FLORAL, FAUNAL, WETLAND AND AQUATIC ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED CONSTRUCTION OF A FERROCHROME SMELTER NEAR NORTHAM, LIMPOPO PROVINCE

Prepared for

SLR Consulting (Africa) (Pty) Ltd.

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Executive and Management Summaries

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Declaration

This report has been prepared according to the requirements of Section 23 (5) of the Environmental Impact Assessments EIA Regulations, 2014 (No. R.982). I (the undersigned) declare the findings of this report free from influence or prejudice.

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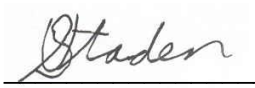

Stephen van Staden

Date: 12/08/2016

EXECUTIVE SUMMARY

Based on the findings of the ecological assessment it may be concluded, that from an ecological point of view, the proposed project, which is to include the development of a smelter within the western portion of Portion 3 of the farm Grootkuil 409 KQ, as well as a powerline and one access road, will not have a highly significant impact on ecological resources in the area, provided that all mitigation and management measures as outlined in this report be adhered to, with specific reference to maintaining the Present Ecological State (PES) and ecological functioning of the delineated wetland and riparian resources and the associated buffer zones.

Due to the proposed project infrastructure being located almost in its entirety within already transformed habitat, the proposed smelter, access road and powerline infrastructure are unlikely to impact significantly on floral and faunal habitat and species diversity. A number of protected *Vachellia erioloba* (Camel thorn) trees, which are abundant within the eastern portion of the study area and surrounding region, are however located within the proposed powerline alignment and permits have to be obtained in order to destroy or remove these species. In terms of faunal ecology, the proposed project may lead to the localised loss of habitat for avifaunal Species of Conservation Concern (SCC), due to identified avifaunal SCC utilising the cultivated fields within the proposed project infrastructure area for foraging purposes. Suitable foraging habitat is however available within adjacent properties and the proposed project will not lead to the direct loss of faunal SCC in the region.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, wetland and aquatic ecological assessment as part of the environmental assessment and authorisation process for the proposed construction of a new ferrochrome (FeCr) Smelter located immediately adjacent to the existing Union Section Mine on Portion 3 of the farm Grootkuil 409 KQ, in the Thabazimbi Local Municipality, Limpopo Province. The proposed Siyanda ferrochrome smelter (hereafter referred to as the 'Project Infrastructure Area'), which will in broad terms comprise a railway siding, a raw materials offloading area, two 70 MW DC furnaces, crushing and screening plant, slag dump and baghouse slurry dam, as well as related facilities such as material stockpiles, workshops, stores and various support infrastructure and services, is located within the western portion of Portion 3 of the farm Grootkuil 409 KQ. In addition, an overhead powerline as well as one access road is proposed, with two access road alternatives, namely Access Road Corridor Option 2 and Access Road Option 3, being considered for development. The proposed powerline will originate from the Spitzkop substation to the southeast of Portion 3 of the farm Grootkuil 409 KQ, run north towards the southeastern corner of Portion 3 of the farm Grootkuil 409 KQ and from there extend along the southern boundary of the property towards the Project Infrastructure Area. The proposed Project Infrastructure Area, together with the proposed powerline and the two access road alternatives, of which only one will be developed, are hereafter referred to as the 'project site' (Figures 1 & 2). As part of the ecological assessment, the remainder of Portion 3 of the farm Grootkuil 409 KQ was also assessed, and, together with the project site, is hereafter referred to as the 'study area'.

The Project Infrastructure Area is situated approximately 10km to the west of the R510 regional road and 8km to the northwest of the town of Northam, and approximately 1,5km to the south of the Brits Road. The Swartklip Mine Village (developed as part of the Union Section Mine) is located immediately to the southwest of the Project Infrastructure Area.

The study area is surrounded by properties in which agricultural and mining activities, as well as rural development dominate, leaving the surrounding areas largely transformed. The ecological assessment was therefore confined to the study are and its immediate surrounds and did not include an ecological assessment of the broader surrounding area. The broader surrounding area was

however considered as part of the desktop assessment of the area including searches undertaken on national and provincial databases.

The terrestrial and wetland field assessments took place during the wet season in April 2015 (Autumn/ Late Summer) and during the dry season in August 2015 (Late Winter), with additional assessments for the Access Road Corridor Option 2 and Access Road Option 3 taking place in December 2015 and July 2016 respectively, while the aquatic baseline assessment took place during April 2015.

Specific outcomes required from this report include the following:

Terrestrial (floral and faunal assessment)

- To conduct a desktop study to gain background information on the physical habitat and potential floral and faunal biodiversity associated with the study area;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the study area and the implementation of a Species of Conservation Concern Sensitivity Index Score (SCCSIS) for the study area;
- To provide inventories of floral and faunal species as encountered within the study area;
- To determine and describe habitat types, communities and the ecological state of the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To describe the spatial significance of the project site with regards to surrounding natural areas; and
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features.

Wetland assessment

- To conduct a desktop study and provide background information pertaining to the various wetlands and riparian features associated with the study area in terms of the National Freshwater Ecosystem Priority Areas (NFEPA) and other relevant databases;
- To identify and characterise Hydrogeomorphic (HGM) Units according to the Classification System for Wetlands and Other Aquatic Ecosystems in South Africa;
- To delineate all wetlands and riparian areas occurring within the study area;
- To define the Present Ecological State (PES) of the HGM Units within the study area through the application of the wetland Index of Habitat Integrity (IHI) and/ or Wet-Health methods of assessment;
- To determine the functioning and the environmental and socio-cultural services that each HGM Unit provide;
- To determine the Ecological Importance and Sensitivity (EIS) of the wetlands and riparian features;
- To advocate a Recommended Ecological Category (REC) for each HGM Unit;
- To determine the environmental impacts of the proposed development activity on the terrestrial, and aquatic resources within the study area; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving aquatic environment.

Aquatic Assessment

- To define the PES and EIS of the aquatic resources and aquatic ecosystems in the vicinity of the study area;
- To monitor spatial and temporal trends in aquatic resource integrity in the vicinity of the study area;
- To define the aquatic habitat conditions prevalent in the area as well as natural constraints posed to the systems along with anthropogenic impacts on these systems;
- To report any emerging issues;
- To develop a database of biological integrity for streams in the region;
- To define the impacts envisaged as part of the proposed development activities on the aquatic resources; and
- To define the required management, mitigation and monitoring measures required in order to minimise the impact of the proposed development on the receiving aquatic environment.

The sections below summarise the key findings of each aspect of the ecological assessment undertaken.

Floral assessment

Background Assessment

- According to the National List of Threatened Terrestrial Ecosystems (2011) the study area does not fall within a threatened ecosystem;
- According to the National Biodiversity Assessment (NBA; 2011), the study area is not located within a formally or informally protected area and falls within an area classified as poorly protected;
- According to the National Protected Area Expansion Strategy (NPAES; 2008) database, the study area is not located within an area as a NPAES focus area;
- According to the Limpopo Conservation Plan version 2 (2013):
  - The Project Infrastructure Area including the proposed infrastructure layout falls within an area identified as having No Natural Habitat Remaining (NNR). The southeastern portion of the Proposed Infrastructure Area, outside of the proposed infrastructure layout, however falls within an Other Natural Area (ONA). The remainder of Portion 3 of the farm Grootkuil 409 KQ comprises areas identified as an ONA, a small portion identified as an Ecological Support Area 1 (ESA1) and an area identified as NNR within the western portion. The central and eastern portions of the study area is located within a Critical Biodiversity Area 2 (CBA2);
  - The eastern portion of the proposed powerline is located largely within an area indicated to be a CBA2, and the western portion thereof traverses areas indicated as an NNRs and an ONA;
  - The preferred access road, namely Access Road Corridor Option 2, is located within an NNR and an ONA; and
  - The alternative access road alignment, namely Access Road Option 3, is located on the boundary between an NNR and an ONA, with the northern portion situated within an area indicated to be a CBA2.
- The study area is located within the Savanna Biome, the Central Bushveld Bioregion and within the Dwaalboom Thornveld vegetation type (Mucina & Rutherford, 2006), which is considered to be Least Threatened.

Field Assessment

Habitat Units

- Four broad habitat units were identified within the study area namely the Transformed Habitat Unit, Secondary Bushveld Habitat Unit, the Bushveld Habitat Unit and the Wetland/ Riparian Habitat Unit;
- The Project Infrastructure Area, including the proposed infrastructure layout, is located within the Transformed Habitat Unit with the southeastern portion thereof located within the Mixed Bushveld, Wetland/ Riparian and Secondary Bushveld Habitat Units. The remainder of Portion 3 of the farm Grootkuil 409 KQ comprises all the habitat units identified to varying extent. The proposed powerline also traverses all the habitat units identified. The preferred access road, namely Access Road Corridor Option 2, is located within the Transformed and Mixed Bushveld Habitat Units and the alternative access road alignment, namely Access Road Option 3, is located within the Transformed and Secondary Bushveld Habitat Units;
- The Bushveld Habitat Unit is in a mostly natural condition. The most significant impact currently on the Bushveld Habitat Unit is grazing by livestock, which has particularly impacted on the graminoid layer. Due to differences in soil types and local topography within the study area, which contributes towards determining species composition, four sub-Habitat Units have been identified within the Bushveld Habitat Unit, namely:
  - Sandy Thorn Bushveld. A high abundance of *Vachellia erioloba* (Camel thorn) trees is present within this habitat unit;
  - Plains (low-lying) Thorn Bushveld, which plays an importance role in flood control within the study area;
  - Turf Thorn Bushveld; and
  - Mixed Bushveld.

- The Wetland/ Riparian Habitat Unit is associated with various drainage lines traversing the study area, including a wetland feature within the west and two rivers, namely the Brakspruit River and its associated tributaries and the Phufane River, located centrally in Portion 3 of the farm Grootkuil 409 KQ. In addition, an ephemeral depression feature is present within the study area as well as several artificial, off-channel dams associated with the Phufane River;
- The Secondary Bushveld Habitat Unit include those areas that have been previously cultivated, but where vegetation has since re-established naturally to some degree;
- The Transformed Habitat Unit includes all areas within the study area that have been impacted by existing infrastructure development such as residential buildings, existing powerlines and access roads, as well as existing agricultural lands. No natural habitat is present within these areas;
- The various habitat units obtained the following Vegetation Index Scores (VIS) which define the integrity of the vegetation in each habitat unit:
  - Bushveld Habitat Unit: Class C (Moderately modified); and
  - Wetland/ Riparian Habitat Unit: Class C (Moderately modified);
  - Secondary Bushveld Habitat Unit: Class D (Largely modified); and
  - Transformed Habitat Unit: Class E (The loss of natural habitat extensive).

Floral SCC

- No national Red Data Listed (RDL) floral species are listed by the South African National Biodiversity Institute (SANBI) to occur in the 2427CC QDS. Two SANBI RDL floral species, listed as 'Declining', namely *Vachellia erioloba* (Camel thorn) and *Crinum macowanii*, were however encountered within the Bushveld and Wetland/ Riparian Habitat Unit respectively. No *V. erioloba* trees have been encountered within the proposed Project Infrastructure Area or within either of the proposed access road alternatives, but a number of these species have been encountered within the proposed powerline footprint area. No *C. macowanii* specimens were encountered within the project site, but do occur within the remainder of Portion 3 of the farm Grootkuil 409 KQ;
- Another SANBI RDL floral species that may be present within the study area but that was not observed during the field assessments, namely *Boophane disticha*, also listed as 'Declining', also has an increased probability of occurring within the study area;
- Due to the Project Infrastructure Area being located almost in its entirety within the Transformed Habitat Unit, no suitable habitat is available for *V. erioloba*, *C. macowanii* or *B. disticha* within the proposed project infrastructure layout area. Although not encountered during the field assessments, should *C. macowanii* or *B. disticha* however be observed within the proposed access road or powerline footprint areas, it is recommended that these species be relocated to similar suitable habitat in the vicinity of the study area, under the supervision of a qualified botanist. In addition, should any *V. erioloba* have been overlooked within these areas, permits should be obtained for the destruction or removal of such trees should it not be possible to avoid damage thereto;
- In addition to being listed as a floral SCC by SANBI, *V. erioloba* is protected under the National Forests Act (Act 84 of 1998). This species occurs throughout the Bushveld Habitat Unit but in higher abundance within the Sandy Thorn Bushveld Habitat Unit. All *V. erioloba* trees located along the 30m wide powerline servitude have been marked through the use of Global Positioning System (GPS). Ideally damage to or removal of these trees should be avoided, however if this is not possible, a permit for the destruction of individual specimens have to be obtained from the Department of Forestry and Fisheries (DAFF) prior to these species being removed. *Boscia albitrunca*, also protected under the National Forests Act (Act 84 of 1998) has also been encountered within the Bushveld Habitat Unit within Portion 3 of the farm Grootkuil 409 KQ, but was not recorded within the project site. Other protected species that may occur within the project site or the remainder of Portion 3 of the farm Grootkuil 409 KQ, due to suitable habitat being present within the Wetland/ Riparian and Bushveld Habitat Units include *Combretum imberbe* and *Sclerocarya birrea* subsp. *caffra*. These two species were however not encountered within the project site or Farm Grootkuil;
- The Limpopo Environmental Management Act (LEMA; Act 7 of 2004) provides for the protection of indigenous plants and lists provincially protected species under Schedules 11 and 12 of this Act. One species listed as protected under this Act, namely *Scadoxus puniceus* was encountered within the Bushveld Habitat Unit on Portion 3 of the farm Grootkuil 409 KQ during the general site assessment, outside of the project site;

- No floral species listed under Section 56 (1) d) of the Threatened Or Protected Species (TOPS) Regulations under the National Environmental Management: Biodiversity Act (NEMBA; Act 10 of 2004) were encountered in the study area;
- Due to the location of the proposed Project Infrastructure Area almost in its entirety within the Transformed Habitat Unit, it is highly unlikely that species protected under LEMA (Act 7 of 2003) or NEMBA (Act 10 of 2004) will be present within its development footprint and no such species were encountered within this area, or within the remainder of the project site. However, should any such species have been overlooked during the field assessment and be encountered within the proposed powerline alignment, unless these can be avoided, then authorisation to relocate such species must be obtained from the Limpopo Department of Economic Development, Environment and Tourism (LEDET) or the Department of Environmental Affairs (DEA) respectively;
- An overall low diversity of alien floral species occurs within the study area, with alien floral species having the highest abundance within the Transformed Habitat Unit. All categorised alien floral species falling within Category 1b should be prioritised for eradication; and
- Several medicinal species were noted during the field assessment. These medicinal species are mostly commonly occurring species and are not confined to the study area, although a number of floral SCC identified have medicinal value.

Floral Impact Assessment

Based on the floral impact assessment it is evident that there are a number of possible impacts on the floral ecology within the project site. From the assessment it was found that prior to management measures being put in place, the perceived floral impacts are of high or medium impact significance for the construction phase and of medium or low impact significance for the operational and decommissioning/ closure phases. All impacts may be mitigated to low and very low impacts provided that effective mitigation measures are put in place. Due to the destruction of some *V. erioloba* trees within the powerline footprint area being highly likely, this impact can only be mitigated to a medium significance level, however through avoidance measures the number of trees impacted could be limited to that which is absolutely necessary.

A summary of the results obtained from the assessment of floral ecological impacts.

CONSTRUCTION PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on floral habitat	M	L
2: Impact on floral diversity	M	L
3: Impact on floral SCC	H	M
OPERATIONAL PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on floral habitat	M	L
2: Impact on floral diversity	L	VL
3: Impact on floral SCC	L	VL
DECOMMISSIONING AND CLOSURE PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on floral habitat	L	VL
2: Impact on floral diversity	L	VL
3: Impact on floral SCC	L	VL

Faunal Assessment

Background Assessment

- The study area does not fall within an Important Bird and Biodiversity Area (IBA), but the Northern Turf Thornveld IBA is situated immediately to the north thereof. *Pterocles gutturalis* (Yellow-throated Sandgrouse) utilises the IBA area and this IBA represents one of the core remaining resident South African populations for this species. Other important avifaunal species also occurring in this IBA are *Falco biarmicus* (Lanner Falcon), *Glareola nordmanni* (Black-winged Pratincole), *Ardeotis kori* (Kori Bustard) and *Sagittarius serpentarius* (Secretary bird).

Field Assessment

- During the field assessment, a number of mammal species were observed either directly, by spoor and territorial markings or through the use of motion sensitive camera traps or sherman traps placed throughout the study area. No mammal RDL species or other faunal SCC were encountered during the field assessment and the likelihood of any such species being present within the study area is considered to be low, with the exception of *Felis lybica* (African Wild Cat), due to the increased level of anthropogenic activities and agricultural activity that is currently taking place throughout the project site, the remainder of Portion 3 of the farm Grootkuil 409 KQ and surrounding areas;
- The majority of avifaunal species observed were common species, with three avifaunal SCC listed as internationally, nationally or regionally threatened also observed within the boundaries of the study area. These species are *Polemaetus bellicosus* (Martial Eagle) which is listed by the International Union for the Conservation of Nature (IUCN) as Vulnerable, *Coracias garrulous, which* (European Roller), which is listed by the IUCN as Near Threatened and *Pteocles gutturalis* (Yellow-throated Sandgrouse), which is considered to be Near Threatened on a regional scale;
- The proposed smelter infrastructure and powerline alignment have been positioned in such a way as to minimise overall ecological impacts by placing infrastructure components mostly within the Transformed Habitat Unit. However, from an avifaunal perspective, the cultivated lands form the preferred habitat for two of the three avifaunal SCC encountered, namely *P. gutturalis* (Yellow-throated Sandgrouse) and *P. bellicosus* (Martial Eagle). In order to ensure sustained habitat for these two species within the vicinity of the project site, it is recommended that existing cultivated lands to the east of the Project Infrastructure Area remain under cultivation. If this is not feasible, existing cultivated fields in the surrounding region beyond the study area are expected to still support these species. The proposed project therefore will not lead to overall loss of avifaunal SCC habitat in the region, but may limit the occurrence of these species within the project site itself. These species will have to move into adjacent territories and an increase of competition for foraging habitat may occur;
- Other avifaunal SCC species that may be present within the project site and its immediate surroundings, either permanently or occasionally, are *Torgos tracheliotos* (Lappet-faced Vulture), *Gyps africanus* (White-backed Vulture), *G. coprotheres* (Cape Vulture), *Sagittarius serpentarius* (Secretary bird), *Falco biarmicus* (Lanner Falcon) and *Glareola nordmanni* (Black-winged Pratincole);
- No common amphibian species or amphibian SCC were encountered during the field assessment. This was potentially due to the limited suitable habitat in the form of perennial water sources for amphibian species. Although no amphibian SCC were encountered, there exists a possibility that the regionally threatened species, *Pyxicephalus adspersus* (Giant Bullfrog), may occur within the Wetland/ Riparian Habitat Unit;
- The proposed Project Infrastructure Area, proposed access roads and powerline alignment have been positioned in such a way as to minimise the impact on amphibian habitat, with the project infrastructure layout placed on existing cultivated land and stream crossings mostly being limited to existing crossings. The proposed development will therefore not pose a significant threat to amphibian SCC habitat, provided that the placement of infrastructure be placed outside of the identified watercourses and associated buffer zones;
- An overall low reptile species diversity was observed within the study area, mainly due to the ongoing anthropogenic and agricultural and grazing activities within the area, coupled with the general secretive behaviour of reptile species;
- No reptile SCC were encountered during the field assessment, but *Python natalensis* (Southern African Python), is likely to be present on Portion 3 of the farm Grootkuil, and possibly within the project site in the vicinity of identified watercourses, as habitat for this species is available within the Wetland/ Riparian Habitat Unit. The proposed project infrastructure layout, due to its location mostly within transformed areas, is however unlikely to impact on reptile conservation in the region;
- No invertebrate SCC were observed during the field assessment, with the distribution patterns for all invertebrate SCC indicated for the Limpopo Province not coinciding with the study area; and
- No threatened arachnid species are listed for the Limpopo Province (LDFED, 2004) and no such species are therefore expected to occur in the study area. As the proposed project infrastructure is located mainly on cultivated land, the proposed project will not pose a significant threat to arachnid SCC habitat;

- Overall, the proposed project is expected to have limited impact on faunal migratory connectivity, with specific emphasis on ensuring that the proposed powerline span the Wetland/ Riparian Habitat Unit as far as possible and that existing culverts within these areas remain in place.

