ECOLOGICAL REPORT

PROPOSED UPGRADING OF THE VAAL GAMAGARA BULK WATER SUPPLY SCHEME

UPGRADING AND EXTENSION (BLACK ROCK TO THE BOTSWANA BORDER) OF THE VAAL GAMAGARA PIPELINE, NORTHERN CAPE PROVINCE

Applicant: **Sedibeng Water**
MDA Ref No: **40478**
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mda Town & Regional Planners, Environmental & Development

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1. INTRODUCTION

1.1 This report was prepared by Johann du Preez, ecologist at MDA Environmental Consultants Free State. Johann du Preez has a Ph.D. (University of the Free State) and is registered as a Professional Natural Scientist (SACNASP No. 400271/07) (Field of expertise: ecology and botany). He is also a member of the International Association for Vegetation Science (IAVS) as well as a member of BirdLife South Africa and IAIAsa. He has 30 years of experience in vegetation science and terrestrial ecology. Since the promulgation of NEMA (National Environmental management Act) (Act 107 of 1998), he is acting as vegetation and ecology specialist.

1.2 In order to comply with regulatory requirements of the National Environmental Management Act (Act 107 of 1998) WorleyParsons RSA Consultants (Kimberley) appointed MDA to undertake the following:

- an assessment of the terrestrial ecology (including the flora and fauna) in the study area as well as
- to identify ecologically sensitive areas along the pipeline routes.

1.3 The brief for this study can be summarised as follows:

- to undertake a terrestrial flora and fauna assessment along the proposed pipeline route;
- to source and review baseline information;
- to undertake the requisite field work and compile a report that considers the following aspects:
  - A broad description of the terrestrial ecological characteristics of the site and surrounds;
  - Identification and description of biodiversity patterns at community and ecosystem level (main vegetation type, plant and animal communities in vicinity and threatened / vulnerable ecosystems species), at species level (Red Data Book species, presence of alien species) and in terms of significant landscape features;
  - Identification of potential impacts and recommendations to mitigate these;

- Comment on whether or not biodiversity processes would be affected by the proposed project, and if so, how these would be affected;
- Identify no-go areas which are too sensitive to develop;
- Provide a preference ranking of the site in terms of terrestrial fauna and flora, with and without mitigation measures;
- To delineate any wetlands on the site and determine the boundaries of any riparian areas on the site associated with seasonal streams;
- The watercourse delineation undertaken as part of this report will be used to inform development plans for the property and to determine the extent of the developable area. The requirement to establish the existence and/or extent of watercourses on the properties are based on the legal requirements contained in both NEMA as well as the National Water Act which make it an offense to develop within a watercourse without the necessary authorization.

2. METHODOLOGY

2.1 Assumptions

A pipeline and pump stations exist along the proposed route. During the previous construction of the pipeline as well as the current operational phase certain impacts were caused to the environment.

2.2 Limitations

2.2.1 No detailed information of the vegetation or terrestrial fauna present on The Study Area exists. However general descriptions of the regional fauna and flora are available and were used. These descriptions were ground-truthed during site visits.

2.2.2 Not all the species present in these vegetation units could be noted due to the large expanse of The Study Area which prevented detailed surveys of the entire area. The pipeline route was devided into sections of more or less similar terrain morphology and vegetation type. These sections are listed below (Table 1). The survey was done in each of theses sections by means of a number of transects within each section.

Table 1: Sections of the proposed Vaal-Gamagara pipeline

Section	Reference points	
	From	To
1	Existing abstraction point	Kneukel pump station
2	Kneukel pump satation	Koopmansfontein
3	Koopmansfontein	Postmasburg
4	Postmasburg	Gamagara River (south bank)
5	Gamagara River (south bank)	Gamagara River (north bank)
6	Gamagara River (north bank)	Vlermuisleegte stream (south bank) (Gloria mine)
7	Vlermuisleegte stream (south bank) (Gloria mine)	Vlermuisleegte stream (north bank) (Gloria mine)
8	Vlermuisleegte stream (north bank) (Gloria mine)	Black Rock reservoir

2.3 Information Base for Desk Study

2.3.1 The following existing databases and Red Data Books were reviewed for relevant information:

2.3.1.1 Vegetation

- Vegetation maps: VEGMAP (Mucina *et al.* 2005);
- BGIS (SANBI);
- POSA (SANBI);
- Red Data Plant Lists (Raymondo *et al.* 2009);
- Vegetation descriptions (Mucina & Rutherford 2006);
- Field guides and books (Van Wyk & Malan, 1992; Van Wyk & Van Wyk 1997; le Roux *et al.* 1994; Van Oudtshoorn 1999).

2.3.1.2 Terrestrial Animals

- Field guides & books (Branch, 1998; Du Preez & Carruthers 2008; Smithers 1983; Stuart & Stuart 1997; Woodall 2005).

