegetation communities and other systems within the landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

High – Sensitive vegetation communities with either low inherent resistance or resilience towards disturbance factors or vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.

Medium – Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems.

Low – Degraded and highly disturbed vegetation with little ecological function.

The sensitivity map (**Figure 46**) was based on the following criteria:

- CBA 1 and 2 (High);
- Pans (High);
- Bat cave (High);
- ESA 1 and 2 (Medium);
- Plant species of conservation concern (Medium);
- ONR (Low);
- NNR (Very Low);

An ecological field assessment was carried out to determine the most sensitive areas within the project area. All the areas denoted as *high* must be taken into account when the final layout is designed or final route is selected. The natural and near natural areas on site contain plants and animal species of conservation concern and it is advisable that the infrastructure development should be placed in areas which are already disturbed or with no natural habitat remaining (shown in Brown colour).

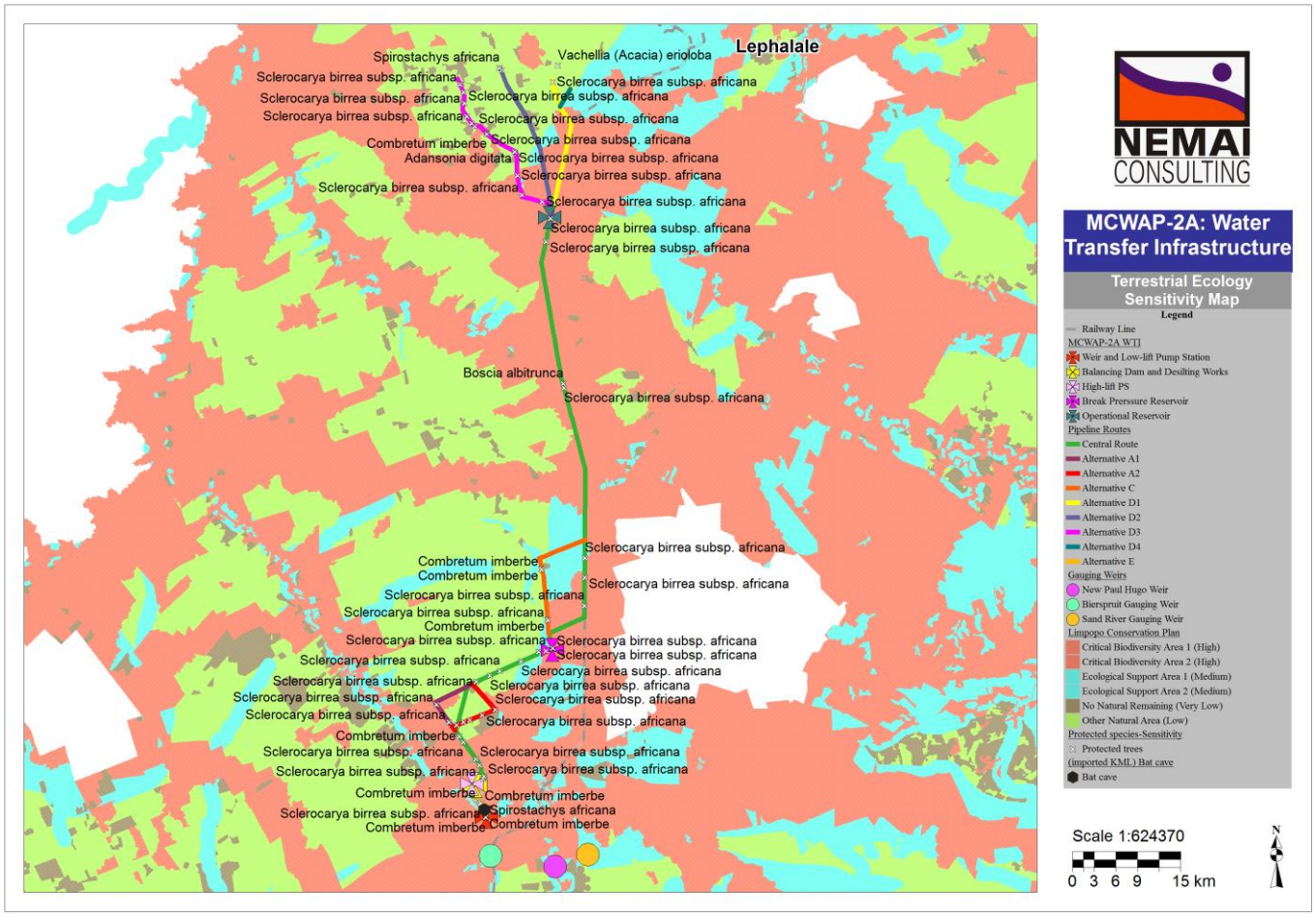

Figure 45. Terrestrial ecological sensitivity map of the study area

12 ENVIRONMENTAL IMPACT ASSESSMENT

12.1 Methodology

All impacts are analysed in the section to follow (**Table 15**) with regard to their nature, extent, magnitude, duration, probability and significance. The following definitions apply:

Nature (Status)
The project could have a positive, negative or neutral impact on the environment.

Extent

- Local – extend to the site and its immediate surroundings.
- Regional – impact on the region but within the province.
- National – impact on an interprovincial scale.
- International – impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.

- Low – natural and social functions and processes are not affected or minimally affected.
- Medium – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.
- High – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration

- Short term – 0-5 years.
- Medium term – 5-11 years.