SCCSIS Assessment

- In addition to the three avifaunal SCC identified during the field assessment, eight other SCC were found to have a 60% or greater probability of occurring within the study area and its immediate vicinity, of which none were observed during the field assessment. The overall SCCSIS for the study area was calculated as 37%, indicating a moderately low importance in terms of faunal SCC conservation.

Faunal Impact Assessment

Based on the faunal impact assessment, it was found that there are three possible impacts on faunal ecology within the project site. The most significant impacts are anticipated to occur during the construction phase with fewer significant operational phase impacts expected. However, if mitigation measures as provided in this report are implemented, all impacts can be reduced from high and medium level impacts to medium and low significance impacts. Considering the impacts, should well-conceived, defined and executed management and rehabilitation practices occur, it is the opinion of the ecologist that the infrastructure development can be considered viable from a faunal perspective.

A summary of the results obtained from the assessment of faunal ecological impacts.

CONSTRUCTION PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on faunal habitat	H	M
2: Impact on faunal diversity	M	L
3: Impact on faunal SCC	M	M
OPERATIONAL PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on faunal habitat	M	L
2: Impact on faunal diversity	H	M
3: Impact on faunal SCC	M	M
DECOMMISSIONING AND CLOSURE PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on faunal habitat	M	L
2: Impact on faunal diversity	M	L
3: Impacts on faunal SCC	M	L

Wetland Assessment

Background Assessment

- The study area falls within the Bushveld Basin Aquatic Ecoregion and is located within two quaternary catchments, namely A24E and A24F. All wetlands and riparian areas identified are located within quaternary catchment A24E;
- The NFEPA (2011) database was consulted to define the aquatic ecology of the wetland or river systems close to or within the project site that may be of ecological importance. Aspects applicable to the study area and surroundings are summarised as follows:
  - The project site falls within the Crocodile (West) and Marico Water Management Area (WMA). The Sub-Water Management Area indicated for the project site is the Lower Crocodile sub-WMA;
  - The subWMA is not regarded important in terms of fish sanctuaries, rehabilitation or corridors;
  - The subWMA is not considered important in terms of translocation and relocation zones for fish;
  - The subWMA is not listed as a fish Freshwater Ecosystem Priority Area (FEPA);
  - Two rivers are indicated by the NFEPA database to traverse the study area, namely the Brakspruit River and its tributaries, the Phufane River;
  - The Phufane River is indicated to be a non-perennial river which is moderately modified (Class C), while the Brakspruit River is also indicated to be a non-perennial river being in a largely modified (Class D) condition; and

- No wetland features are indicated by the NFEPA wetland database to occur within the study area, however a small channelled valley bottom wetland is indicated just beyond the southern boundary of the study area and an unchannelled valley bottom wetland is indicated just outside the northern boundary. Two other channelled valley bottom wetlands are indicated approximately 2km further to the north and south of the study area.

Field Assessment

- Two HGM Units have been identified within the study area that can be categorised as wetland habitat in line with the DWAF (2008) definition. One wetland feature, which can be described as an unchannelled valley bottom HGM Unit, associated with an unnamed tributary of the Brakspruit River has been identified within and to the east of the Project Infrastructure Area. Several impoundments are present within this feature, with one such impoundment located immediately upstream of the Project Infrastructure Area, which has influence surface hydrology downstream. Two drainage features with a riparian (river) HGM Unit were encountered, namely the Brakspruit River (including its tributaries within Portion 3 of the farm Grootkuil 409KQ) and the Phufane River;
- In addition to the above two HGM Units, one ephemeral depression was encountered which cannot be classified as a wetland in line with the DWAF (2008) due to no wetland soils and vegetation being present. In addition, three artificial off-channel dams, located outside of any drainage channel and associated with the valley bottom landscape unit of the Phufane River were encountered;
- The ephemeral depression and the artificial dams were not assessed in detail in this report, but due to these features contributing towards habitat creation and landscape ecology, these features should remain outside of the proposed and future development footprint areas;
- The wetland indicators such as vegetation and terrain units were used to determine boundary of the channelled valley bottom wetland feature;
- The riparian zones associated with the Brakspruit and Phufane Rivers were delineated during the field assessment, using the riparian vegetation indicators and the topography of the banks of the river as primary indicators;
- The channelled valley bottom wetland feature and the riparian features were assessed in detail with the following results:

	Brakspruit River	Phufane River	Wetland feature
PES	C/D (Moderately to Largely Modified)	C (Moderately Modified)	C (Moderate)
Wetland Ecoservices Provision	Moderately Low	Moderately Low	Intermediate
Ecological Importance and Sensitivity (EIS)	C (Moderate)	C (Moderate)	C (Moderate)
Recommended Ecological Category	C (Moderate)	C (Moderate)	C (Moderate)

- The wetland and riparian features were also delineated according to the guidelines advocated by DWAF (2008) and the wetland and riparian delineations as presented in this report is regarded as a best estimate of the wetland boundary based on the site conditions present at the time of assessment.

Wetland Impact Assessment

Based on the wetland assessment it is evident that there are three possible impacts that may affect the wetland and riparian ecology within the study area, with reference to the Project Infrastructure Area and the proposed powerline. Neither of the proposed access road alternatives are affected by watercourses. The tables below summarise the findings indicating the significance of the impacts of the development before mitigation takes place and the likely impact levels if management and mitigation takes place. In the consideration of mitigation it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs. From the table it is evident that both prior to mitigation, impact levels are of medium or low significance, while post-mitigation impact levels may be reduced to low or very low significance. This is mainly due to the fact that project infrastructure has been positioned with wetland and water course avoidance in mind.

A summary of the results obtained from the assessment of wetland ecological impacts for the Project Infrastructure Area.

CONSTRUCTION PHASE		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland and riparian habitat and ecological structure	M	L
2: Changes to wetland and riparian ecological and sociocultural service provision	L	VL
3: Impacts on wetland and riparian hydrological function and sediment balance	M	VL
OPERATIONAL PHASE		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland and riparian habitat and ecological structure	M	L
2: Changes to wetland and riparian ecological and sociocultural service provision	L	VL
3: Impacts on wetland and riparian hydrological function and sediment balance	M	L
DECOMMISSIONING AND CLOSURE PHASE		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland and riparian habitat and ecological structure	M	L
2: Changes to wetland and riparian ecological and sociocultural service provision	L	VL
3: Impacts on wetland and riparian hydrological function and sediment balance	M	VL

The tables below summarise the findings of the impact assessment of the proposed powerline development, indicating the likely significance of the impacts prior to mitigation taking place and the significance of the impacts if appropriate and effective management and mitigation takes place. From the table it is evident that both prior to mitigation, impact levels are of medium significance levels, while post-mitigation impact levels may be reduced to a low significance level.

A summary of the results obtained from the assessment of wetland ecological impacts for the powerline development.

CONSTRUCTION PHASE		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland and riparian habitat and ecological structure	M	L
2: Changes to wetland and riparian ecological and sociocultural service provision	M	L
3: Impacts on wetland and riparian hydrological function and sediment balance	M	L
OPERATIONAL PHASE		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland and riparian habitat and ecological structure	M	L
2: Changes to wetland and riparian ecological and sociocultural service provision	M	L
3: Impacts on wetland and riparian hydrological function and sediment balance	M	L

Aquatic Assessment

Background Assessment

The PES/ EIS database, as developed by the Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS), was utilised to obtain background information on the aquatic resources associated with the project site and its surroundings. According to the ecological importance classification for the quaternary catchment, the Brakspruit and Phufane River systems can be can be considered to be in Class C (moderately modified) stream conditions according to the PES/ EIS classification. In terms of the Default Ecological Management Class (DEMC), these systems must be managed according to Class C conditions.

Field Assessment

Six aquatic assessment sites (SC1 – SC6) were visually assessed, of which three out of the six sites (SC2, SC4 and SC6) were subjected to further detailed aquatic assessment due to the presence of water at the time of the assessment.

Biota specific water quality variables assessed

- The water quality can be considered as fair at the SC2 and SC4 sites with low dissolved salt concentrations at the time of the assessment. This is likely due to the remote location of the two sites, while the Electrical Conductivity (EC) can be considered as slightly elevated at the SC6 site. The elevated EC concentration at site SC6 is most likely due to runoff from the tarred road and bridge crossing located at the site. Site SC6 is also located downstream of existing mining activities which is likely to affect the EC;
- The pH values can be considered as largely natural at each of the sites. The pH value is slightly elevated at site SC6, again, this is likely due to runoff from the bridge crossing present at the site;
- The Dissolved Oxygen (DO) concentrations at site SC2 and SC4 do not comply with the recommended guideline and will likely limit the macro-invertebrate diversity and sensitivity present at these sites. This is likely due to the stagnant water as well as the high turbidity present at both sites. The DO concentration at site SC6 exceeds 80% saturation and can therefore be considered as suitable in sustaining a diverse and sensitive macro-invertebrate community; and
- The temperature at each site can be regarded as natural for the time of year and time of day during which sampling took place. The variation between the values can be ascribed to diurnal variation between sampling times.

Intermediate Habitat Integrity Assessment (IHIA)

Overall, for habitat integrity the Upstream Brakspruit River scored 59.0% (Class D), the Phufane River scored 58.8% (Class D) and the Downstream Brakspruit River scored 56.1% (Class D). Future development planning should ensure that activities do not lead to a reduction of stream flow or dewatering of any aquatic resources and connectivity of the aquatic features in the vicinity of the study area should be maintained.

Invertebrate Habitat Assessment (IHAS)

- The habitat structure and diversity of each site can be regarded as inadequate for supporting a diverse and sensitive aquatic community; and
- Lack of flowing water, suitable rocky habitat and marginal or aquatic vegetation will severely impact the macro-invertebrate community diversity and sensitivity expected at each site.

Riparian Vegetation Response Assessment Index (VEGRAI)

Because the riparian vegetation was very similar along all sites assessed on the various drainage systems, VEGRAI was applied to each system as a whole and not to individual sites. The scores attained for the VEGRAI assessment indicate that the riparian systems within the study area falls within a PES category D for both the Brakspruit and Phufane systems. The Ecological Category D attained within the Brakspruit and Phufane systems indicate that the riparian vegetation has undergone large modifications, with a large loss of natural habitat, biota and basic ecosystem functions. This is due to the significant erosion and modification of water flow at all three sites.

South African Scoring System (SASS5)

- Six aquatic sites were assessed (SC 1 – SC 6), of which sites SC2, SC4 and SC6 contained limited surface water;
- Sites SC2, SC4 and SC6 may be considered to be in a Class E/F (severely impaired) condition according to the Dallas (2007) classification system;
- Sites SC2 and SC6 can be classified as critically modified (Class F) according to the Dickens & Graham (2001) classification system, while site SC4 can be classified as a Class E (seriously impaired) condition;
- The aquatic macro-invertebrate community in the systems can be regarded as having low diversity and sensitivity in relation to the expected conditions for the Bushveld Basin ecoregion as a result of the lack of perennial flow and limited habitat present at the sites. The aquatic community members present were generally present in low abundances with a relatively low diversity of taxa present;
- Due to the relatively poor habitat conditions, the Dallas (2007) classification of the site is regarded as being a more accurate description of the PES of the aquatic macro-invertebrates

of the systems and indicates that the Brakspruit and Phufane systems are in severely modified conditions and could be considered to be largely to moderately modified from the natural conditions of the naturally constrained systems; and

- Care should be taken not to further impact on the aquatic ecosystems with the proposed activities with specific mention of measures to ensure that streamflow reduction activities and loss of catchment yield are kept to an absolute minimum.

Macro-invertebrate Assessment Index (MIRAI)

The MIRAI results indicate that the sites can be considered as having largely modified conditions, as measured by the Ecological Category classification. A trend of general deterioration from expected natural conditions in terms of macro-invertebrate community integrity is clearly evident. This is due to the modified flow conditions and limited habitat availability at the biomonitoring sites. The inadequate habitat availability and lack of flowing water will severely limit the macro-invertebrate community diversity and sensitivity expected at each of the sites.

Aquatic Impact Assessment

Based on the impact assessment it is evident that there are three possible impacts that may have an effect on the overall riparian and aquatic integrity for both the proposed smelter construction and powerline construction. The tables below summarise the findings indicating the likely significance of the impacts before mitigation takes place and the significance of the impacts if appropriate management and mitigation takes place. In the consideration of mitigation, it is assumed that a high level of mitigation will take place without high prohibitive costs.

Based on the findings of the impact assessment it is clear that the development of the proposed smelter may have a high to medium impact on the receiving aquatic environment prior to mitigation, while the development of the powerline will have a low impact on the receiving environment should no mitigation or management measures be implemented. If suitable mitigation measures are applied, the possible impacts as a result of the smelter and powerline construction will be alleviated to medium, low and very low impacts on the receiving environment.

A summary of the results obtained from the assessment of aquatic ecological impacts arising from development of the proposed Project Infrastructure Area.

CONSTRUCTION PHASE

Impact	Unmanaged	Managed
1: Loss of aquatic habitat and ecological structure	M	L
2: Impacts on aquatic hydrological function and sediment balance	H	M
3: Impacts on instream biota	M	L

OPERATIONAL PHASE

Impact	Unmanaged	Managed
1: Loss of aquatic habitat and ecological structure	M	L
2: Impacts on aquatic hydrological function and sediment balance	H	M
3: Impacts on instream biota	M	L

DECOMMISSIONING AND CLOSURE PHASE

Impact	Unmanaged	Managed
1: Loss of aquatic habitat and ecological structure	M	L
2: Impacts on aquatic hydrological function and sediment balance	H	M
3: Impacts on instream biota	M	L

A summary of the results obtained from the assessment of aquatic ecological impacts arising from development of the proposed Project Infrastructure Area.

CONSTRUCTION PHASE

Impact	Unmanaged	Managed
1: Loss of aquatic habitat and ecological structure	L	VL
2: Impacts on riparian hydrological function and sediment balance	L	VL
3: Impacts on instream biota	L	VL

OPERATIONAL PHASE

Impact	Unmanaged	Managed
1: Loss of aquatic habitat and ecological structure	L	VL
2: Impacts on riparian hydrological function and sediment balance	L	VL
3: Impacts on instream biota	L	VL

Alternatives Analysis

A map indicating the location of the various infrastructure site layout alternatives is included in Figure 3 of this report.

- **Project Infrastructure Area:** From a floral, faunal, wetland and aquatic perspective, the expected impact resulting from the development of Project Infrastructure Area 1 (preferred) and Project Infrastructure Area 2 is similar provided that no infrastructure encroaches on the wetland habitat and associated buffer zone.
- **Access Road:** From a floral, faunal, wetland and aquatic ecological perspective, the expected impact from the development of Access Road Corridor Option 2 (preferred) and Access Road Option 3 is expected to be similar. Access Road Option 1 is likely to have an increased ecological impact due to the confirmed presence of *Vachellia erioloba* trees along this alignment and various watercourse crossing being present. It should be kept in mind that the Proposed Powerline Option 1 follows a similar alignment and watercourse crossings are therefore unlikely to be avoided.
- **Powerline:** From a floral, faunal, wetland and aquatic ecological perspective, Powerline Option 1 (preferred), Powerline Option 2 and Powerline Option 4 are expected to have similar impacts and impact ratings due these alignment all being located largely on existing dirt roads and various watercourses being crosses. Powerline Option 3 is however the least preferred alternative due to this alignment not being located along existing disturbed areas and crossing watercourses where no existing dirt roads exist.

Sensitivity mapping

A sensitivity map (Figure A) was created with the use of the floral and faunal integrity and diversity encountered during the assessment of the study area, as well as taking consideration of the location and extent of wetland and riparian features traversing the area. The Wetland/ Riparian Habitat Unit is regarded as being of high ecological sensitivity due to the contribution of the various wetland and riparian features to faunal migratory connectivity, wetland eco-services provision and habitat provision for faunal and floral species. A 32m statutory zone of regulation is also indicated and any activity within this zone will trigger a listed activity in terms of the National Environmental Management Act (NEMA; Act 107 of 1998). 32m is also considered to a suitable buffer zone for conservation of the features. As part of the project, the proposed powerline will be required to cross various drainage lines, and in this regard care should be taken to ensure that these infrastructure components cross at existing crossings where possible, to avoid further impacts on the drainage features. Where this is not possible, it must be ensured that crossings span as far as possible at right angles to the features, with no infrastructure to be placed within the active riparian channels or within the delineated extent of the wetland feature.

The Bushveld Habitat Unit comprises the majority of Portion 3 of the farm Grootkuil 409KQ, which is in a largely natural condition, while the Project Infrastructure Area, as well as the two alternative road alignments are located predominantly within the Transformed Habitat Unit.

Due to differences in soil types and local topography within the area, which determines species composition, four sub-habitat units have been identified within the Bushveld Habitat Unit, with differing ecological importance, as follows:

- Sandy Thorn Bushveld: this habitat provides largely intact habitat and a high abundance of floral SCC occur in this area. This habitat is considered to be of a Moderately High ecological sensitivity;
- Plains (low-lying) Thorn Bushveld: this habitat plays an important role in flood control within this area and is therefore also considered to be of Moderately High ecological sensitivity;
- Turf Thorn Bushveld: This habitat is considered to be largely intact, provides good habitat for floral and faunal species and is considered to be of Moderate ecological importance and sensitivity; and
- Mixed Bushveld: This habitat is considered to have a lowered ecological sensitivity and conservation value due to the alteration of floral species composition and vegetation structure as a result of the abovementioned impacts.

Both the Secondary Bushveld and the Transformed Habitat Units are considered to have Low ecological sensitivity.

One protected tree species namely *Vachellia erioloba* was encountered along the proposed powerline alignment. The positions of this species, in addition to ecologically sensitive habitat identified, are also presented in the site sensitivity map below.