2.3.1.3 The bird study made use of the following data sources:

- The sites were visited by foot and vehicle;

- Bird distribution data of the Southern African Bird Atlas Project (SABAP)(Harrison et al. 1997);
- Red Data List of Birds (Chitten et al. 2005);
- The Important Bird Areas (IBA) project data was consulted to establish if any bird areas are located in The Study Area (Barnes 1998).

2.4 Survey

2.4.1 Terrestrial study

The site was visited and transects were walked across possible sensitive areas (depressions and stream areas). The following was noted:

2.4.1.1 Veld composition in terms of:

- Vegetative structure and classification (main vegetation types);
- Plant species, including an indication of dominant species, rare and endangered species (Red data species), and exotic and invader species;
- Plant species and the environment;
- Plant species inter-relations.

2.4.1.2 Veld condition:

- Assessment of veld condition;
- Interpretation of veld condition assessment;
- Rehabilitation needs and options;
- Conservation status and potential.

2.4.1.3 Animal species identification, including an indication of dominant species, rare and endangered species (Red data species), and exotic and invader species;

2.4.2.4 Animal species and their habitats.

2.4.2.5 Assessment of the habitat condition of the animals.

2.4.2 Wetland Classification, Delineation and Mapping

2.4.2.1 1:50 000 topographic maps were used and geo-referenced Google Earth images to generate digital base maps of the study area onto which the wetland boundaries were delineated. A desktop delineation of suspected wetland areas was undertaken by identifying streams and wetness signatures from the digital base maps. All identified areas suspected to be wetlands were then further investigated on site.

2.4.2.2 Wetlands were delineated according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005). The study area was sub divided into transects. The soil profile was examined for signs of wetness within 50 cm of the surface using a hand augur. Augur sites were spaced along these transects. The wetland boundaries were then determined based on the positions of augured holes that showed signs of wetness.

2.4.2.3 The wetlands were subsequently classified according to their hydro-geomorphic determinants based on modification of the system proposed by Brinson (1993), and modified for use in South Africa by Marneweck and Batchelor (2002) and subsequently revised by Kotze *et al.* (2004). Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present.

2.4.3 Delineation of the riparian zone

2.4.3.1 The method of delineating riparian zones is largely based on geomorphological setting and/or vegetation indicators (DWAF, 2005). The riparian zone delineation method primarily uses the geomorphology or the shape of the river banks, the extent of riparian vegetation as well as evidence of recent alluvial soils. The geomorphology involves the use geomorphological cues that include paired terraces, levees and sediment benches. While the vegetation involves the use of obligate riparian zone species within the Northern Cape Province. An inflection point (edge of the flood zone where obligate riparian vegetation is no longer evident and where

river flooding activities are no longer evident) between riparian area and upland slopes is taken as the edge of the riparian zone. For an accurate delineation of riparian zones in highly disturbed areas the method requires the location and use of reference sites. The reference site is used to provide an indication of the likely riparian extent prior to disturbance.

2.5 Criteria Used To Rank Site

In order to rank the suitability of the proposed site's footprint, an assessment was done, based on the vegetation characteristics, vegetation condition, and presence of terrestrial protected animals.

2.5.1 Vegetation characteristics

2.5.1.1 Habitat diversity: Species composition / richness: Normally a function of locality, habitat diversity and climatic conditions.
[Scoring: High - 1, Medium - 2, Low - 3]

2.5.1.2 Presence of rare and endangered species: The occurrence or potential occurrence of any of the listed and /or endangered species can play a major role in the decision making process. Depending on the status and provincial conservation policy, presence of a Red Data species can potentially be a fatal flaw.
[Scoring: Occurrence actual or highly likely - 1, Occurrence possible - 2, Occurrence highly unlikely - 3]

2.5.1.3 Ecological function: All plant communities play a role within the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones[1], etc.
[Scoring: Ecological function critical for greater system - 1, Ecological function of medium importance - 2, No special ecological function (system will not fail if absent) - 3]

[1] Ecotones are areas of overlap or change between two different ecosystems eg. between veld and pans.

2.5.1.4 Degree of rarity / conservation value:

[Scoring: Very rare and / or in pristine condition - 1, Fair to good condition and / or relatively rare - 2, Not rare, degraded and / or poorly conserved - 3]

2.5.1.5 Vegetation condition

The footprints were compared to a theoretical benchmark site in a good to excellent condition. Vegetation management practices (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of vegetation.

2.5.1.6 Percentage ground cover: Ground cover is under normal and natural conditions a function of climate, and biophysical characteristics of the site. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.

[Scoring: Good to excellent - 1, Fair - 2, Poor - 3]

2.5.1.7 Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. This ratio could be affected by browsing and grazing by animals.