- Long term – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- Permanent – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability

- Almost certain – the event is expected to occur in most circumstances.
- Likely – the event will probably occur in most circumstances.
- Moderate – the event should occur at some time.
- Unlikely – the event could occur at some time.
- Rare/Remote – the event may occur only in exceptional circumstances.

Significance

Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-

- 0 – Impact will not affect the environment. No mitigation necessary.
- 1 – No impact after mitigation.
- 2 – Residual impact after mitigation.
- 3 – Impact cannot be mitigated.

12.2 Assessment of Environmental Impacts and Suggested Mitigation Measures

Only the environmental issues identified during the appraisal of the receiving environment and potential impacts are assessed (**Table 15**). Mitigation measures are provided to prevent (first priority), reduce or remediate adverse environmental impacts.

Table 15. Proposed impacts and the recommended mitigation measures for the proposed MCWAP-2A: Water Transfer Infrastructure

FLORA AND FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Loss of plant species of conservation concern			• Permits from DAFF and LEDET are required before construction commences in order to cut, disturb, destroy or remove the several protected trees noted within the project area. • It is recommended that search, rescue and relocation be conducted taking into consideration red data, protected and endangered flora and fauna species. For flora species, the following factors need to be considered (amongst others) as part of this plan: ○ Detailed plan of action (including timeframes, methodology and costs); ○ Site investigations; ○ Consultation with authorities and stakeholders; ○ Marking of species to be relocated; ○ Applying for permits; ○ Identification of suitable areas for relocation; ○ Aftercare; and ○ Monitoring (including targets and indicators to measure success).			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Regional	High	Short-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Regional	Low	Short-term	Likely	1