KEY MITIGATION MEASURES

Development Footprint

- A sensitivity map has been developed for the study area, indicating wetland and riparian features, as well as moderately high terrestrial bushveld habitat considered to be of increased ecological importance. It is recommended that this sensitivity map together with the proposed wetland/ riparian buffer zones be considered during the planning/ pre-construction and construction phases of the proposed project to aid in the conservation of ecology within the area;
- Placement of infrastructure should be as far as possible from the areas of increased ecological sensitivity including buffer zones associated with wetland and riparian areas;
- During the construction phase, access to the construction site should be limited to existing access roads in order to minimise stream and wetland crossings. It is recommended that no new crossings for access roads be constructed. Access to wetland and riparian areas within the remainder of the Portion 3 of the farm Grootkuil 409 KQ by site personnel should be prohibited to prevent compaction of soils, loss of vegetation and increased erosion;
- Smelter and access road infrastructure, including contractor laydown areas and areas designated for washing, cutting, mixing, etc. should be placed, as planned, within designated low sensitivity areas as far as possible and well outside of the wetland buffer zones;
- It must be ensured that operational related activities are kept strictly within the development footprint and designated operational areas;
- The proposed project, particularly road upgrades and stream crossings should not lead to a reduction of stream flow and connectivity of the wetland and riparian features should be maintained;
- It must be ensured that no incision and canalisation of the riparian resource takes place as a result of the construction of the powerline;
- Disturbances within the active riparian channels and riverbeds need to be minimised as far as possible. In this regard the following key points are highlighted:
    - The powerline should ideally span the entire delineated riparian zone, with no infrastructure being placed within the active river channels. Placement of the powerline and its support structures must ensure that no upstream ponding and no downstream erosion and scouring occur;
    - The narrowest points in the rivers should be identified and potentially used as the crossing point and the powerline should not cross the rivers longitudinally, i.e. run within or adjacent to the river for extended lengths, with particular reference to the Phufane River where it traverses the proposed powerline in the southeast of the study area;
    - The powerline should cross the rivers at a 90 degree angle to minimise the damage to riparian areas; and
    - The powerline should not cross the rivers in any area where the river or active channel makes sharp bends.

- The duration of impacts on the rivers should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised; and
- It is recommended that construction be restricted to the low flow season, during the drier winter months if possible, to avoid further sedimentation of wetland and riparian features in the vicinity of proposed road or powerline stream crossings and to decrease the potential for erosion and sedimentation within disturbed areas due to rainfall.

Vehicles

- Vehicles should be limited to travelling only on designated roadways to limit the ecological footprint of the proposed project activities; and
- Any exposed soils, particularly topsoil stockpiles, must be protected by means of covering with a geotextile such as hessian sheeting or Geojute and stabilised with sandbags, in order to limit transportation of sediment to the wetland and riparian via stormwater runoff.

Soils

- All soils compacted as a result of construction activities falling outside of the proposed project footprint should be ripped and profiled;
- Edge effects of activities including erosion and alien vegetation eradication and control need to be strictly managed in wetland and riparian areas;
- Erosion berms may be installed in any areas where soil disturbances within the vicinity of the wetland and riparian features have occurred to prevent gully formation and siltation of the aquatic resources; and
- Any areas where active erosion is observed in the vicinity of the powerline, must be immediately rehabilitated through reprofiling, revegetation and stream bank stabilisation if necessary. This must be done in such a way as to ensure that the hydrology and geomorphological characteristics of the area are re-instated to conditions which are as natural as possible.

Alien Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas and common agricultural weeds are already present within the proposed smelter footprint area. These species, as well as emerging species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, also has to be controlled; and
- Removal of the alien and weed species must take place in order to comply with existing legislation (NEMBA Alien and Invasive Species Regulations, 2014). Focus should be on the removal of Category 1 alien species and should take place throughout the construction, operational and decommissioning and closure phases.

Rehabilitation

- As much vegetation growth as possible should be promoted within the project site in order to protect soils. In this regard special mention is made of the need to use indigenous vegetation species where hydroseeding, landscaping and rehabilitation are to be implemented;
- As far as possible soft engineering should be used in rehabilitation works;
- After construction has been completed and upon closure, suitable reprofiling, reseeding with indigenous grasses and revegetation of any bare or disturbed areas must take place to minimise the potential of sedimentation and erosion of wetland features. Potential disturbed areas in the vicinity of stream crossings must also be suitably rehabilitated if required to ensure adequate vegetation cover, the absence of alien vegetation and stream bank stability;
- Any disturbed wetland and riparian areas must be rehabilitated upon decommissioning to ensure that wetland and riparian functions are re-instated to at least pre-development conditions; and
- Culverts associated with stream crossings must be desilted and regularly cleared of any debris.

Waste

- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss;

- Effective waste management must be implemented in order to prevent construction and operational related waste from entering the wetland and riparian environment. All waste and rubble must be removed from site and disposed of according to relevant SABS standards;
- It must be ensured that the smelter process water system is managed in such a way as to prevent discharge to the receiving environment;
- Seepage from the slag and slurry facilities must be prevented by ensuring that this infrastructure is adequately lined;
- Run-off from dirty water areas must be prevented from entering wetland and riparian areas; and
- It must be ensured that any activities impacting on water resources, particularly in the vicinity of stream crossings, are managed according to the relevant DWS Licensing regulations.

Fire

- Informal fires in the vicinity of development construction areas should be prohibited.

Floral SCC

- Permits must be obtained for the removal/ destruction of *V. erioloba* under the National Forests Act (Act 84 of 1998) within the proposed powerline alignment, prior to the construction phase;
- The number of *V. erioloba* removed for construction of the powerline should be kept to a minimum and no trees should be needlessly destroyed;
- Prior to the commencement of construction and once the final access road alignment has been confirmed, a final walkdown of the powerline alignment and access road must be undertaken to ensure no *V. erioloba* or other tree species protected under the National Forests Act (Act 84 of 1998) has been overlooked;
- Should any other floral SCC, including SANBI RDL species, such as *Crinum macowanii* or *Boophane disticha* be encountered within the development footprint, these species are to be relocated and monitoring of relocation success, if undertaken, should take place during the operational phase and during and beyond the decommissioning and closure phase.
- Should any floral species protected under LEMA (Act 7 of 2003), such as *Scadoxus puniceus* or NEMBA (Act 10 of 2004) be encountered within the project site, authorisation to relocate such species must be obtained from LEDET or DEA respectively;
- Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a suitably qualified botanist; and
- The collection of plant material for medicinal purposes or collection of firewood should be prohibited.

Fauna

- Should any *Pyxicephalus adspersus* (Giant Bullfrog) be encountered within the project site, special care must be taken to catch and relocate such species to similar habitat within the vicinity of the project site. Relocation must be done by a suitably qualified person;
- Should avifaunal SCC be encountered within the project site during the construction or operational phases of the project, care must be taken not to disturb these species, particularly when foraging;
- No trapping or hunting of fauna is to take place and all staff should be briefed and educated in this regard;
- It is recommended that bird flappers be placed along the powerline, also in areas in close vicinity to remaining cultivated fields in order to minimise collisions of avifaunal species with powerlines; and
- In order to conserve foraging habitat for avifaunal SCC, the cultivated land to the east of the Project Infrastructure Area should ideally remain under cultivation as this will ensure sustained habitat for the avifaunal SCC *Polemaetus bellicosus* (Martial Eagle) and *Pteocles gutturalis* (Yellow-throated Sandgrouse) within the vicinity of the project site.

Aquatic Monitoring

- Since the aquatic systems within the study area lacked flowing water at the time of the aquatic assessment, it is recommended that a high flow aquatic ecological assessment be undertaken in the future to provide improved insight on the local aquatic ecological conditions;
- On-going aquatic ecological monitoring must take place on an annual basis in the high flow season by a suitably qualified assessor focusing on aquatic macro-invertebrates, habitat integrity and biota specific water quality; and
- Future development planning should ensure that activities do not lead to a reduction of stream flow or dewatering of any aquatic / wetland / riparian areas and connectivity of the aquatic features in the vicinity of the study area should be maintained.

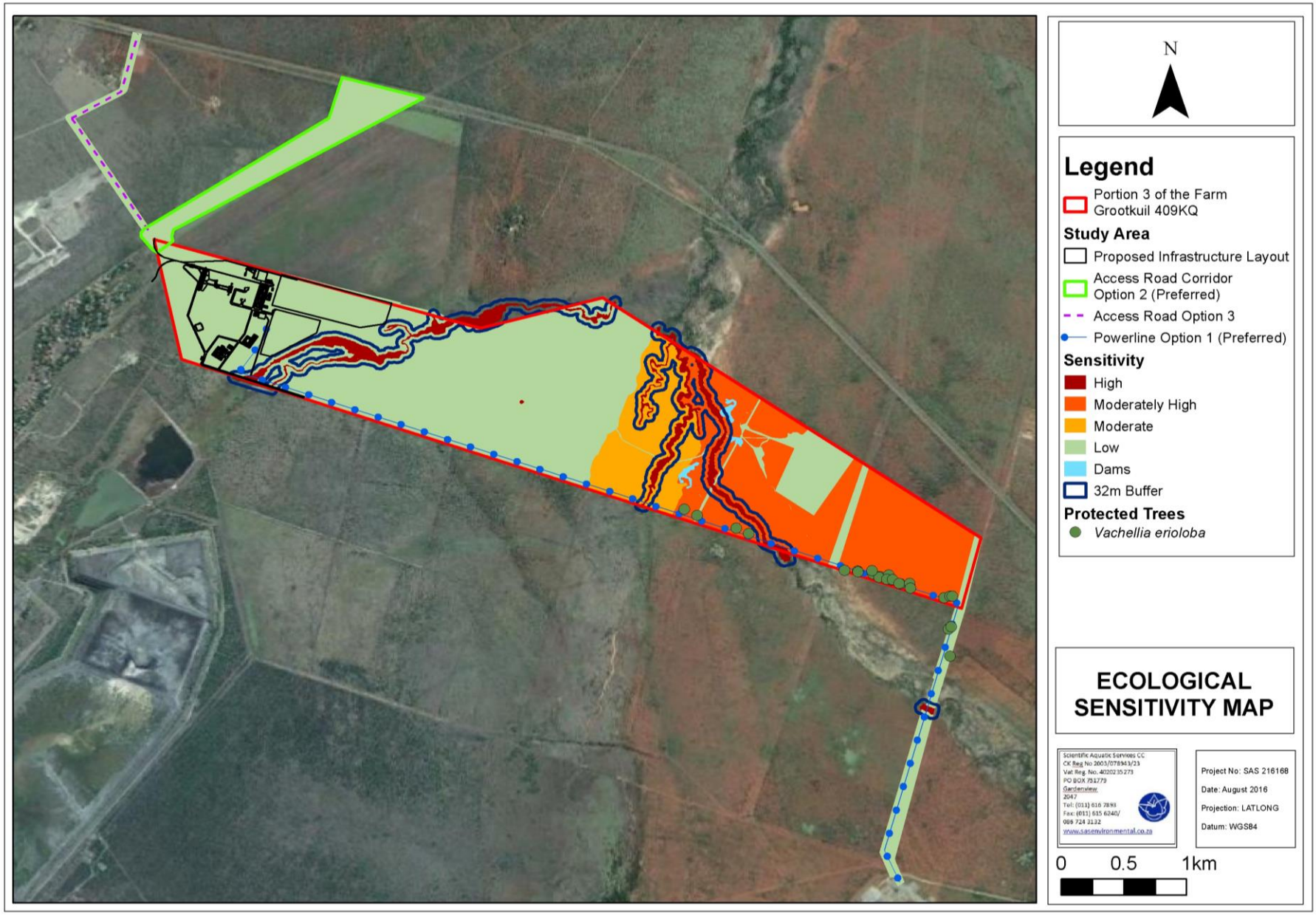

Figure A: Sensitivity Map for the study area.

FLORAL, FAUNAL, WETLAND AND AQUATIC ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED CONSTRUCTION OF A FERROCHROME SMELTER NEAR NORTHAM, LIMPOPO PROVINCE

Prepared for

SLR Consulting (Africa) (Pty) Ltd.

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SECTION A – Background Information and Methods of Assessment

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the Ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area contributing to runoff at a particular point in a river feature.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of Ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Ephemeral stream:	A stream that has transitory or short-lived flow.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Fluvial:	Resulting from water movement.

Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the “background colour” referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater.
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named

after the city of Ramsar in Iran, where the Convention was signed in 1971.

RDL (Red Data listed) species: Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.

Species of Conservation Concern: The term SCC in the context of this report refers to all Red Data Listed (RDL) and International Union for the Conservation of Nature (IUCN) listed species as well as provincially protected species of relevance to the project.

Seasonal zone of wetness: The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface.

Temporary zone of wetness: The outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year.

LIST OF ACRONYMS

°C	Degrees Celsius
ASTP	Average Score per Taxon
BGIS	Biodiversity Geographic Information Systems
BMWP	British Biological Monitoring Working Party
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Forestry and Fisheries (DAFF)
DEA	Department of Environmental Affairs
DEMC	Default Ecological Management Class
DO	Dissolved Oxygen
DWA	Department of Water Affairs (currently known as the DWS)
DWAF	Department of Water Affairs and Forestry (currently known as the DWS)
DWS	Department of Water and Sanitation (previously known as the DWA/DWAF)
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
ECat	Ecological Category
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EPA	United States Environmental Protection Agency
EPFI	Equator Principles Financial Institution
ES	Ecological Sensitivity
ESA	Ecological Support Areas
EVC	Extent of Vegetation Cover (used in VIS calculations)
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information Feature
GPS	Global Positioning Feature
ha	Hectares
HGM	Hydrogeomorphic
IHAS	Invertebrate Habitat Assessment System

IHI	Index of Habitat Integrity
IHIA	Intermediate Habitat Integrity Assessment
IUCN	International Union for the Conservation of Nature
IWQS	Institute for Water Quality Studies
LDFED	Limpopo Department of Finance and Economic Development
LEDET	Limpopo Department of Economic Development, Environment and Tourism
Limpopo SoER	Limpopo State of the Environment Report (2004)
m	Metres
MAP	Mean Annual Precipitation
MIRAI	Macro-invertebrate Response Assessment Index
mm	Millimetres
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NNR	No Natural Habitat Remaining
NPAES	National Protected Areas Expansion Strategy (2008)
NWA	National Water Act (Act 36 of 1998)
ONA	Other Natural Area
PEMC	Present Ecological Management Class
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computer Information Systems
PVC	Percentage Vegetation Cover of indigenous species (used in VIS calculations)
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDL	Red Data List(ed)
RDM	Resource Directed Measures
REC	Recommended Ecological Category
RHP	River Health Programme
RIS	Recruitment of Indigenous Species (used in VIS calculations)
RQIS	Resource Quality Information Services
SABAP2	South African Bird Atlas Project 2
SABS	South African Bureau of Standards

SAIAB	Southern African Institute of Aquatic Biodiversity
SANBI	Southern African National Biodiversity Institute
SANParks	Southern African National Parks
SAS	Scientific Aquatic Services
SASS5	South African Scoring System version 5
SCC	Species of Conservation Concern
SCCSIS	Species of Conservation Concern Sensitivity Index Score
SI	Structural Intactness (used in VIS calculations)
SoER	State of the Environment Report
SQ	Sub-Quaternary
SQR	Sub-Quaternary Reach
subWMA	Sub-Water Management Area
TOPS	Threatened or Protected Species (2013)
TSP	Threatened Species Programme
TSS	Total Species Score (used in SCCSIS calculations)
TWQR	Target Water Quality Requirements
VEGRAI	Riparian Vegetation Response Assessment Index
VIS	Vegetation Index Score
WMA	Water Management Area
WMS	Water Management System
WRC	Water Research Commission

1. INTRODUCTION

1.1. Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, wetland and aquatic ecological assessment as part of the environmental assessment and authorisation process for the proposed construction of a new ferrochrome (FeCr) Smelter located immediately adjacent to the existing Union Section Mine on Portion 3 of the farm Grootkuil 409 KQ, in the Thabazimbi Local Municipality, Limpopo Province. The proposed Siyanda ferrochrome smelter (hereafter referred to as the 'Project Infrastructure Area'), which will in broad terms comprise a railway siding, a raw materials offloading area, two 70 MW DC furnaces, crushing and screening plant, slag dump and baghouse slurry dam, as well as related facilities such as material stockpiles, workshops, stores and various support infrastructure and services, is located within the western portion of Portion 3 of the farm Grootkuil 409 KQ. In addition, an overhead powerline as well as one access road is proposed, with two access road alternatives, namely Access Road Corridor Option 2 and Access Road Option 3, being considered for development. The proposed powerline will originate from the Spitzkop substation to the southeast of Portion 3 of the farm Grootkuil 409 KQ, run north towards the southeastern corner of Portion 3 of the farm Grootkuil 409 KQ and from there extend along the southern boundary of the property towards the Project Infrastructure Area. The proposed Project Infrastructure Area, together with the proposed powerline and the two access road alternatives, of which only one will be developed, are hereafter referred to as the 'project site' (Figures 1 & 2). As part of the ecological assessment, the remainder of Portion 3 of the farm Grootkuil 409 KQ was also assessed, and, together with the project site, is hereafter referred to as the 'study area'.

The Project Infrastructure Area is situated approximately 10km to the west of the R510 regional road and 8km to the northwest of the town of Northam, and approximately 1,5km to the south of the Brits Road. The Swartklip Mine Village (developed as part of the Union Section Mine) is located immediately to the southwest of the Project Infrastructure Area.

As part of the project, various site layout alternatives have been proposed, which is indicated in Figure 3 below and discussed within the various report sections.

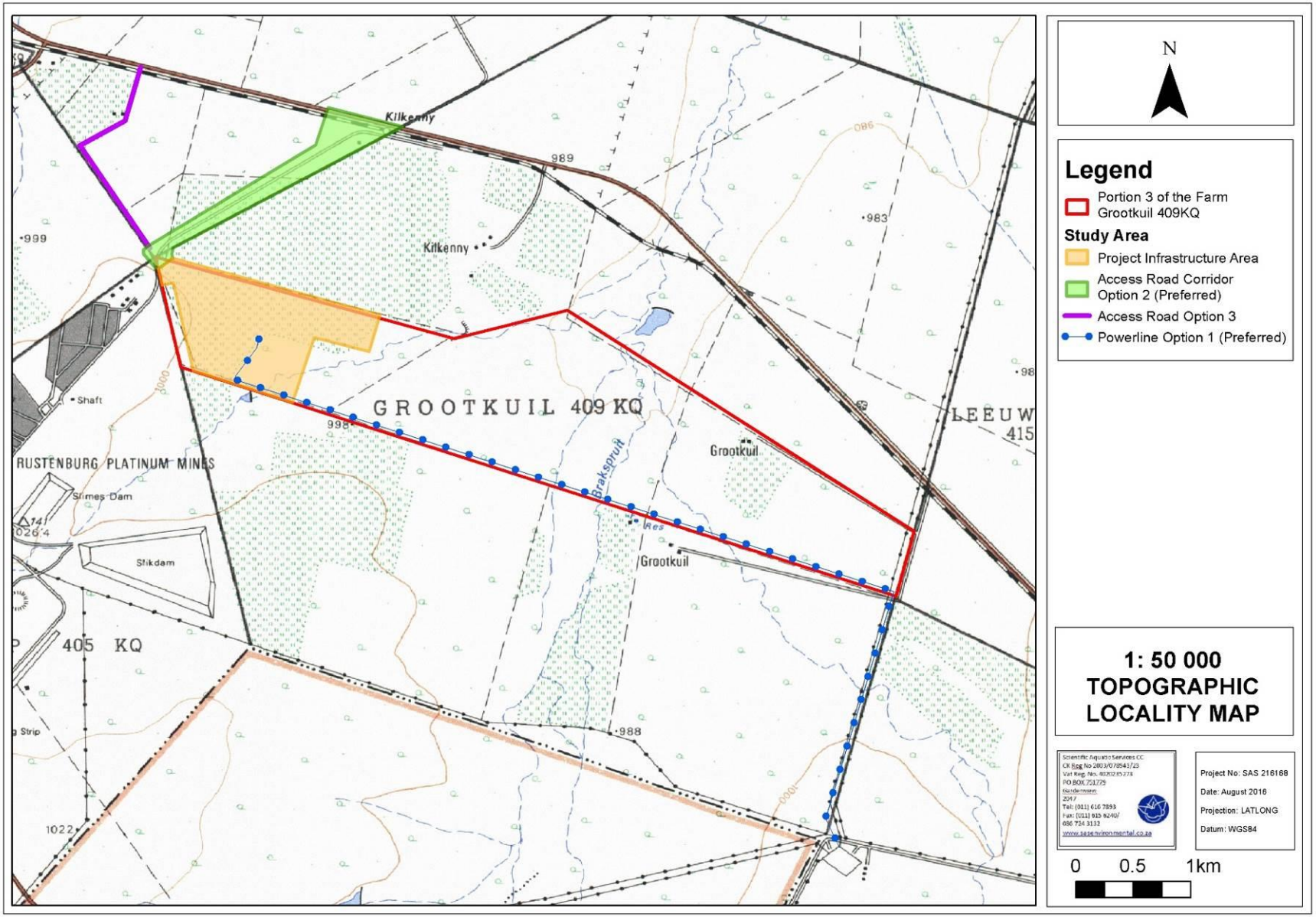

Figure 1: 1:50 000 topographic map depicting the location of the project site in relation to surrounding areas.

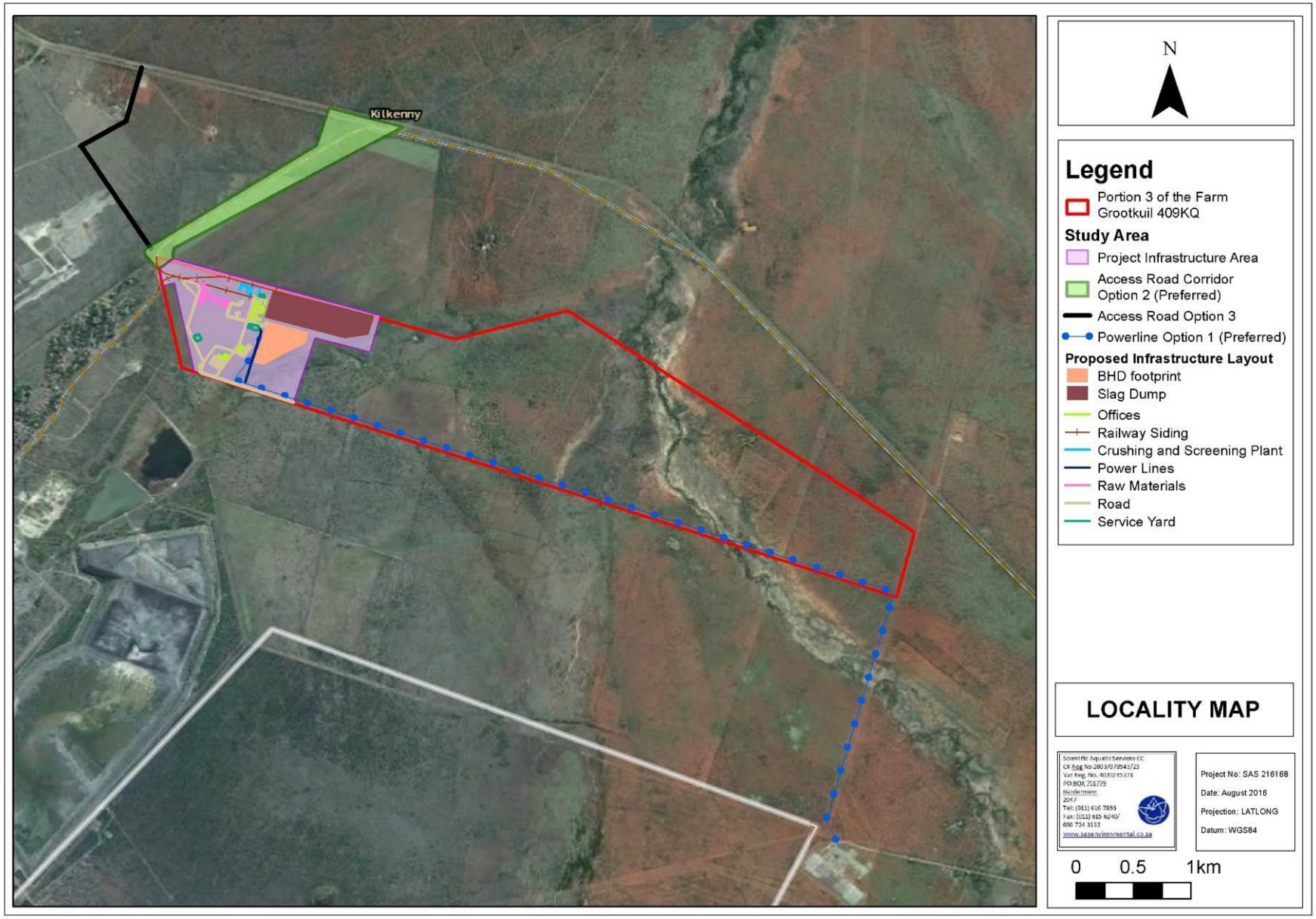

Figure 2: Digital satellite image depicting the location of the project site in relation to surrounding areas.

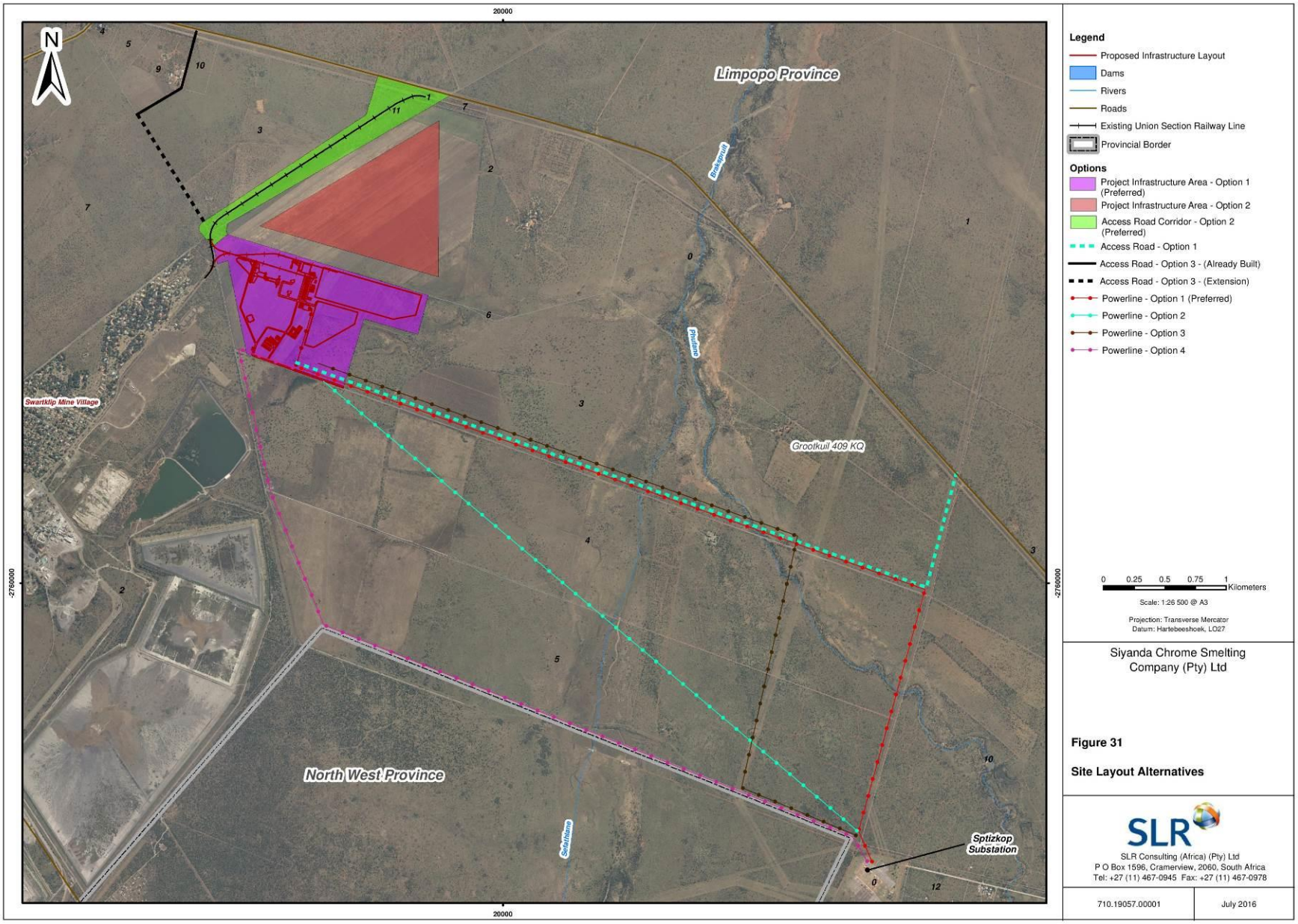

Figure 3: Site layout alternatives provided as part of the project (map supplied by SLR).

1.2. Project Scope

Specific outcomes in terms of this report are outlined below.

Terrestrial (floral and faunal assessment)

- To conduct a desktop study to gain background information on the physical habitat and potential floral and faunal biodiversity associated with the study area;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the study area and the implementation of a Species of Conservation Concern Sensitivity Index Score (SCCSIS) for the assessment area;
- To provide inventories of floral and faunal species as encountered within the study area;
- To determine and describe habitat types, communities and the ecological state of the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To describe the spatial significance of the project site with regards to surrounding natural areas; and
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features.

Wetland assessment

- To conduct a desktop study and provide background information pertaining to the various wetlands and riparian features associated with the study area in terms of the National Freshwater Ecosystem Priority Areas (NFEPA) and other relevant databases;
- To identify and characterise Hydrogeomorphic (HGM) Units according to the Classification System for Wetlands and Other Aquatic Ecosystems in South Africa;
- To delineate all wetlands and riparian areas occurring within the study area;
- To define the Present Ecological State (PES) of the HGM Units within the study area through the application of the wetland Index of Habitat Integrity (IHI) and/ or Wet-Health methods of assessment;
- To determine the functioning and the environmental and socio-cultural services that each HGM Unit provide;
- To determine the Ecological Importance and Sensitivity (EIS) of the wetlands and riparian features;
- To advocate a Recommended Ecological Category (REC) for each HGM Unit;

- To determine the environmental impacts of the proposed development activity on the terrestrial, and aquatic resources within the study area; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving aquatic environment.

Aquatic Assessment

- To define the PES and EIS of the aquatic resources and aquatic ecosystems in the vicinity of the study area;
- To monitor spatial and temporal trends in aquatic resource integrity in the vicinity of the study area;
- To define the aquatic habitat conditions prevalent in the area as well as natural constraints posed to the systems along with anthropogenic impacts on these systems;
- To report any emerging issues;
- To develop a database of biological integrity for streams in the region;
- To define the impacts envisaged as part of the proposed development activities on the aquatic resources; and
- To define the required management, mitigation and monitoring measures required in order to minimise the impact of the proposed development on the receiving aquatic environment.

1.3. Assumptions and Limitations

The following points serve to indicate the assumptions and limitations with regard to the terrestrial and wetland ecological assessments:

- The ecological assessment is confined to the project site as well as the remainder of Portion 3 of the farm Grootkuil 409 KQ, which together comprise the study area, and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a field assessment of limited duration. Therefore, field observations are compared with literature studies where necessary;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal and floral communities have been accurately assessed and considered;

- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the study area may therefore been missed during the assessment;
- The wetland delineation as presented in this report is regarded as a best estimate of the wetland/ riparian boundary based on the site conditions present at the time of the assessment and limitations in the accuracy of the delineation due to anthropogenic disturbances are deemed possible;
- Wetland/ riparian and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative and obligate wetland species. Within the transition zone some variation of opinion on the wetland boundary may occur, however if the Department of Water Affairs[1] (DWA, 2008) method is followed, all assessors should get largely similar results;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required the study area will need to be surveyed and pegged according to surveying principles; and
- Field assessments were undertaken during April 2015 (rainy season) and August 2015 (dry season) with the Access Road Corridor Option 2 and Access Road Option 3 footprint area assessed during December 2015 and July 2016 respectively, in order to determine the ecological status of the study area and the surrounding area. This is considered to be suitable times of year to conduct ecological assessments within this region due to favourable habitat conditions and these timeframe also still allowing the majority of floral species to be accurately identified within different seasons. Although considered sufficient, a more accurate assessment would require that assessments take place in all seasons of the year.

The following points serve to indicate the assumptions and limitations with regard to the aquatic assessment:

- **Ecological conditions at the time of assessment**: At the time of assessment the several aquatic systems lacked flowing water and consisted of shallow still pools at the time of the assessment. This will greatly limit the aquatic macro-invertebrate community diversity and sensitivity expected at the sites;

[1] The Department of Water Affairs (DWA) is currently known as the Department of Water and Sanitation (DWS) and prior to being known as DWA, it was known as the Department of Water Affairs and Forestry (DWAF). For the purposes of referencing in this report, the name under which the Department was known at the time of publication of reference material, will be used.

- **Reference conditions are unknown**: The composition of aquatic biota associated with the relevant aquatic systems, prior to major disturbance, is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available. It is however deemed essential that an aquatic biomonitoring program be implemented to define the seasonal community composition of the aquatic resources.
- **Temporal variability**: The data presented in this report are based on a single assessment performed in April 2015. No analyses of temporal trends are therefore currently possible; and
- **Ecological assessment timing**: Aquatic ecosystems are dynamic and complex. It is likely that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require routine seasonal sampling, with sampling being undertaken on a minimum of a six-monthly basis to cover seasonal variability.

1.4. Legislation

1.4.1 National Environmental Management Act, 1998 (NEMA)

- The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated EIA Regulations (GN R982 of 2014) and well as listing notices 1, 2 and 3 (GN R983, R984 and R985 of 2014), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the Environmental Impact Assessment (EIA) process depending on the nature of the activity and scale of the impact; and
- In terms of the NEMA (2014) EIA Regulations contained in GN R982 all specialist studies must comply with Appendix 6. Table 1 below indicates how these requirements have been complied with in this report.

Table 1: Legal Requirements for All Specialist Studies Conducted.

Legal Requirement		Relevant Section in Specialist Study
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	Section A: Appendix A
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Section A: Appendix A
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	To be submitted separately

Legal Requirement		**Relevant Section in Specialist Study**
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section A: 1.2
(d)	the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section A: 1.3 & 2.1
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process	Section A: 2 Section B: 2 & 3 Section C: 2 Section D: 2 Section E: 2
(f)	the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Management Summary Section B: 5 Section D: 3.8
(g)	an identification of any areas to be avoided, including buffers;	Management Summary Section B: 5 Section D: 3.8
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Management Summary Section B: 5 Section D: 3.8
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section A: 1.3
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Section B: 7 Section C:6 Section D: 5 Section E: 5
(k)	any mitigation measures for inclusion in the EMP;	Section B: 6 Section C: 5 Section D: 4 Section E: 4
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Management Summary
(m)	any monitoring requirements for inclusion in the EMP or environmental authorisation;	Management Summary
(n)	a reasoned opinion[2] (Environmental Impact Statement)-	
	as to whether the proposed activity or portions thereof should be authorised; and	Executive Summary
	if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Executive Summary Management Summary
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	As indicated in the scoping report/ EIA
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	As indicated in the scoping report/ EIA
(q)	any other information requested by the competent authority.	As indicated in the scoping report/ EIA

[2] Also include a summary of the impacts.

1.4.2 National Water Act, 1998 (NWA)

- The National Water Act (NWA; Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved;
- According to GN1199 of the NWA all activities within 500m of a watercourse must be authorised in terms of Section 21c and 21i of the NWA. The Department of Water and Sanitation (DWS) has however released a risk assessment process that allows projects to be screened and all projects with a low risk may be authorised by means of a General Authorisation;
- No activity may therefore take place within a watercourse unless it is authorised by the DWS; and
- Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from DWS in terms of Section 21.

1.5. Equator Principles

The Equator Principles aim to ensure that all companies that apply to the Equator Principles Financial Institution (EPFI) for capital are utilising natural resources responsibly and with focus on sustainability of their operations. The Equator Principles further aim to ensure that any development projects in foreign countries are managed to the same level as they would be in a more developed country, or the country of origin in which the development corporation is based.

1.6. Indemnity and Terms of use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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2. ASSESSMENT APPROACH

2.1. General Approach

In order to accurately determine the PES of the study area and capture comprehensive data with respect to floral, faunal and wetland taxa, the following methodology was used:

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potential sites of high or increased ecological sensitivity including wetland resources and ridge habitats. An initial visual on-site assessment of the study area was made in order to confirm the assumptions made during consultation of the maps;
- A literature review with respect to habitats, vegetation types and species distribution was conducted. Relevant databases considered during the assessment of the study area included the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP), the Limpopo Environmental Management Act (LEMA, 2003), the National Environmental Management Biodiversity Act (NEMBA, Act 10 of 2004), Threatened or Protected Species (TOPS, 2013), the South African Bird Atlas Project (SABAP2), Pretoria Computer Information Systems (PRECIS) as well as the NFEPA and Limpopo Conservation Plan database and other relevant datasets;
- Field assessments were undertaken during April 2015 (Autumn/ Late Summer) and August 2015 (Late Winter) to determine the ecological status of the project site and the surrounding area. This is considered to be suitable times of year to conduct wet and dry season ecological assessment within this region;
- A reconnaissance ‘walkabout’ was initially undertaken to determine the general habitat types found throughout the study area and, following this, specific study sites were selected that were considered to be representative of the habitats found within

the area, with special emphasis being placed on areas that may potentially support RDL and other SCC species. Sites were investigated on foot in order identify the occurrence of the dominant plant species and habitat diversities; and

- Specific methodologies for the assessment, in terms of field work and data analysis of floral, faunal, wetland and aquatic ecological assemblages will be presented in the relevant sections.