FAUNA PRE & CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Loss of *Protected species* listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Threatened or Protected Species regulations			• In order to protect Southern African Python on or around the site, should this species be encountered or exposed during the construction phase, it should be removed and relocated to natural areas in the vicinity. This remedial action requires the engagement of a herpetologist and or ecologist to oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). However, if this species if found during winter period, when it is in hibernation, then a permit from LEDET would be required in order to catch and release it to a safer environment. • The desktop study shows that spider species such as *Ceratogyrus darlingi* are expected to occur in the area, and it is therefore suggested that during the walk down survey, if any of these are found, a permit from LEDET will be required before relocation can take place.			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Regional	High	Short-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Regional	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Destruction of indigenous flora during site establishment		• Clearly demarcate the construction servitude prior. • Vegetation clearing should be kept to a minimum (restricted to construction servitude), and this should only occur where it is absolutely necessary. • Rehabilitate all disturbed areas as soon as the construction is completed on the proposed development sites. • Ensure that all personnel have the appropriate level of environmental awareness and competence. • Vehicles and construction workers should under no circumstances be allowed outside the construction servitude to prevent impact on the surrounding vegetation. • Prevent contamination of natural areas. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site. • Proliferation of alien and invasive species is expected within the disturbed areas and they should be eradicated and controlled to prevent further spread. • No storage of any construction material on sensitive areas. • Avoid translocating stockpiles of topsoil from one place to sensitive areas in order to avoid translocating soil seed banks of alien species. • Disturbance of vegetation must be limited to the servitude area acquired for the project.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Short-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss and displacement of animals on site.		• If any herpetological species be encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity. This remedial action requires the employment of a herpetologist and or ecologist to oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). • Training of construction workers to recognise threatened animal species will reduce the probability of fauna being harmed unnecessarily. • The contractor must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase. • No trapping or any other method of catching of any animal or bird may be performed on site • Vehicles must adhere to a speed limit, 30-40 km/h is recommended for light vehicles and a lower speed for heavy vehicles. • All construction and maintenance vehicles must stick to properly demarcated and prepared roads. Off-road driving should be strictly prohibited. • No fires should be allowed at the site • No dogs or other domestic pets should be allowed at the site. • Any fauna (mammal and reptile) that becomes trapped in the trenches or in any construction or operational related activity may not be harmed and must be placed rescued and relocated by an experienced person.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Short-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss of vegetation due to fuel and chemical spills.		• Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person. • Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. • Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Short-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Management of alien invasive species.		• Control of alien invasive species and noxious weeds for areas disturbed by the construction activities, in accordance with the requirements of the NEM:BA Alien and Invasive Species Regulations. Eradication method to be approved by the Project Manager. • To prevent unnecessary alien plant infestations, an alien plant monitoring and eradication programme needs to be in place, at least until the disturbed areas have recovered and properly stabilised. • Promote awareness of all personnel.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss of topsoil and erosion.		• During site preparation, topsoil and subsoil are to be stripped separately from each other and must be stored separately from spoil material for use in the rehabilitation phase. It should be protected from wind and rain, as well as contamination from diesel, concrete or wastewater. • An ecologically-sound storm water management plan must be implemented during construction and appropriate water diversion systems put in place.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA AND FAUNA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss of CBA and ESA habitats		• The most significant way to mitigate the loss of habitat is to limit the construction footprint within the natural habitat areas remaining. Disturbance of vegetation must be limited to the servitude area acquired for the project. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site. • Vehicles and construction workers should under no circumstances be allowed outside the site boundaries to prevent impact on the surrounding vegetation. • All stockpiles, construction vehicles, equipment and machinery should only be situated within the servitudes acquired for the project. • Prevent contamination of natural areas. • No structures should be built outside the area demarcated for the development. • Although it is unavoidable that sections of the project infrastructure development will need to traverse areas of potential high sensitivity, the clearing of vegetation must be limited to the servitude area acquired for the project. • Where possible, linear infrastructure proposed as part of the development should be aligned with existing infrastructure or routed through already transformed/degraded areas.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Regional	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Regional	Low	Short-term	Likely	1

FLORA AND FAUNA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Damage to plant and animal life outside of the project area	• Any fauna (mammal, reptile and amphibian) that becomes trapped in the trenches or in any construction or operational related activity may not be harmed and must be rescued and relocated by an experienced person. • Proliferation of alien and invasive species is expected within the disturbed areas and they should be eradicated and controlled to prevent further spread. • No unauthorised vehicles should be allowed to drive through the site during the construction activities. • No trapping or any other method of catching of any animal may be performed on site. • Illegal hunting is prohibited. • No dumping of any form is permitted. • No damage and/or removal/trapping/snaring of indigenous plant or animal material for cooking and other purposes will be allowed. • All areas affected by construction should be rehabilitated upon completion of the construction phase of the development to its pre-construction state where possible, in agreement with the ECO. • Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by Environmental Control Officer (ECO). • Natural areas which could be deemed as no go should be clearly marked.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Disturbance and displacement to bat species	• No damage to the caves due to construction activities • Determine the risk to the bat cave (subterranean chambers) in Mooivallei area based on outcomes of the geotechnical investigations.* • Shift the low pressure pipeline within the 100m that was assessed to avoid the bat cave as much as possible. • Bat species residing within the Mooivallei area (cave) shall not be unnecessarily disturbed, which includes their unhindered access to be cave. • Caution should be taken to ensure construction footprints are kept to an absolute minimum, including storage of materials, stockpiling etc. • Toolbox talks should be provided to contractors regarding disturbance to bats.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Likely	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Unlikely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Disturbance to animals	• Animals residing within the designated area shall not be unnecessarily disturbed. • During construction, refresher training can be conducted to construction workers with regards to littering and poaching. • The Contractor and his/her employees shall not bring any domestic animals onto site. • Toolbox talks should be provided to contractors regarding disturbance to animals. Particular emphasis should be placed on talks regarding snakes.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION/POST CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Rehabilitation of site after construction.	• Bare surfaces should be grassed as soon as possible after construction to minimise time of exposure. Locally occurring, indigenous grasses should be used. • The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertilizer 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 locally indigenous vegetation is to be used for rehabilitation. • All waste generated by the construction activities will be stored in a temporary demarcated storage area, prior to disposal thereof at a licensed registered landfill site. • All areas affected by construction should be rehabilitated upon completion of the construction phase of the development to its pre-construction state where possible, in agreement with the ECO					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA OPERATIONAL PHASE						
Potential Impact		Mitigation				
Disturbance of faunal species		• The disturbance of fauna should be minimized. • Maintain proper access control for the servitude. • Ensure that the Ecological Reserve is released from the abstraction point to cater for downstream sensitive faunal species (including crocodiles, Greater Painted-snipe, Yellow-billed Stork and Black Stork).				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