2.2. Ecological Impact Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/ impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/ impacts have been assessed. The method to be used for assessing risks/ impacts is outlined in the sections below.

The first stage of risk/ impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[3]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as

[3] The definition has been aligned with that used in the ISO 14001 Standard.

components of the biophysical environment such as wetlands, flora and riverine systems.

- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to Table 2 below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[4].

The assessment of significance is undertaken twice. Initial significance is based only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (NEMA; Act 108 of 1997) in instances of uncertainty or lack of information by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[4] Some risks/impacts that have low significance will however still require mitigation

Table 2: Criteria for assessing impacts.

Note: Part A provides the definition for determining impact consequence (combining intensity, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D.

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, spatial extent and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**VL**	Very short, always less than a year.
	L	Short-term, occurs for more than 1 but less than 5 years.
	M	Medium-term, 5 to 10 years.
	H	Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)
	VH	Very long, permanent, +20 years (Irreversible. Beyond closure)
Criteria for ranking the EXTENT of impacts	**VL**	A portion of the site.
	L	Whole site.
	M	Beyond the site boundary, affecting immediate neighbours
	H	Local area, extending far beyond site boundary.
	VH	Regional/National

PART B: DETERMINING CONSEQUENCE

INTENSITY = VL

DURATION							
	Very long	VH	Medium	Medium	Medium	High	High
	Long term	H	Low	Medium	Medium	Medium	High
	Medium term	M	Low	Low	Medium	Medium	Medium
	Short term	L	Very low	Low	Low	Medium	Medium
	Very short	VL	Very low	Low	Low	Low	Medium

INTENSITY = L

DURATION							
	Very long	VH	Medium	Medium	High	High	High
	Long term	H	Medium	Medium	Medium	High	High
	Medium term	M	Low	Medium	Medium	Medium	High
	Short term	L	Low	Low	Medium	Medium	Medium
	Very short	VL	Very low	Low	Low	Medium	Medium

INTENSITY = M

DURATION							
	Very long	VH	Medium	High	High	High	Very High
	Long term	H	Medium	Medium	High	High	High
	Medium term	M	Medium	Medium	Medium	High	High
	Short term	L	Low	Medium	Medium	Medium	High
	Very short	VL	Very low	Low	Medium	Medium	Medium

INTENSITY = H

DURATION							
	Very long	VH	High	High	High	Very High	Very High
	Long term	H	Medium	High	High	High	Very High
	Medium term	M	Medium	Medium	High	High	High
	Short term	L	Medium	Medium	Medium	High	High
	Very short	VL	Low	Medium	Medium	Medium	High

INTENSITY = VH

DURATION							
	Very long	VH	High	High	Very High	Very High	Very High
	Long term	H	High	High	High	Very High	Very High
	Medium term	M	Medium	High	High	High	Very High
	Short term	L	Medium	Medium	High	High	High
	Very short	VL	Low	Medium	Medium	High	High
			VL	L	M	H	VH
			A portion of the site	Whole site	Beyond the site boundary, affecting immediate neighbours	Local area, extending far beyond site boundary.	Regional/ National
			EXTENT				

PART C: DETERMINING SIGNIFICANCE							
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**VH**	Medium	High	High	Very High	Very High
	Probable	**H**	Medium	Medium	High	High	Very High
	Possible/ frequent	**M**	**Low**	Medium	Medium	High	High
	Conceivable	**L**	**Low**	**Low**	Medium	Medium	High
	Unlikely/ improbable	**VL**	**Very low**	**Low**	**Low**	Medium	Medium
			VL	**L**	**M**	**H**	**VH**
			CONSEQUENCE				

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
Very High	Potential fatal flaw unless mitigated to lower significance.
High	It must have an influence on the decision. Substantial mitigation will be required.
Medium	It should have an influence on the decision. Mitigation will be required.
Low	Unlikely that it will have a real influence on the decision. Limited mitigation is likely to be required.
Very Low	It will not have an influence on the decision. Does not require any mitigation

***VH = very high, H = high, M= medium, L= low and VL= very low and + denotes a positive impact.**

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the project's area of influence encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/ Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction;
  - Operation; and
  - Rehabilitation/ Decommissioning and Closure.
- If applicable, transboundary or global effects were assessed;
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

2.2.1 Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed construction.

- Mitigation and performance improvement *measures* and actions that address the risks and impacts[5] are identified and described in as much detail as possible;
- Measures and actions to address negative impacts will favour avoidance and prevention over minimization, mitigation or compensation; and
- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation.

2.3. Sensitivity Mapping

All the ecological features of the study area were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). In addition identified locations of protected species were also marked by means of GPS. A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the proposed development.

2.4. Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through construction, operation and closure through to after care and maintenance.

[5] Mitigation measures should address both positive and negative impacts

3. LAND USE AND CONSERVATION CHARACTERISTICS OF THE PROJECT SITE

The following sections (Sections 3.1 – 3.5) contain data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable, high quality data, the various databases used not always provide an entirely accurate indication of a property's actual site characteristics. This information is however considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and areas where increased conservation importance is indicated were paid attention to.

3.1. National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI; BGIS).

According to the National List of Threatened Terrestrial Ecosystems (2011) the study area does not fall within an area identified as a threatened ecosystem.

3.2. National Biodiversity Assessment (NBA; 2011)

The latest NBA provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The NBA was led by the SANBI in partnership with a range of organisations. It follows on from the National Spatial Biodiversity Assessment (2004), broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial and local levels (SANBI BGIS).

According to the NBA, the study area is not located within a formally or informally protected area and falls within an area classified as poorly protected.

3.3. National Protected Area Expansion Strategy (NPAES, 2008)

The goal of the National Protected Area Expansion Strategy (NPAES) is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI BGIS).

According to the NPAES database, the study area is not affected by areas earmarked as part of the NPAES. A NPAES focus area is situated approximately 9km south east of the Project Infrastructure area, namely the North West/Gauteng Bushveld NPAES focus area, as depicted in Figure 4.

3.4. Important Bird and Biodiversity Areas (IBA; 2013)

The study area does not fall within an Important Bird and Biodiversity Area (IBA), but the Northern Turf Thornveld IBA is situated between 500m and 1,5km to the north thereof, as depicted in Figure 5. The Northern Turf Thornveld IBA holds the core of the remaining resident South African *Pterocles gutturalis* (Yellow-throated Sandgrouse) population, which inhabits short open grasslands, fallow fields and recently burnt veld, especially on black clay soils near water and is regionally threatened.

In addition to *P. gutturalis*, the globally threatened avifaunal species *Glareola nordmanni* (Black-winged Pratincole) and *Sagittarius serpentarius* (Secretarybird), as well as other regionally threatened species namely *Falco biarmicus* (Lanner Falcon) and *Ardeotis kori* (Kori Bustard) occur within this IBA.

Common biome-restricted species include *Turdus libonyanus* (Kurrichane Thrush), *Cossypha humeralis* (White-throated Robin-chat), *Lamprotornis australis* (Burchell's Starling), *Cinnyris talatala* (White-bellied Sunbird) and the fairly common *Erythropygia paean (*Kalahari Scrub Robin) (BirdLife South Africa, 2013).

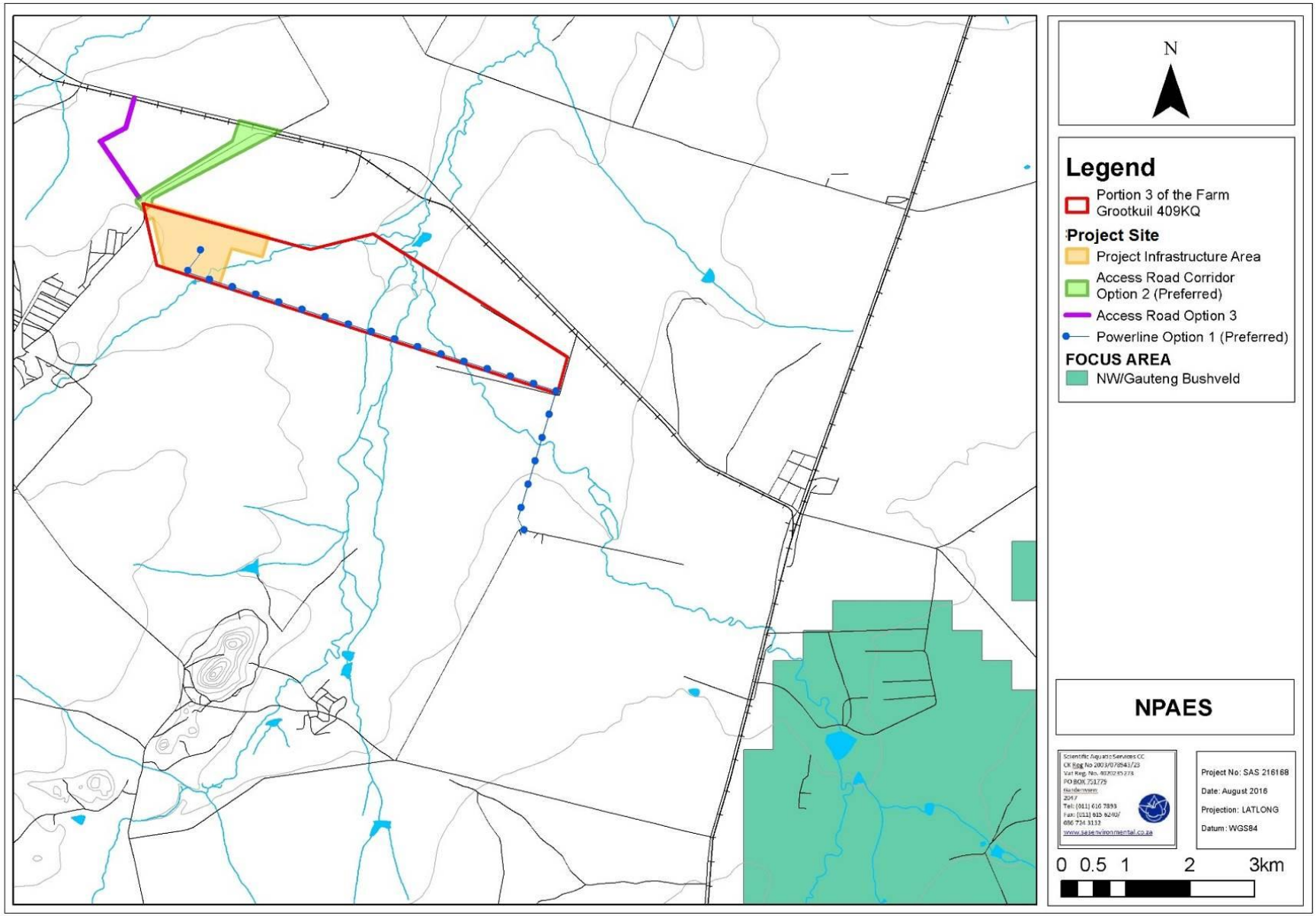

Figure 4: Map indicating an NPAES focus area to the south east of the study area.

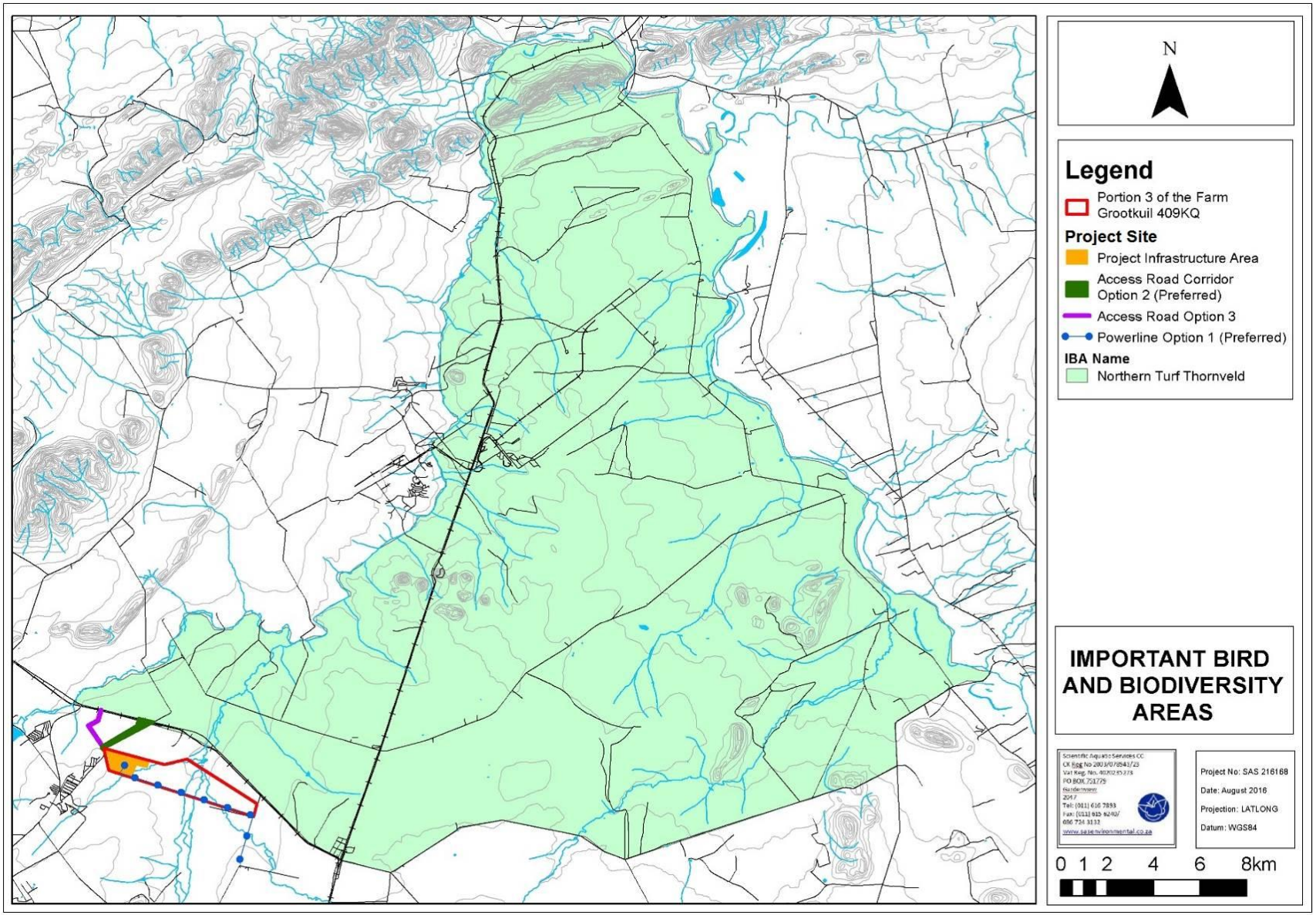

Figure 5: Study area in relation to the Northern Turf Thornveld Important Bird and Biodiversity Area.

3.5. Importance According to the Limpopo Conservation Plan Version 2 (2013)

The Limpopo Conservation Plan (2013) is one of a range of tools provided for in the National Environmental Management: Biodiversity Act (NEMBA; Act 10 of 2004) that can be used to facilitate biodiversity conservation in priority areas outside the protected area network. The purpose of this plan is to inform land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity (SANBI, BGIS).

The Limpopo Conservation Plan v2 was consulted in order to determine whether the study area, or specifically any portion of the Project Site, falls within any areas of conservation importance. From Figure 6, it is evident that The Project Infrastructure Area including the proposed infrastructure layout, falls within an area identified as having No Natural Habitat Remaining (NNR). The southeastern portion of the Proposed Infrastructure Area, outside of the proposed infrastructure layout, however falls within an Other Natural Area (ONA). The remainder of Portion 3 of the farm Grootkuil 409 KQ comprises areas identified as an ONA, a small portion identified as an Ecological Support Area 1 (ESA1) and an area identified as NNR within the western portion. The central and eastern portions of the study area is located within a Critical Biodiversity Area 2 (CBA2).

The eastern portion of the proposed powerline is located largely within an area indicated to be a CBA2, and the western portion thereof traverses areas indicated as an NNRs and an ONA. The preferred access road, namely Access Road Corridor Option 2, is located within an NNR and an ONA. The alternative access road alignment, namely Access Road Option 3, is located on the boundary between an NNR and an ONA, with the northern portion situated within an area indicated to be a CBA2.

It is important to note that the proposed infrastructure layout is located within an area indicated as a NNR, while the proposed powerline, although indicated to be located partially within a CBA2 is to be development along an existing powerline servitude (Section B). Both of the proposed access road alternative, of which one will be developed, also follow existing road or railway servitudes, and as such the proposed project is unlikely to impact on CBAs associated with the study area. Land management objectives have been identified for each category (LEDET, 2013) and are outlined in Table 3 below.

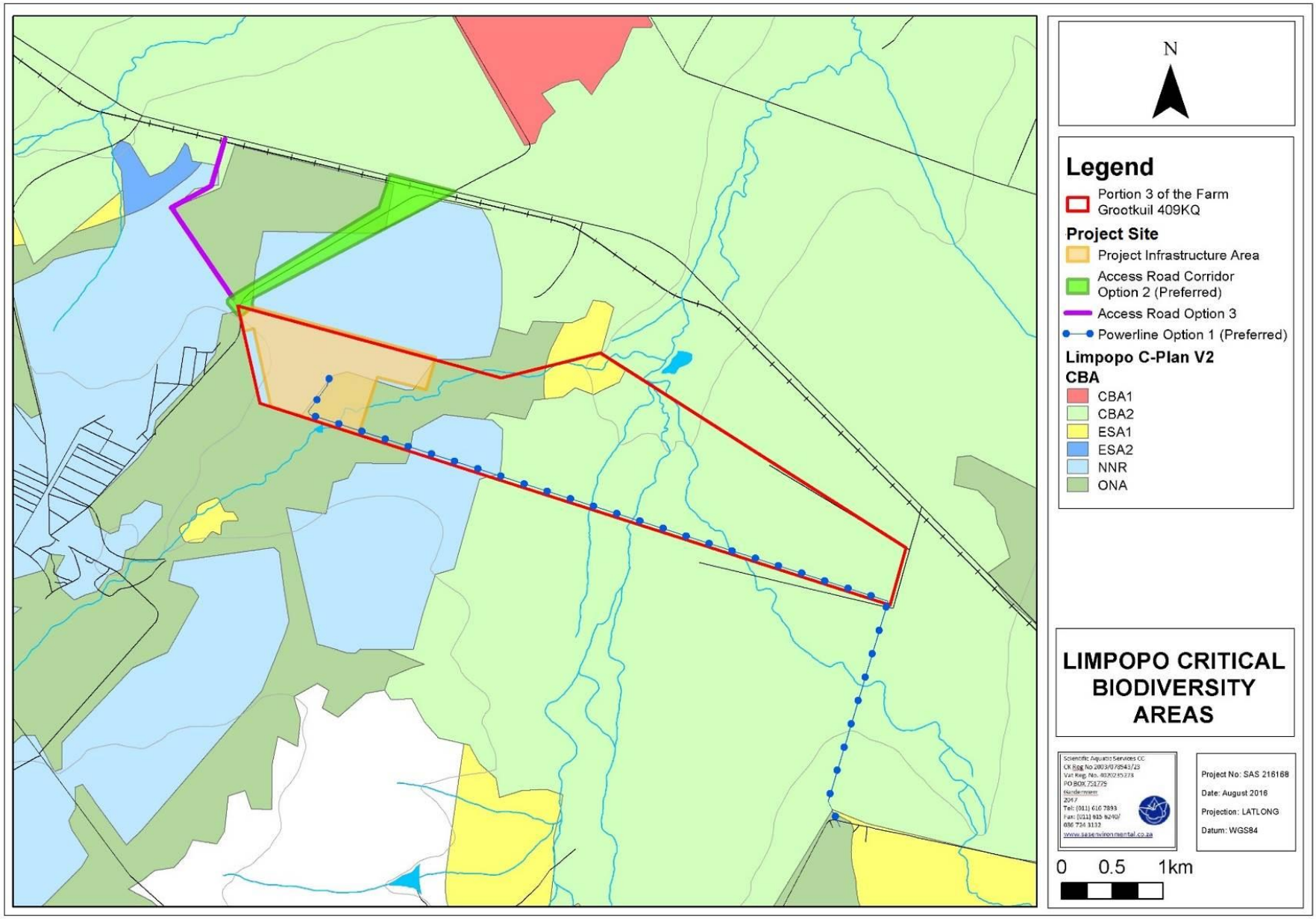

Figure 6: The study area in relation to the CBA map categories as indicated by the Limpopo Conservation Plan Version 2 (2013).