12.3 Cumulative Impacts

Cumulative impacts can be identified by combining the potential environmental implications of the proposed project with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area. The following cumulative impacts are anticipated:

- Loss of CBAs and ESAs;
- Encroachment of alien vegetation and
- Loss of plant species of conservation concern and protected trees.

Cumulative Impacts						
Potential Impact:	Loss of CBAs and ESAs					
Proposed Mitigation:	• Where possible, natural vegetation must not be cleared and encouraged to grow. • Disturbance of vegetation must be limited to the servitude area acquired for the project. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site. • Vehicles and construction workers should under no circumstances be allowed outside the site boundaries to prevent impact on the surrounding vegetation. • All stockpiles, construction vehicles, equipment and machinery should only be situated within the servitudes acquired for the project. • Indigenous plants naturally growing within the project area, but that would be otherwise destroyed during clearing for development purposes should be incorporated into the rehabilitation programme. • The most significant way to mitigate the loss of habitat is to limit the footprint within the natural habitat areas remaining. • No structures should be built outside the area demarcated for the development. • Although it is unavoidable that sections of the project infrastructure development will need to traverse areas of potential high sensitivity, the clearing of vegetation must be limited to the servitude area acquired for the project. • Where possible, linear infrastructure development should be aligned adjacent to the existing infrastructure or routed through already transformed/degraded areas.					
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Without Mitigation	-	Local	Medium	Long Term	Likely	2
With Mitigation	-	Local	Low	Long Term	Unlikely	1
Potential Impact:	Encroachment of alien vegetation					
Proposed Mitigation:	• Control of alien invasive species and noxious weeds for areas disturbed by the construction activities, in accordance with the requirements of the NEM:BA Alien and Invasive Species Regulations. Eradication method to be approved by the Project Manager. • To prevent unnecessary alien plant infestations, an alien plant monitoring and eradication programme needs to be in place, at least until the disturbed areas have recovered and properly stabilised. • Promote awareness of all personnel.					
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Without Mitigation	-	Local	Medium	Short	Moderate	2
With Mitigation	-	Local	Low	Short	Unlikely	1
Potential Impact:	Loss of plant protected trees.					
Proposed Mitigation:	• Permits from DAFF and LEDET are required before construction commences in order to cut, disturb, destroy or remove the several protected trees noted within the project area.					
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Without Mitigation	-	Local	Medium	Short	Likely	2
With Mitigation	-	Local	Low	Short	Unlikely	1

13 ANALYSIS OF ALTERNATIVES

Based on the terrestrial ecological sensitivity map and analysis, the proposed route alternatives were compared to identify the route with the least impacts from a terrestrial ecological point of view (**Table 16**).