Table 3: General description of CBA Map categories and associated land management objectives (LEDET, 2013)

CBA map category	Description	Land management Objective	Land management recommendation	Compatible Land-use	Incompatible land-use
CBA1	Best Design Selected Sites. Areas selected to meet biodiversity pattern and/ or ecological process targets. Alternative sites may be available to meet targets.	Maintain in a natural state with limited or no biodiversity loss. Maintain current agricultural activities. Ensure that land use is not intensified and that activities are managed to minimise impact on threatened species.	Avoid conversion of agricultural land to more intensive land uses, which may have a negative impact on threatened species or ecological processes.	Current agricultural practices including arable agriculture, intensive and extensive animal production, as well as game and 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. Other (as for CBA1): 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 and 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.
ESA1	Natural, near natural and degraded areas supporting CBAs by maintaining ecological processes.	Maintain ecosystem functionality and connectivity allowing for limited loss of biodiversity patterns.	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, powerlines, 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). 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.
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 infrastructure.				

4. FLORAL DESCRIPTION

4.1. Biome and Bioregion

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford, 1997). The study area under assessment falls within the Savanna biome (Rutherford & Westfall, 1994). Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. The study area is situated within the Central Bushveld Bioregion (Mucina & Rutherford, 2006).

4.2. Vegetation Type

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area. Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. When the boundary of the study area is superimposed on the vegetation types of the surrounding area, it is clear that the study area falls within the Dwaalboom Thornveld vegetation type (Mucina & Rutherford, 2006) (Figure 7), which was previously classified as Other Turf Thornveld (Acocks, 1953) and Clay Thorn Bushveld by Low & Rebelo (1996).

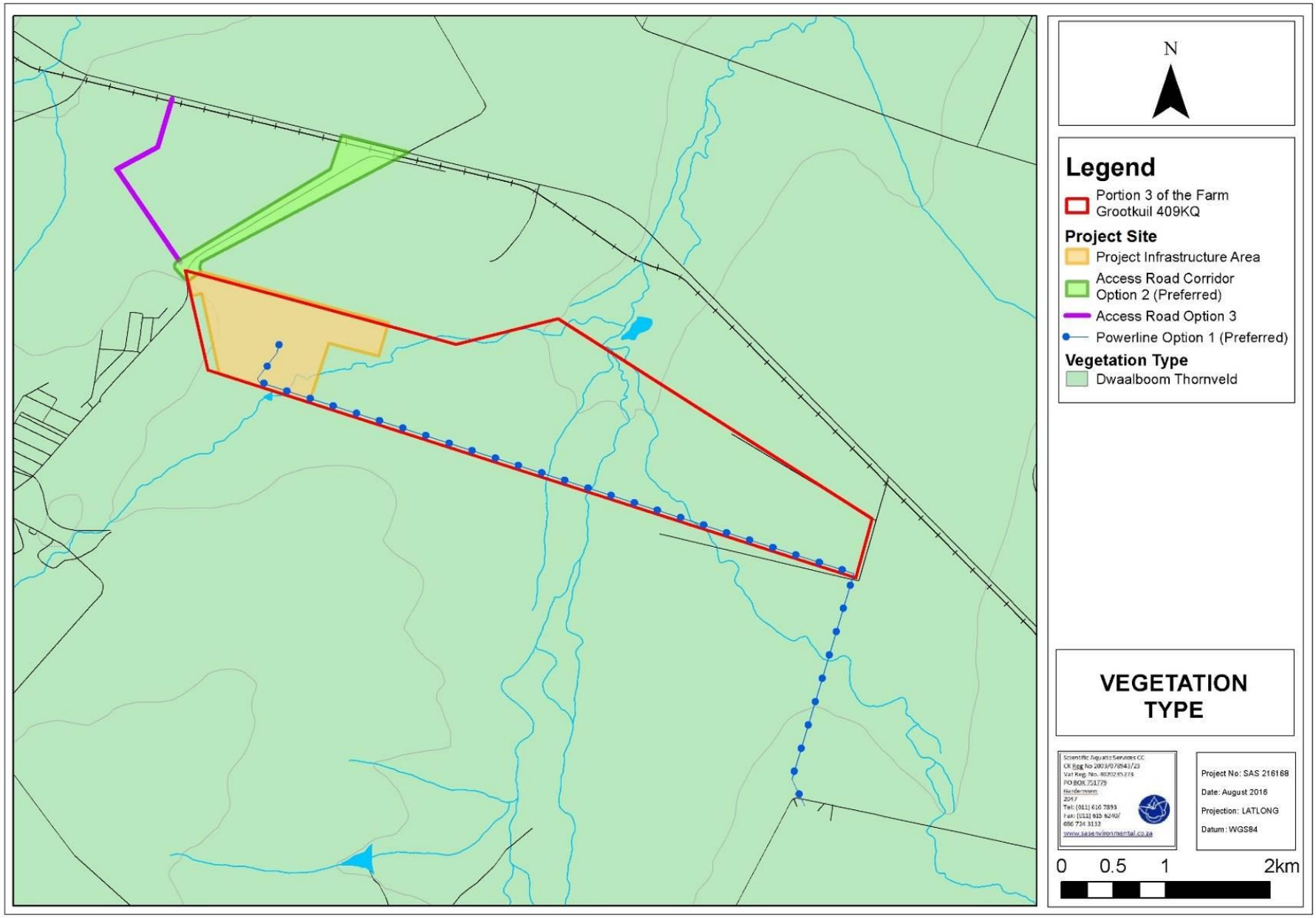

Figure 7: Vegetation type associated with the study area (Mucina & Rutherford, 2010).

4.3. Dwaalboom Thornveld Landscape Characteristics

4.3.1 Distribution

The Dwaalboom Thornveld vegetation type occurs in the Limpopo and North West Provinces on flats north of the Dwarsberg and associated ridges, mostly 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. The altitude associated with this vegetation type varies between 900m and 1200m (Mucina & Rutherford, 2006).

4.3.2 Climate

Dwaalboom Thornveld is characterised by summer rainfalls with very dry winters. Mean Annual Precipitation (MAP) ranges from about 500-600mm. This vegetation type has the highest Mean Annual Potential Evaporation (MAPE) of savannah vegetation units outside the two Kalahari bioregions and frost is fairly frequent in winter (Mucina & Rutherford, 2006).

4.3.3 Geology and soils

The area is characterised by vertic black ultramafic clays which developed from norite and gabbro, also locally in small depressions along streams. Some areas have less clay, while other areas have a high base status and eutrophic red soils. Underlying geology is an Archaean granite-gneiss terrane of Swazian Erathem that is covered in parts by the mainly clastic as well as chemical sediments and volcanics of the Rayton and Silverton Formation, both of the Pretoria Group. Mafic intrusive rock of the Rustenberg Layered Suite and Bushveld Igneous Complex are present in the east and include the Bierkraal Manetite Gabbro. Bronzite, harzburgite, norite and anorthosite are the major rocks of the Rustenberg Suite and the land types are mainly Ea and Ae (Mucina & Rutherford, 2006).

4.3.4 Conservation

In terms of conservation, Dwaalboom Thornveld is considered to be Least Threatened and is not endemic to the Limpopo Province. The conservation target for the vegetation type is 19%, but only around 6% is statutorily conserved, mostly within the Madikwe Game Reserve in the west. About 14% of the vegetation type is transformed, mainly as a result of cultivation activities and extensive cattle grazing, which is the main land use within the vegetation type.

In general, erosion throughout the vegetation type is very low to low (Mucina & Rutherford, 2006).

4.3.5 Dominant Floral Taxa

In terms of recent vegetation classifications, the study area occurs within the Dwaalboom Thornveld vegetation type (Mucina & Rutherford, 2006). This vegetation type occurs as plains with a layer of scattered, low to medium high, deciduous microphyllous trees and shrubs with a few broad-leaved tree species, and an almost continuous herbaceaous layer dominated by grass species. *Vachellia tortilis* and *V. nilotica* dominate on the medium clay soils. On particularly heavy clays most other woody plants are excluded and the diminutive *V. tenuispina* dominates at a height of less than 1m above the ground. On the sandy clay loams *V. erubescens* is the most prominent tree. The alternation of these substrate types creates a mosaic of patches typically 1-5 km across, for example in the unit west of Thabazimbi (Mucina & Rutherford, 2006)

Table 4: Dominant and typical floristic species of Dwaalboom Thornveld (Mucina & Rutherford, 2006).

GRASS SPECIES	FORB SPECIES	TREE/SHRUB SPECIES
Aristida bipartita (*d) *Bothriochloa insculpta* (d) *Digitaria eriantha* subsp. *eriantha* (d) *Ischaemum afrum* (d) *Panicum maximum* (d) *Cymbopogon pospischilii* *Eragrostis curvula* *Sehima galpinii* *Setaria incrassata*	*Heliotropium ciliatum* *Kohautia caespitose* subsp. *brachyloba* *Nidorella hottentotica.*	Tall trees: ***Vachellia erioloba* Small trees: *Vachellia erubescens* (d) *V. nilotica* (d) *V. tortilis* subsp. *heteracantha* (d) ***Senegalia fleckii* *S. melifera* subsp. *detinens* *Combretum imberbe* *Searsia lancea* *Ziziphus mucronata* Tall shrubs: *Acacia hebeclada* subsp. *hebeclada* *Combretum hereroense* *Diospyros lycioides* subsp. *lycioides* *Euclea undulate* *Grewia flava* *Tarchonanthus camphoratus* Low shrubs: *Acacia tenuispina* (d) *Abutilon austro-africanum* *Aptosimum elongatum* *Hirpicium bechuanense* *Pavonia burchellii* *Solanum delagoense* Succulent shrubs: *Kalanchoe rotundifolia* *Talinum caffrum* Herbaceous climber: *Rhynchosia minima*

***(d) – Dominant species for the vegetation type.**
****The genus *Acacia* has been recategorised into *Vachellia* or *Senegalia***

5. AQUATIC CHARACTERISTICS

5.1. Aquatic Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the study area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The study area falls within the Bushveld Basin Aquatic Ecoregion and is located within two quaternary catchments, A24E and A24F. All wetlands and riparian features within the study area are however located in the A24E quaternary catchment and this catchment is therefore applicable to the biomonitoring sites assessed as part of the Aquatic Assessment. The main attributes of the Bushveld Basin Aquatic Ecoregion are presented in Table 5 below:

Table 5: Main attributes of the Bushveld Basin Ecoregion.

Main attributes	Bushveld basin
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief**; Plains; Moderate Relief; Lowlands; Hills and Mountains: Moderate and High Relief; Open Hills; Lowlands; Mountains: Moderate to High Relief; Closed Hills; Mountains: Moderate and High Relief (limited)
Vegetation types (dominant types in bold) (Primary)	**Mixed Bushveld;** Clay Thorn Bushveld; Waterberg Moist Mountain Bushveld (limited)
Altitude (m a.m.s.l) (modifying)	700-1700 (1700-1900 very limited)
MAP (mm) (Secondary)	400 to 600
Coefficient of Variation (% of annual precipitation)	25 to 35
Rainfall concentration index	55 to >65
Rainfall seasonality	Early to mid-summer
Mean annual temp. (°C)	14 to 22
Mean daily max. temp. (°C): February	22 to 32
Mean daily max. temp. (°C): July	14 to 24
Mean daily min. temp. (°C): February	12 to 20
Mean daily min temp. (°C): July	0 to 6
Median annual simulated runoff (mm) for quaternary catchment	20 to 100

5.2. Quaternary Catchment

The PES/EIS database, as developed by the DWS Resource Quality Information Services (RQIS) department, was utilised to obtain additional background information on the study area and surrounds. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-

Quaternary Catchment Reach (SQR) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, Ecological Water Requirements (EWR) sites and Hydro Water Management System (WMS) sites.

The results obtained serve to summarise this information as a background to the conditions within the study area:

Table 6: Summary of the ecological status of quaternary catchment A24E.

Sub-Quaternary Reach (SQR)	SQR Name	PES Category Median	Mean EI Class	Mean ES Class	Length (km)	Stream order	Default EC (Based on Median PES and Highest of EI or ES means)
A24E-00642	Sefathlane (Brakspruit)	C	Moderate	Low	13.56	2	C
A24E-00652	Phufane	C	Moderate	Very Low	36.08	1	C
A24E-00623	Brakspruit	C	Moderate	Moderate	7.26	2	C
A24E-00696	Sefathlane (Brakspruit)	C	Moderate	Low	35.03	1	C

From the assessment of the PES/EIS data, the following points are highlighted which summarise the data:

The invertebrate data list, indicated below, which is available for the Brakspruit (A24E-00623) is considered to be representative of the larger study area (Table 7). However, this SQR specifically represents the larger Brakspruit. Because some of the assessed sites are located on smaller rivers which are tributaries of the Brakspruit, all the families listed below may not necessarily occur there due to natural limitations caused by lack of flowing water and limited habitat.

Table 7: Invertebrate families listed for the Brakspruit (A24E-00623).

Invertebrate families listed for the Brakspruit (A24E-00623).		
Aeshnidae	Dytiscidae	Muscidae
Atyidae	Gerridae	Naucoridae
Baetidae (1 species)	Gomphidae	Nepidae
Belostomatidae	Gyrinidae	Notonectidae
Caenidae	Hirudinea	Oligochaeta
Ceratopogonidae	Hydrophilidae	Pleidae
Chironomidae	Hydracarina	Potamanautidae
Coenagrionidae	Hydrometridae	Tabanidae
Corixidae	Leptoceridae	Tipulidae
Culicidae	Libellulidae	Vellidae/ Mesovellidae

Fish data is available for the Brakspruit (A24E-00623) in the larger project site and is considered to be representative of what may be expected in the study area (Table 8).

Table 8: Fish data listed for the Brakspruit (A24E-00623).

Scientific Name	Common name
Aplocheilichthys johnstoni Günther, 1893	Johnston's Lampeye
Labeobarbus marequensis Smith, 1841	Largesclae Yellowfish
Barbus paludinosus Peters, 1852	Straightfin Barb
Barbus trimaculatus Peters, 1852	Threespot Barb
Barbus unitaeniatus Günther, 1866	Longbeard Barb
Chetia flaviventris Trewavas, 1961	Canary Kurper
Clarias gariepinus Burchell, 1822	African Sharptooth Catfish
Labeo cylindricus Peters, 1852	Redeye Labeo
Labeo molybdinus Du Plessis, 1963	Leaden Labeo
Boulenger, 1908	River Sardine
Oreochromis mossambicus Peters, 1852	Mozambique Tilapia
Pseudocrenilabrus philander Weber, 1897	Southern Mouth-Brooder
Tilapia sparrmanii Smith, 1840	Banded Tilapia

Table 9: Summary of the ecological status of the sub-quaternary catchment reach (SQR) A24E-00623 (Brakspruit) based on the DWS RQS PES/EIS database

Synopsis (SQR A24E-00623 Brakspruit)					
PES[1] category median	**Mean EI[2] class**	**Mean ES[3] class**	**Length (km)**	**Stream order**	**Default EC[4]**
C	Moderate	Moderate	7.26	2.0	C
PES details					
Instream habitat continuity MOD		Small	**Riparian/wetland zone MOD**		Moderate
RIP/wetland zone continuity MOD		Small	**Potential flow MOD activities**		Moderate
Potential instream habitat MOD activities		Moderate	**Potential physico-chemical MOD activities**		Large
EI details					
Invertebrate taxa/SQ		30.00	**Invertebrate average confidence**		3.0
Invertebrate representivity per secondary class		Moderate	**Invertebrate rarity per secondary class**		Moderate
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating		Low	**Habitat diversity class**		Very Low
Habitat size (length) class		Very Low	**Instream migration link class**		Very High
Riparian-wetland zone migration link		Very High	**Riparian-wetland zone habitat integrity class**		High
Instream habitat integrity class		High	**Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m**		Very High
Riparian-wetland natural vegetation rating based on expert rating					High
Fish spp./SQ		13.00	**Fish: Average confidence**		1.00
Fish representivity per secondary per secondary class		Moderate	**Fish rarity per secondary per secondary class**		Moderate
ES details					
Fish physical-chemical sensitivity description		High	**Fish no-flow sensitivity description**		High
Invertebrates physical-chemical sensitivity description		Moderate	**Invertebrates velocity sensitivity**		High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description					Very Low
Stream size sensitivity to modified flow/water level changes description					Low
Riparian-wetland vegetation intolerance to water level changes description					Low

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the South African River Health Programme (RHP) as part of the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), are presented in the table below and will be used as the basis of classification of the systems in this desktop study as well as future field studies.

Table 10: Classification of river health assessment classes in line with the NAEHMP.

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

The Institute for Water Quality Studies (IWQS) quaternary catchment database was used as reference for the catchment of concern, in order to define the EIS, Present Ecological Management Class (PEMC) and Default Ecological Management Class (DEMC). The sections that follow indicate the aquatic ecoregion and quaternary catchment in which the study area falls and the characteristics of the ecology of the major drainage system in this quaternary catchment. It must be noted that the Brakspruit and Phufane River systems are tributaries of the Bierspruit located north of the study area.

According to the ecological importance classification for the quaternary catchment, the Bierspruit can be classified as a resilient system, which, in its present state, can be considered a Class B (Largely natural) stream. The results of the assessment are summarised in the table below. It must be noted however that the assessment point for the quaternary catchment is located on the Bierspruit and some significant deviations from the conditions in the various tributaries of the Bierspruit are likely. Extrapolation of these observations must therefore be done with caution.

Table 11: Quaternary Catchment information.

Catchment	Resource	EIS	PESC	DEMC
A24E	Bierspruit	Low/Marginal	Class B	Class D (Resilient Systems)

The points that follow summarise the impacts on the aquatic resources in A24E quaternary catchment (Kleynhans, 1999):

- The aquatic resources within this quaternary catchment have not been significantly affected by bed modification;

- Low/ marginal impacts have occurred as a result of flow modifications;
- Low impacts from introduced instream biota;
- Low/ marginal impacts from inundation are present within the catchment;
- Moderate impacts of riparian and bank conditions; and
- Low impacts from water quality modification.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riparian systems in this catchment have a marginal/low diversity of habitat types;
- Very low importance in terms of conservation areas and conservation of biodiversity;
- The riparian resources have a low intolerance to changes in flow and flow related water quality;
- Low importance in terms of faunal migration;
- No importance in terms of rare and endangered species conservation;
- Marginal/low importance as a source of refugia for aquatic species;
- Low sensitivity to changes in water quality and water flow;
- Low species/taxon richness; and
- No importance in terms of unique species conservation.

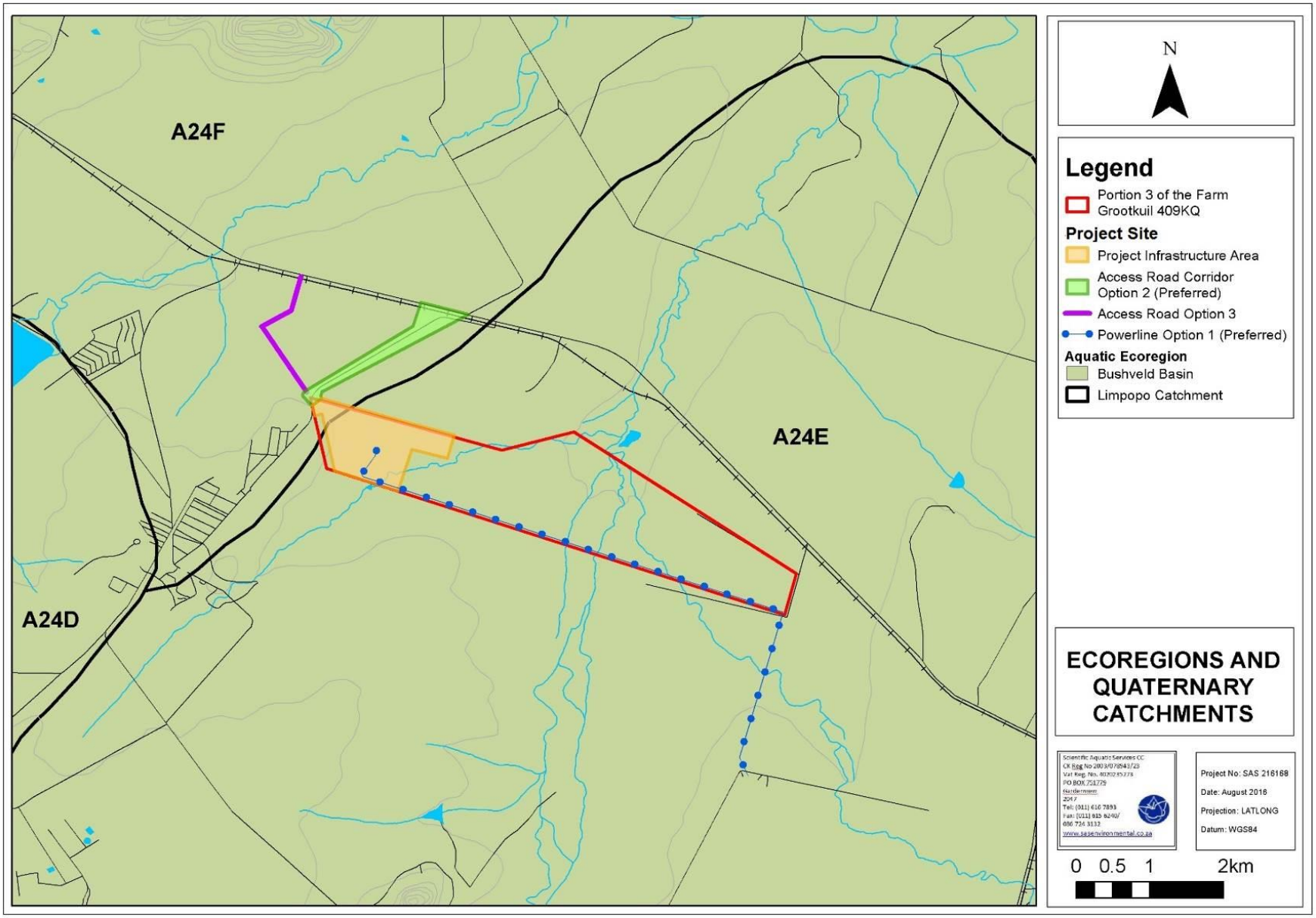

Figure 8: The Aquatic Ecoregion and quaternary catchments applicable to the study area.

5.3. Importance According to the National Freshwater Ecosystems Priority Areas (NFEPA) database (2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), SANBI, DWS, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable natural resource, with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA (2011) database was consulted to define the aquatic ecology of the wetlands and riparian systems close to and within the study area that may be of ecological importance. Aspects applicable to the study area and surroundings are discussed below:

- The study area falls within the Crocodile (West) and Marico Water Management Area (WMA). Each Water Management Area is divided into several sub-Water Management Areas (subWMA), where catchment or watershed is defined as a topographically defined area which is drained by a stream or river network. The Sub-Water management unit indicated for the study area is the Lower Crocodile sub-WMA;
- The subWMA is not regarded important in terms of fish sanctuaries, rehabilitation or corridors;
- The subWMA is not considered important in terms of translocation and relocation zones for fish;
- The subWMA is not listed as a fish Freshwater Ecosystem Priority Area (FEPA);
- Two rivers are indicated by the NFEPA database to traverse the study area, namely the Phufane River and the Sefathlane River. These two rivers form tributaries of the

Brakspruit River that is situated north of the study area, as depicted in Figure 9. It is important to note that a discrepancy exists between this and the topographical map regarding the extent of the Sefathlane River. It has therefore been assumed the confluence of the Sefathlane and Brakspruit is south of the study area although Figure 9 suggests otherwise;

- The Phufane River is indicated to be a non-perennial river which is in a Class C (Moderately modified) condition, while the non-perennial Sefathlane River (Bierspruit River) is indicated to be in a Class D (Largely modified) condition (Figure 10); and
- No wetland features are indicated by the NFEPA wetland database to occur within the study area, however a small channelled valley bottom wetland, is indicated to the south and an unchannelled valley bottom wetland is indicated just outside of the northern boundary of the proposed project site, as depicted in Figure 11.

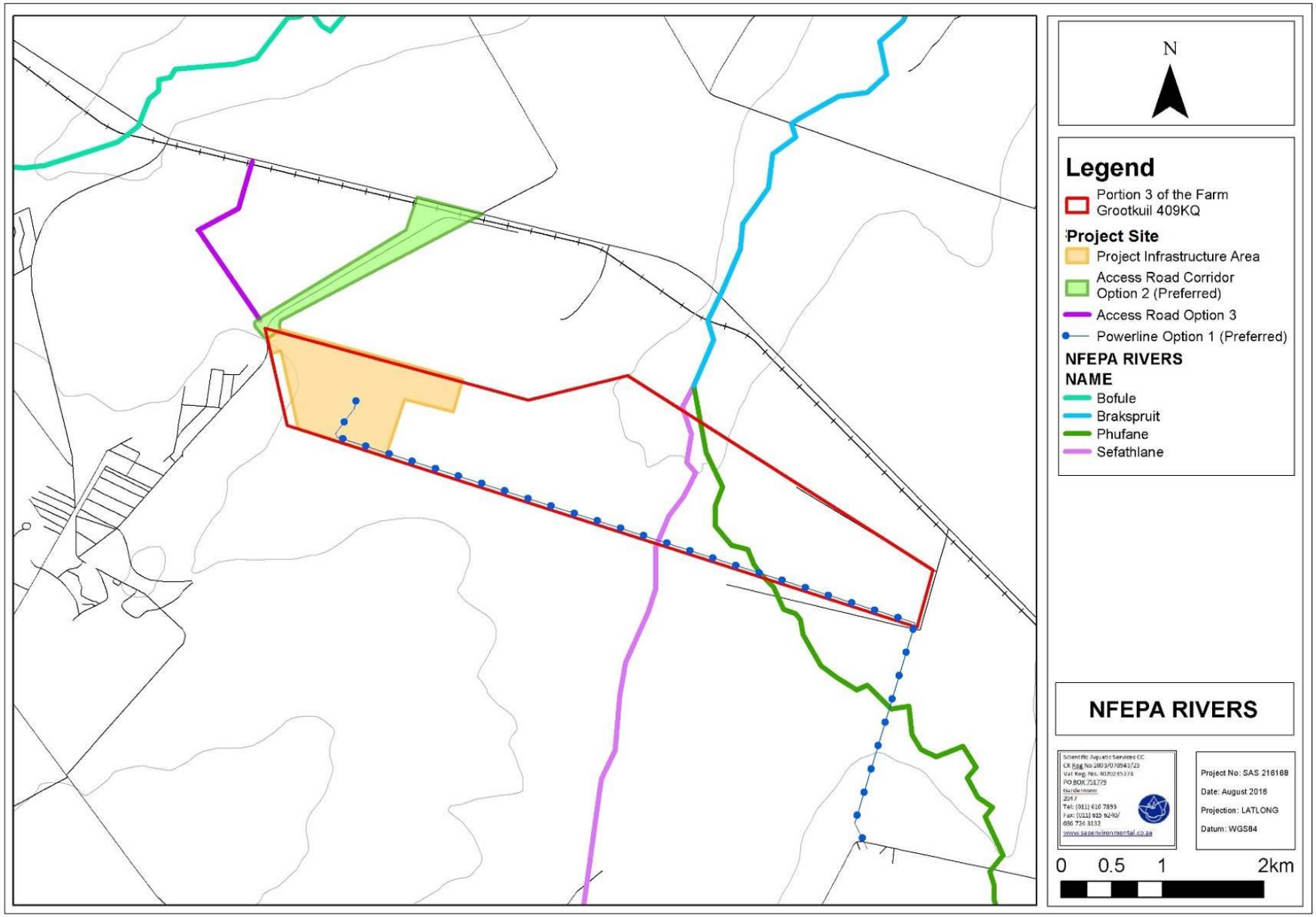

Figure 9: Map depicting the location of rivers located in the vicinity of the study area according to the NFEPA database.

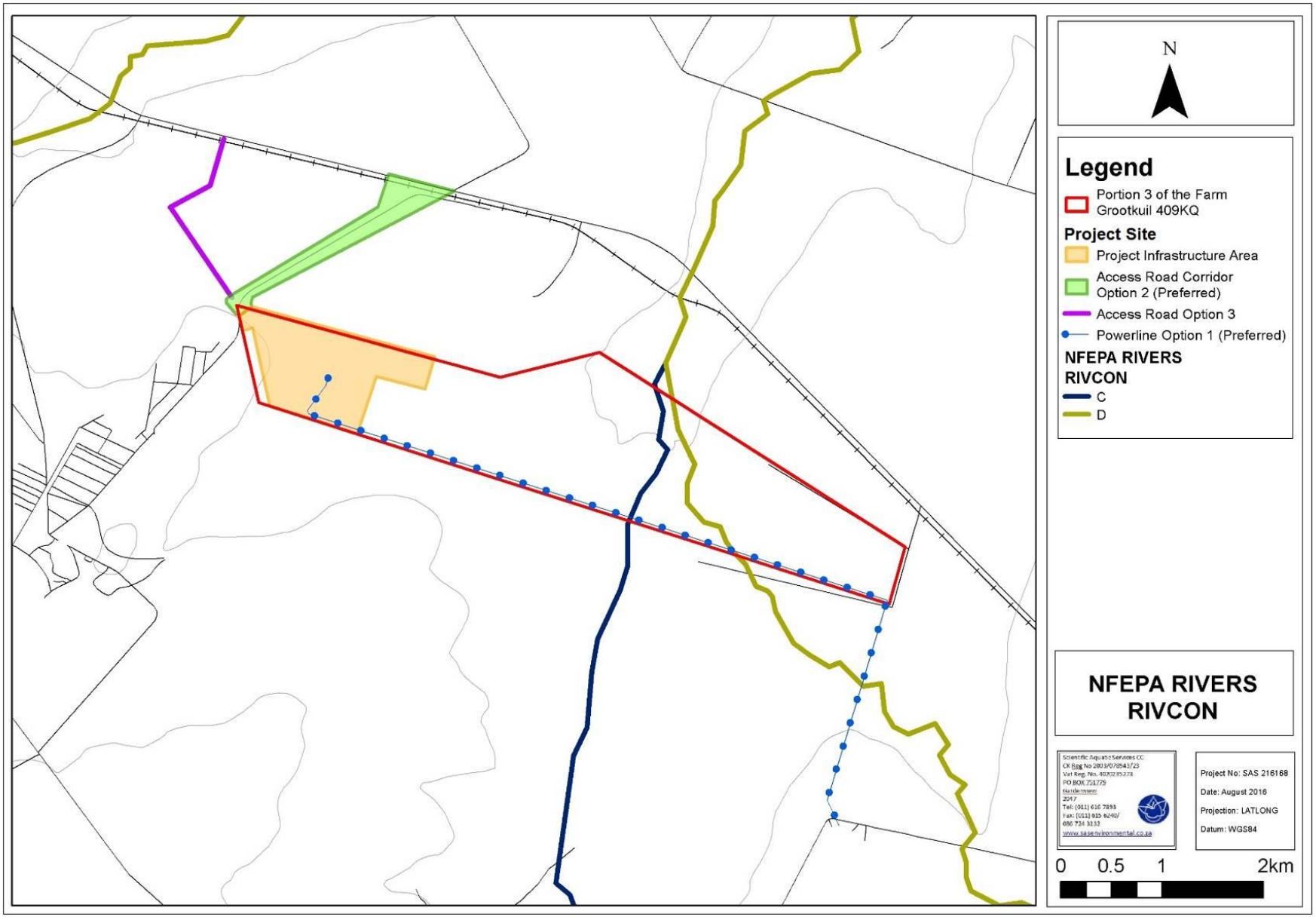

Figure 10: Map depicting the river conditions of the rivers in the vicinity of the study area according to the NFEPA database.

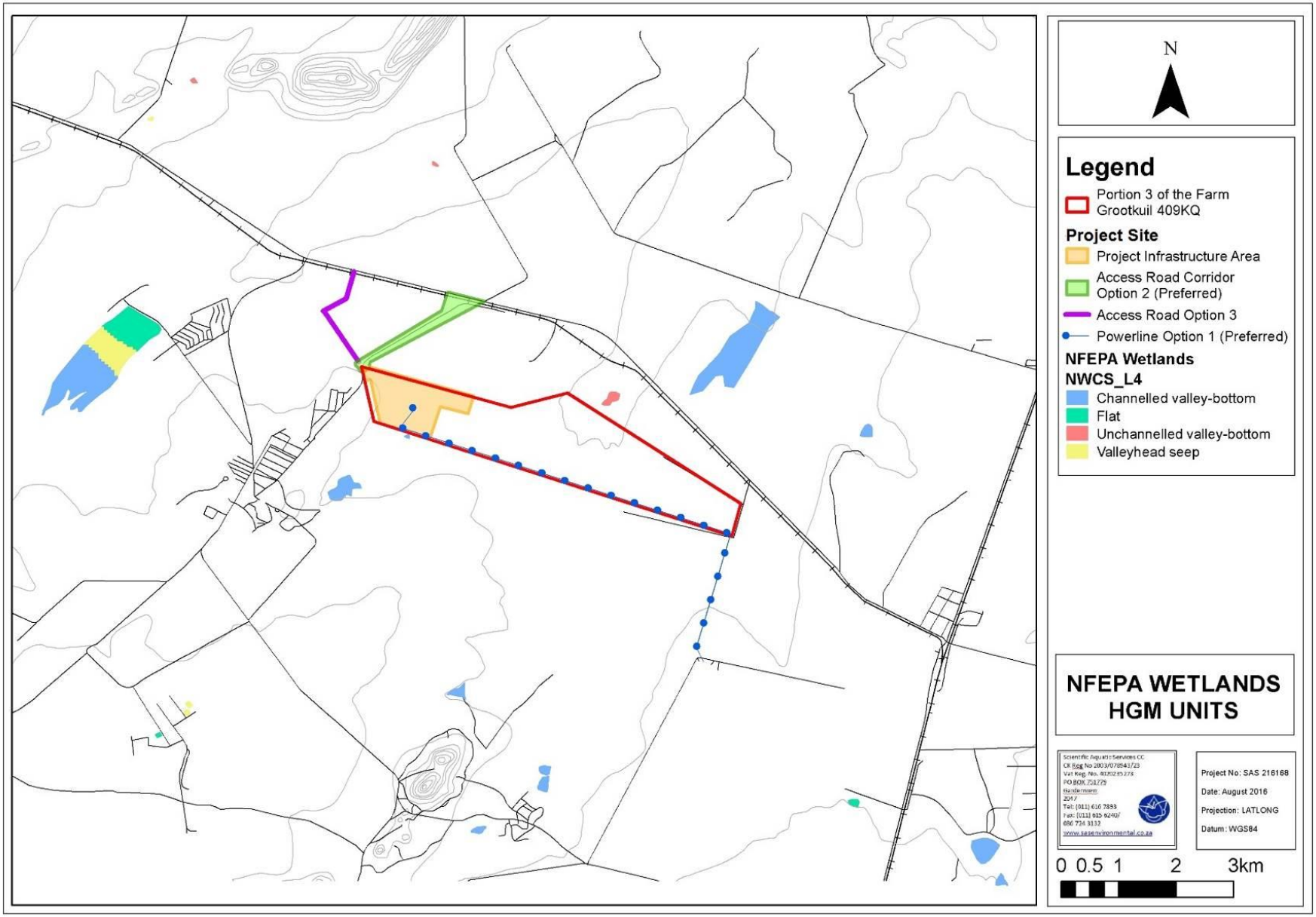

Figure 11: Map depicting wetlands in the vicinity of the study area according to the NFEPA database.

6. SURROUNDING PROPERTIES/LAND USES

Land uses surrounding the study area include a combination of crop farming, livestock grazing, game farming, mining, roads, rail and residences and other recreational land uses.

7. STRUCTURE OF THE REPORT

Section A of this report served to provide an introduction to the study area, the general approach to the study as well as the method of impact assessment. Section A also presents the results of general desktop information reviewed as part of the study including the information generated by the relevant authorities as well as the context of the site in relation to the surrounding anthropogenic activities and ecological character. In addition to this, Section A also provides the reader with details of how and in what sections the requirements for specialist studies (in accordance with Appendix 6 of the NEMA (2014) EIA Regulations contained in GN R982) are met. The section also includes the requirements for mitigation, monitoring and rehabilitation that are addressed in each section.