Table 16. Comparative of route alternatives

Project Component	Preferred Option	Motivation
Central Route	✓	This route follows the existing ESKOM's powerlines servitude in the Farm Paarl 124KQ, with existing disturbance.
Route A1	**X**	About 4km of this route follows the gravel road (even though for almost 2.8km of it falls within the CBA1).
Route A2	**X**	For about 6km, this route follows the existing gravel road
Route C	✓	This route follows the R510 main road. Most sections of this route falls within CBA 2, ESA 1, ESA 2 and Other Natural Area. Only less than 1% falls within the sensitive CBA 1 region.
Route D3	✓	This route mainly follows the existing gravel road and with No Natural Remaining. In areas denoted as CBA 1, mitigation measures mentioned in this report must be followed in order to minimise the negative impacts. The pipeline should be aligned along the fence boundary, which is mostly cleared.
Route D2	**X**	Most sections of this route falls within the natural vegetation (Other Natural Areas).
Route D1	**X**	For about 13km, this route follows the existing railway line (even though denoted as CBA 2) and for about 4km, the route falls within the area denoted as Other Natural Areas. This route passes through two pans.
Route D4	**X**	For about 13km, this route follows the existing railway line (even though denoted as CBA 2) and for about 4km, the route falls within the area denoted as Other Natural Areas.
Route E	✓	Sections of this route follow the farm roads and traverses agricultural areas in Mooivallei Farms. This route is situated on the southern side of the Bat cave (almost 70m).

14 CONCLUSION AND RECOMMENDATIONS

The proposed MCWAP-2A WTI falls within the within the Savanna biome. However, a very small section of Central Route, Alternative E, Balancing Dams and Desilting Works fall within an Azonal vegetation. The Savanna Biome is the largest Biome in South Africa and occupies over one third of the whole area. It is characterized by a grassy ground layer and distinct upper layer of woody plants. The study area is classified as falling within the following vegetation types: Subtropical Alluvial Vegetation (Azonal vegetation), Dwaalboom Thornveld (Savanna biome), Western Sandy Bushveld (Savanna biome), Waterberg Mountain Bushveld (Savanna biome) and Limpopo Sweet Bushveld (Savanna biome). The greater part of the Central Route and the entire Alternative C fall within the Western Sandy Bushveld. Alternative routes A1 and A2 fall within the Dwaalboom Thornveld. Only sections of Alternative route E traverse the Subtropical Alluvial Vegetation. Balancing Dams, Desilting Works and Low-lift Pump Station fall within the Waterberg Mountain Bushveld.

During the field survey, no threatened plant species were observed within the project area; however, only one (1) species of conservation concern (Orange Listed Plants) (listed as *Declining)* was found, namely *Vachellia erioloba (=Acacia erioloba)* (known as Camel Thorn). These plant species were recorded along the Central, A2 and D2 routes.

In terms of the National Forests Act (Act No. 84 of 1998), certain tree species can be identified and declared as protected. Protected trees occurring in the study area are *Vachellia (Acacia) erioloba* (Camel Thorn), *Adansonia digitata* (Baobab)*, Boscia albitrunca* (Shepherd's tree)*, Combretum imberbe* (Leadwood) and *Sclerocarya birrea* subsp*. africana* (Marula)*.* According to a part of section 51(1) of the National Forests Act (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 of DAFF. There is only one plant species which falls within "*protected plants*" in terms of LEMA (Act No. 7 of 2003) Schedule 12, namely *Spirostachys africana* (Tamboti). A permit from the Limpopo Department of Economic Development, Environment and Tourism (LEDET) is required before construction commences in order to cut, disturb, destroy or remove these trees noted within the project area.

The major concerns on site are alien invasives, weeds and potential invasives. All areas affected by construction should be rehabilitated upon completion of the construction phase of the development to its pre-construction state where possible, in agreement with the ECO. Mitigation measures provided will ensure that any available ecological linkages between sensitive areas are not affected negatively. Mitigation measures included within this report are feasible and will be easy to achieve. Several of the mitigation measures included here have been implemented successfully on several different construction sites.