Section B addresses all aspects pertaining to the assessment of the floral ecology of the study area.

Section C addresses all aspects pertaining to the assessment of the faunal ecology of the study area.

Section D addresses all aspects pertaining to the assessment of the wetland ecology of the study area.

Section E addresses all aspects pertaining to the assessment of the aquatic ecology of the study area.

8. REFERENCES

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APPENDIX A

Specialist CVs

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)

Accredited River Health practitioner by the South African River Health Program (RHP)

Member of the South African Soil Surveyors Association (SASSO)

Member of the Gauteng Wetland Forum

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2002
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2000
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	1999

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces

Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe

Eastern Africa – Tanzania

West Africa – Ghana, Liberia, Angola, Guinea Bissau

Central Africa – Democratic Republic of the Congo

SELECTED PROJECT EXAMPLES

Development compliance studies

- Project co-leader for the development of the EMP for the use of the Wanderers stadium for the Ubuntu village for the World Summit on Sustainable Development (WSSD).
- Environmental Control Officer for Eskom for the construction of an 86Km 400kV power line in the Rustenburg Region.
- Numerous Environmental Impact Assessment (EIA) and EIA exemption applications for township developments and as part of the Development Facilitation Act requirements.

- EIA for the extension of mining rights for a Platinum mine in the Rustenburg area by Lonmin Platinum.
- EIA Exemption application for a proposed biodiesel refinery in Chamdor.
- Compilation of an EIA as part of the Bankable Feasibility Study process for proposed mining of a gold deposit in the Lofa province, Liberia.
- EIA for the development of a Chrome Recovery Plant at the Two Rivers Platinum Mine in the Limpopo province, South Africa.
- Compilation of an EIA as part of the Bankable Feasibility Study process for the Mooihoek Chrome Mine in the Limpopo province, South Africa.
- Mine Closure Plan for the Vlakfontein Nickel Mine in the North West Province.

Specialist studies and project management

- Development of a zero discharge strategy and associated risk, gap and cost benefit analyses for the Lonmin Platinum group.
- Development of a computerised water balance monitoring and management tool for the management of Lonmin Platinum process and purchased water.
- The compilation of the annual water monitoring and management program for the Lonmin Platinum group of mines.
- Analyses of ground water for potable use on a small diamond mine in the North West Province.
- Project management and overview of various soil and land capability studies for residential, industrial and mining developments.
- The design of a stream diversion of a tributary of the Olifants River for a proposed opencast coal mine.
- Waste rock dump design for a gold mine in the North West province.
- Numerous wetland delineation and function studies in the North West, Gauteng and Mpumalanga Kwa-Zulu Natal provinces, South Africa.
- Hartebeespoort Dam Littoral and Shoreline PES and rehabilitation plan.
- Development of rehabilitation principles and guidelines for the Crocodile West Marico Catchment, DWAF North West.

Aquatic and water quality monitoring and compliance reporting

- Development of the Resource quality Objective framework for Water Use licensing in the Crocodile West Marico Water management Area.
- Development of the Resource Quality Objectives for the Local Authorities in the Upper Crocodile West Marico Water management Area.
- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Lonmin Platinum groups water monitoring program.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Initiation and management of a physical, chemical and biological monitoring program, President Steyn Gold Mine Welkom.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for African Rainbow Minerals Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several Gold mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for the Valpre bottled water plant (Coca Cola South Africa).
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane for all their Waste Water Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.
- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in southern, central and west Africa.

Wetland delineation and wetland function assessment

- Wetland biodiversity studies for three copper mines on the copper belt in the Democratic Republic of the Congo.
- Wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Terrestrial and wetland biodiversity studies for developments in the mining industry.
- Terrestrial and wetland biodiversity studies for developments in the residential commercial and industrial sectors.
- Development of wetland riparian resource protection measures for the Hartbeespoort Dam as part of the Harties Metsi A Me integrated biological remediation program.
- Priority wetland mammal species studies for numerous residential, commercial, industrial and mining developments throughout South Africa.

Terrestrial ecological studies and biodiversity studies

- Development of a biodiversity offset plan for Xstrata Alloys Rustenburg Operations.
- Biodiversity Action plans for numerous mining operations of Anglo Platinum throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Assmang Chrome throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Xstrata Alloys and Mining throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plan for the Nkomati Nickel and Chrome Mine Joint Venture.
- Terrestrial and wetland biodiversity studies for three copper mines on the copperbelt in the Democratic Republic of the Congo.
- Terrestrial and wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Numerous terrestrial ecological assessments for proposed platinum and coal mining projects.
- Numerous terrestrial ecological assessments for proposed residential and commercial property developments throughout most of South Africa.
- Specialist Giant bullfrog (*Pyxicephalus adspersus*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist Marsh sylph (*Metisella meninx*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Project management of several Red Data Listed (RDL) bird studies with special mention of African grass owl (*Tyto capensis*).
- Project management of several studies for RDL Scorpions, spiders and beetles for proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist assessments of terrestrial ecosystems for the potential occurrence of RDL spiders and owls.
- Project management and site specific assessment on numerous terrestrial ecological surveys including numerous studies in the Johannesburg-Pretoria area, Witbank area, and the Vredefort dome complex.
- Biodiversity assessments of estuarine areas in the Kwa-Zulu Natal and Eastern Cape provinces.
- Impact assessment of a spill event on a commercial maize farm including soil impact assessments.

Fisheries management studies

- Tamryn Manor (Pty.) Ltd. still water fishery initiation, enhancement and management.
- Verlorenkloof Estate fishery management strategising, fishery enhancement, financial planning and stocking strategy.
- Mooifontein fishery management strategising, fishery enhancement and stocking programs.
- Wickams retreat management strategising.
- Gregg Brackenridge management strategising and stream recalibration design and stocking strategy.
- Eljira Farm baseline fishery study compared against DWAF 1996 aquaculture and aquatic ecosystem guidelines.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF MICHELLE PRETORIUS

PERSONAL DETAILS

Position in Company	Ecologist, Botanist, Visual specialist
Date of Birth	5 October 1982
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2011

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP)

Professional member of the South African Council for the Landscape Architectural Profession (SACLAP)

Member of the Botanical Society of South Africa

EDUCATION

Qualifications

BSc (Hons) Plant Science (University of Pretoria)	2009
BSc (Landscape Architecture) (University of Pretoria)	2006
BSc (Botany) (University of Pretoria)	2003

Short Courses

Global Mapper Training – Blue Marble Training	2014
Rehabilitation of Mine-impacted Land – Africa Land Use Training	2011
Mine Closure and Rehabilitation Conference – ITC	2011
Rehabilitation of Degraded Land – Africa Land Use Training	2009

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Western Cape

Tanzania

Democratic Republic of the Congo

SELECTED PROJECT EXAMPLES

Floral Assessments

- Floral assessment as part of the environmental assessment and authorisation process for the proposed Vandyksdrift project at the Wolvekrans Colliery, Mpumalanga.
- Floral assessment as part of the environmental authorisation process for the proposed Tharisa

North eastern waste rock dump, North West Province.

- Terrestrial ecological scan as part of the environmental authorisation process for the proposed Olievenhoutbosch linkage road, Gauteng.
- Floral assessment as part of the proposed Lekutung hotel, residential and golf estate development, North West Province.
- Phytosociological description, PES and function assessment of the floral resources in the vicinity of the Musonoi project in Kolwezi, Democratic Republic of Congo.
- Vegetation management plan for input into the closure planning process of the Tulawaka Gold Mine, Tanzania.
- Habitat evaluation in terms of floral integrity and PES in order to determine whether the grassland on the proposed Gillimead Agricultural Holdings development site has high conservation value, Gillimead, Gauteng.

Wetland Assessments

- Consideration of potential wetland features on the proposed Lanseria Extension 57 development site, Sunrella A.H, Gauteng.
- Riparian Vegetation Index determination and wetland delineation for the proposed Libertas Road upgrades, Gauteng.
- Wetland assessment along the proposed alignment of the bus rapid transit line 2a and 2b in the City of Tshwane, Gauteng.
- Wetland delineation in the vicinity of a proposed open pit development site, Modikwa Platinum Mine, Limpopo Province.

Rehabilitation Projects

- Wetland and watercourse rehabilitation plan for the river crossing in the vicinity of the Olifants River on Kleinfontein Mine, Mpumalanga
- Thaba Mall terrestrial rehabilitation plan – guideline document for landscape rehabilitation, Thabazimbi, Limpopo Province.
- Rehabilitation plan for a portion of a borrow pit in the vicinity of Soshanguve, Gauteng
- Rehabilitation and management plan for the Mamelodi Hatherley 132kV Power Line, City of Tshwane, Gauteng.

Environmental and Ecological Management Plans

- Environmental Management Plan for the Montana Tuine Erf 1611 & 1673 development, City of Tshwane, Gauteng.
- Ecological Management plan for the South Hills Mixed-use development, situated on Erf 1202 South Hills, Holding 88 of the Farm Klipriviersberg Estate Small Holding A.H. and Portion 65 (a portion of Portion 7) of the Farm Klipriviersberg 106-IR, South Hills (Moffat Park), Johannesburg, Gauteng.
- Environmental management plan for Erf 275, Meerhof township, Hartbeespoort dam, North West Province.

Environmental Control Officer

- Monthly specialist Environmental Control Officer (ECO) function to oversee the implementation of the wetland and watercourse rehabilitation plan for the river crossing in the vicinity of the

Olifants River on Kleinfontein Mine, Mpumalanga.

- Monthly specialist Environmental Control Officer (ECO) for the monitoring of wetland and ecological impacts on Portion 16 of the Farm Zondagsvlei 9-IS, Ogies, Mpumalanga.
- Monthly specialist Environmental Control Officer (ECO) function to oversee the implementation of the rehabilitation and management plan for the Klipkruisfontein development site, Shoshanguwe, Gauteng.

Plant Rescue and Relocation

- Report on the rescue and relocation of Hypoxis hemerocallidea adjacent to Lanseria Airport, Johannesburg, Gauteng.
- Report on the rescue of Hypoxis hemerocallidea, Boophane disticha and various other floral species at the mall of the south development site, Alberton, Gauteng.
- Report on the rescue and relocation of Hypoxis hemerocallidea at Forest Hill City – Phase 1, Monavoni x58, Gauteng.

Terrestrial Monitoring

- Terrestrial monitoring programme for Glencore Xstrata Eland Platinum Mine, North West Province.
- Terrestrial monitoring programme for Xstrata Boshoek, North West Province.

Visual Impact Assessments

- Visual impact assessment as part of the environmental assessment and authorisation process for the proposed Argent Colliery, Mpumalanga.
- Visual Impact Assessment as part of the EIA process for the proposed upgrade of the Zonderwater Prison Waste Water Treatment Works in the vicinity of Cullinan, Gauteng.
- Visual Impact Assessment as part of the EIA process for the proposed Springboklaagte Colliery, Mpumalanga.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF HENNIE DE BEER

PERSONAL DETAILS

Position in Company	Ecologist – Focusing on Avifaunal species
Date of Birth	20 October 1986
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2014

EDUCATION

Qualifications

National Diploma Nature Conservation (Tshwane University of Technology) 2008

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape and Freestate

Mozambique

SELECTED PROJECT EXAMPLES

Faunal

- Leandra Colliery (2015) – Faunal assessment as part of the environmental assessment and authorisation process for the proposed the Leandra Coal Project, Gauteng and Mpumalanga Provinces;
- Siyanda Chrome Smelter (2015) - Faunal assessment as part of the environmental assessment and authorisation process for a proposed construction of a ferrochrome smelter, Limpopo province;
- Lace Diamond Mine (2015) – Faunal assessment as part of the environmental assessment and authorisation process for the lace diamond mine near Kroonstad, free state province;
- Duhva Solar Plant (2015) – Avifaunal as part of the Environmental Impact Assessment and authorisation process for the proposed solar photovoltaic power plant with associated infrastructure at the Duvha Coal Fired Power Station, Mpumalanga province;
- Arnot Solar Plant – Avifaunal Assessment as part of the Environmental Impact Assessment and authorisation process for the proposed solar photovoltaic power plant with associated infrastructure at the Arnot coal fired power station, Mpumalanga Province;
- Braakfontein Colliery – Faunal Assessment as part of the Environmental Assessment and

authorisation process for the proposed Braakfontein Coal Mine near Newcastle, KwaZulu-Natal Province;

- Kekana Powerline – Faunal Ecological Assessment as part of the Environmental Assessment and authorisation process for the proposed Kekana and Wonderboom 132kV powerlines and substations, Hammanskraal, Gauteng;
- Samrand Phase 3 / Olievenhoutbosch – Floral, Faunal and Wetland Ecological Assessment as part of the Environmental Assessment and authorisation process for the proposed development of the Kosmosdal township on the remainder of portion 2 of the farm Olievenhoutbosch no. 389-jr, Gauteng Province;
- Jeanette Gold Mine – Faunal Assessment as part of the Environmental assessment and authorisation process for Jeanette expansion project at the Taung Gold International mine near Welkom within the Free State Province; and
- PTN 38 Elandspruit Farm – Faunal Assessment as part of the Environmental Assessment and authorisation process for the proposed mining development on portion 38 of the Elandspruit farm. Mpumalanga Province.

Terrestrial scan:

- K77 (2014) - Terrestrial scan Assessment as part of the Environmental Impact Assessment and authorisation process for the proposed development of the Provincial road K77, Gauteng highlands: Elizabeth road to K154; and
- Blue Hills EXT 39 - Biodiversity Assessment Fauna and Flora.

Alien Vegetation Monitoring Plan:

- Bokoni Platinum Mine (2015) - Alien vegetation study.

Maintenance and Management Plans:

- Levendal Pearl Valley Phase 2 Roads Bar – Maintenance and Management Plan;
- Sanbona Wildlife Reserve/Dwyka Lodge – Maintenance and Management Plan;
- Pearl Valley Bulk Services – Maintenance and Management Plan;
- Ariadne Eros Powerline – Maintenance and Management Plan; and
- Rhodes Drive/Constantia – Maintenance and Management Plan.

Wetland:

- R40 Ring Road Bushbuck Ridge – Wetland delineation and field work.

Previous Work Experience

- Eradication of aquatic plants from water canals using chemicals.
- Junior Research Technician National Rangeland Monitoring Program (NRMP) at Agriculture Research Council (ARC) doing Vegetation Condition Assessment for cattle farmers in the Vryheid area. Also did the following work for the Savanna Ecosystem Project: Vegetation Condition Assessments, Carrying Capacity, and annual game counts were done on 24 reserves in the Lowveld area, also at Gorongoza Mozambique. Rehabilitation monitoring of the mine dumps for Phalaborwa Mining Company.
- Assisted in the following programs doing practical year at Timbavati Private Nature Reserve:
    - Ringing of Ground Hornbill chicks on the reserve;
    - Monitoring project on nesting sites of White backed Vultures at Timbavati Private Nature

Reserve by using game census data and visiting the sites to see if the nesting sites were still active or not;

- Burning programs;
- Anti-poaching;
- Hunting;
- Culling;
- Bush thinning of *Colophospermum mopane (*Mopane); and
- Started a Lion identification key for all the Male lions on the reserve.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF MMAMPE APHANE

PERSONAL DETAILS

Position in Company	Wetland Ecologist
Date of Birth	16 May 1980
Nationality	South African
Languages	English, Sepedi
Joined SAS	2014

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South Africa Wetland Society

EDUCATION

Qualifications

BSc (Hons) Plant Science (University of Pretoria)	2011
BSc (Botany and Microbiology) (University of Limpopo)	2004

Short Courses

Wetland Assessment Course	2013

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal

SELECTED PROJECT EXAMPLES

Risk Assessments

- Motivation for the General Authorisation (GA) for the development of a medical waste facility in Rustenburg, North-West Province.
- Motivation for a GA for the prospecting activities on the Heuningkranz Farm, near Postmasburg, Northern-Cape Province.

Wetland assessments

- Wetland delineation assessment as part of the Environmental Authorisation (EA) process for the proposed Bokamoso housing project, North-West Province.
- Wetland delineation, Present Ecological State (PES) and ecoservices assessment of the wetland resources in the vicinity of the vanggatfontein and moabsveldin operations, Mpumalanga Province.
- Wetland study as part of the EA and authorisation process for the proposed development of a fire station in Cosmo City, Gauteng Province.

- Wetland Assessment as part of the environmental assessment for the proposed road crossing in Waterfall Estates, Gauteng Province.
- Assessment for the Royal Bafokeng resources Styldrift mining complex – EA to include the proposed Styldrift tailings storage facility, return water dams, topsoil stockpile and other associated infrastructure, North-West Province.
- Verification of the presence or absence of wetlands as part of the Environmental Assessment and Authorisation process for the proposed Sasol Charlie pollution control dam in Secunda, Mpumalanga Province.
- Wetland studies as part of the water use licensing process for the construction of a powerline from the Kashan sub-station to a new proposed sub-station, North-West Province.
- Wetland ecological assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the development of a pipeline in Sedibeng Municipality, Gauteng Province.
- Wetland ecological assessment for the proposed Bosmont Park recreational development, City of Johannesburg, Gauteng Province.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF LEANDRA JONKER

PERSONAL DETAILS

Position in Company	Aquatic Ecologist
Date of Birth	6 September 1988
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2012

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Accredited River Health practitioner by the South African River Health Program (RHP)

EDUCATION

Qualifications

MSc Aquatic Health (University of Johannesburg)	2015
BSc Environmental Management (Hons) (University of South Africa)	2011
BSc Botany and Zoology (North-West University)	2009

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo

SELECTED PROJECT EXAMPLES

Aquatic Biomonitoring

- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for Harmony Gold.
- Aquatic biomonitoring programs for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for selected North-West Waste Water Treatment Works.

Water Quality and Toxicity Monitoring

- Annual and Quarterly Water Monitoring and Management for the Bokoni Platinum Mine.
- Toxicological monitoring programs for several Xtrata Alloys Mines and Smelters.
- Toxicological monitoring programs for several Anglo Platinum Mines.
- Toxicological monitoring programs for several Assmang Chrome Operations.

- Toxicological monitoring programs for several Samancor Chrome Operations.

Water Use License Applications (WULA)

- A Water Use License Application for the construction of a box culvert bridge to provide access to the approved Olievenhoutbosch Shopping Centre, located on a portion of portion 123 of the farm Olievenhoutbosch 389 JR.
- A Water Use License Application for the proposed construction of a filling station on Erf 121 Laezonia Agricultural Holdings, Tshwane.
- A Water Use License Application for the proposed residential township establishment on portions 25 and 26 of the farm Swartkop 383 JR, (Celtisdal X 65 & 66), Raslouw Agricultural Holdings, City of Tshwane, Gauteng.

Rehabilitation Projects

- Riparian Rehabilitation and Management Plan for the Rustenburg Rapid Transport bridge upgrades, Rustenburg.
- Riparian Habitat Integrity Assessment and Rehabilitation Action Plan for the Pilanesberg Platinum Mine Stream Diversion.