The greater area was historically commonly used for cattle grazing. Game farms are now more common, with an associated high faunal biodiversity. Local occurrences of mammal species are more closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. The riverine areas and ridges in the area are regarded as significant in terms of the habitat that they provide to fauna. Riparian zones also serve as important corridors to allow for animal migration. The bats recorded from the caves situated in the Mooivallei area are reported to be *Rhinolophus darlingi* and *Miniopterus schreibersii.* According to Jacobs *et al*. (2016), *Rhinolophus darling* is now classified as '*Least Concern'* whereas *Miniopterus schreibersii* is no longer listed. According to Macewan *et al.* (2016), *M. schreibersii* assessment is not included for the region because it previously included *M. natalensis* (Least Concern) (which was considered a subspecies but is not listed on its own) (Dr Harriet Davies-Mostert pers.comm, June 2018). However, Chapter 10 of the Limpopo Environmental Management Act (LEMA) (Act No. 7 of 2003) deals with preservation of caves and caves-formation and according to Section 70 (2 a):

> "*No person may deposit, dump or drain and refuse, waste, substance or thing, whether solid, liquid, gaseous or explosive, into a cave or near a cave or near a cave entrance, or cause or allow it to enter or percolate into a cave*"

It is recommended that a blasting expert and geologist also assess the potential impact of blasting on the cave. The geotechnical investigations need to be taken into consideration during the design phase and the line can be shifted within the 100m corridor in order to avoid the cave and also to minimize impacts.

The proposed route should preferably follow existing roads and railways. This will have a minimal effect on the natural vegetation on the study routes. The banks of the Crocodile River where the weir will be constructed are steep with reeds that grow in most areas followed by riparian vegetation that varies in density from place to place and three of the Red Data species will be directly affected by the availability of water downstream from the proposed weir in the Crocodile River, namely Greater Painted-snipe, Yellow-billed Stork and Black Stork. It is therefore recommend that the abstraction of water from the river must therefore ensure that enough water is released for the ecological Reserve to ensure the continued existence of these bird species.

The main potential impact of the proposed development on reptile species is probable to be habitat loss or degradation. Nevertheless, in the long-term, effects on reptile species are probable to be comparatively low as the extent of habitat loss would be low. Habitat destruction should be limited to the absolute minimum throughout the survey area. In order to protect Southern African Python on site, should this species be encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity. This remedial action requires the engagement of a herpetologist and or ecologist to oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). However, if this species

if found during winter period, when it is in hibernation, then a permit from LEDET would be required in order to catch and release it to a safer environment

Some sections within the project area offer suitable habitat for Giant Bullfrog and African Bullfrog to occur in the study area. The conservation of these species and of any amphibians in general will be met by the protected area network as well as the designation of priority habitats *i.e.,* pans or quaternary catchments, with associated restrictions on land use.

An attractive feature of the Central route as the preferred option is that for the most it follows public amenities (powerlines, roads and the railway line), which would avoid interference during the construction and operational phases with ecotourism activities on private properties. The Central route incorporates habitat units that would support a variety of both faunal and floral species biodiversity to a greater or lesser extent and the impacts on biodiversity and habitat conservation can be successfully mitigated with the sincere efforts of the contractor and construction teams. Pipelines do not result in large-scale clearing and suitable mitigation measures can be implemented to reduce the identified impacts.

Biodiversity offsets are not deemed to be necessary, however, it is recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Red Data Listed species and also to propose mitigation measures to limit the impacts imposed by the proposed development activities on site. The walk-down survey should preferably be undertaken during summer season in order to have a higher probability of detecting species of special concern. This is relevant in the areas that have been labelled as ecologically sensitive. In order to conserve the faunal species community structures within the region, habitat destruction should be limited to an absolute minimum as intact habitat would result in higher faunal and floral species diversity. It is therefore critical that operations are limited to the required footprint only. It is recommended that the larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes.

During the field surveys, it was found that the Central pipeline route either runs on or along servitudes of tar roads, gravel roads, farm roads, railway lines, or power lines and most of the areas directly linked to these servitudes are disturbed to a certain degree. It was therefore found that the proposed pipeline will not have a significant impact on the flora and fauna in the area, given that the servitude width be kept to a minimum and that the mitigation measures proposed above be implemented. After the conclusion of this Terrestrial Ecological Assessment, it is the opinion of the ecologist that the proposed development be considered favourably provided that the sensitivity map be considered during the planning and construction phases of the proposed development activities to aid in the conservation of ecology within the study area. Once the proposed development has been constructed, rehabilitation process needs to take place and should ensure that alien plant emergence and erosion do not occur.

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