[Scoring: All layers still intact and showing specimens of all age classes - 1, Sub-shrubs and / or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) - 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) - 3]

2.5.1.8 Infestation with exotic weeds and invader plants or encroachers

[Scoring: No, or very slight infestation levels by weeds and invaders - 1, Medium infestation by one or more species - 2, several weed and invader species present and high occurrence of one or more species (eg. Wattle, Mesquite, etc.) - 3]

2.5.1.9 Degree of grazing / browsing impact:

[Scoring: No, or very slight notable signs of browsing and / or grazing - 1, Some browse lines evident, shrubs shows signs of browsing, grass

layer grazed though still intact - 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent - 3]

2.5.1.10 Signs of erosion: The formation of erosion scars can often give an indication of the severity and /or duration of vegetation degradation
[Scoring: No or very little evidence of soil erosion - 1, Small erosion gullies present and / or evidence of slight sheet erosion - 2, Gully erosion well developed (medium to big dongas) and / or sheet erosion removed the topsoil over large areas - 3]

2.5.2 Terrestrial animal characteristics

2.5.2.1 Presence of rare and endangered species: The occurrence or potential occurrence of any of the listed and /or endangered species can play a major role in the decision making process. Depending on the status and provincial conservation policy, presence of a Red Data species can potentially be a fatal flaw.
[Scoring: Occurrence actual or highly likely - 1, Occurrence possible - 2, Occurrence highly unlikely - 3]

2.6 Site Preference Rating (SPR)

The total scores for the criteria above were used to determine the preference ranking order for the site investigated. On a scale of 0 – 30, six different classes are described to assess the suitability of the footprint for the development of the proposed new facility. The different classes are described in the table below:

Table 2: Site preference ranking

SPR	SPR general flora description	Floral score equating to SPR class
IDEAL (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and / or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and the potential for successful rehabilitation is very low. The site is ideal for the proposed development.	29 – 30
PREFERRED (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and / or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low. The area is preferred for the proposed development.	26 – 28

SPR	SPR general flora description	Floral score equating to SPR class
ACCEPTABLE (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low. The area is acceptable for the proposed development.	21 – 25
NOT PREFERRED (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological functioning is intact and very little rehabilitation is needed. The area is of medium conservation importance. The area is not preferred for the proposed development.	11 – 20

SPR	SPR general flora description	Floral score equating to SPR class
SENSITIVE (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high. The area is regarded as sensitive and not suitable for the proposed development.	0 – 10

3. REGULATORY AND LEGISLATIVE OVERVIEW

3.1 It is widely recognised that it is critical to conserve natural resources in order to maintain ecological processes and life support systems for plants, invertebrates, vertebrates and humans. An assessment of the environment before relevant authorities approve any development is vital to ensure that sustainable development takes place. This is part of the legislation that protects the natural environment.

Acts such as the Environmental Conservation Act (Act 73 of 1989), the National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998), the National Environmental Management Biodiversity Act, 2004. NEMA (Act 10 of 2004) as well as the Forest Act (Act 84 of 1998) ensure the protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment. It also ensures the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes or products or human activities. A draft list of Threatened Ecosystems was published (Government Gazette 2009) as part of the National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004). These Threatened Ecosystems are described by SANBI & DEAT (2009).

All components of the ecosystems (physical environment, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include the development, utilisation and where necessary conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001).

It is therefore necessary to make a thorough inventory of the plant communities and biodiversity on the site, in order to evaluate the biodiversity and possible rare species. This inventory should then serve as a scientific and ecological basis for the planning exercises.

In order to remove or destroy protected species two acts and one provincial ordinance are applicable namely the:

- National Environmental Management Biodiversity Act, 2004 (NEMBA) (Act 10 of 2004) for protected and Red Data species;
- National Forest Act, 1998 (Act 84 of 1998) for the protected tree species and
- Provincial Nature Conservation Ordinance, 1989 (Ordinance 8 of 1989).

3.2 All relevant permits must be obtained before construction commences.

3.3 Procedure to obtain documentation:

3.3.1 Application to remove protected species must be obtained from the following address:
Contact person: Miss Marietjie Smit
e-mail address: msmit@half.ncape.gov.za
EIA reference number must be indicated on permit application form.

3.3.2 Application to remove protected species as listed under the Forest Act must be obtained from the following address:
Contact person: Me. Jacqueline Mans
Department of Environmental Affairs & Forestry
Private Bag X5912
UPINGTON
8800
Tel: 054 - 3385860

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 Study Area

The study area is situated in the Northern Cape Province. The proposed pipeline route is next to the existing Vaal - Gamagara pipeline. The route will be from the existing abstraction point is in the Vaal River near Delportshoop to the Barkley West – Postmasburg road (R385). From here the route is along the southern side of the R385 to Koopmansfontein. From Koopmansfontein the pipeline route follows the railway line to Postmasburg. From Postmasburg it is situated along the western side of the R385 to Dingle west of the Kumba mine and from here to a pumpstation near the Kathu airstrip. From this pumpstation the route goes north to the Black Rock mine (**Fig 1).**

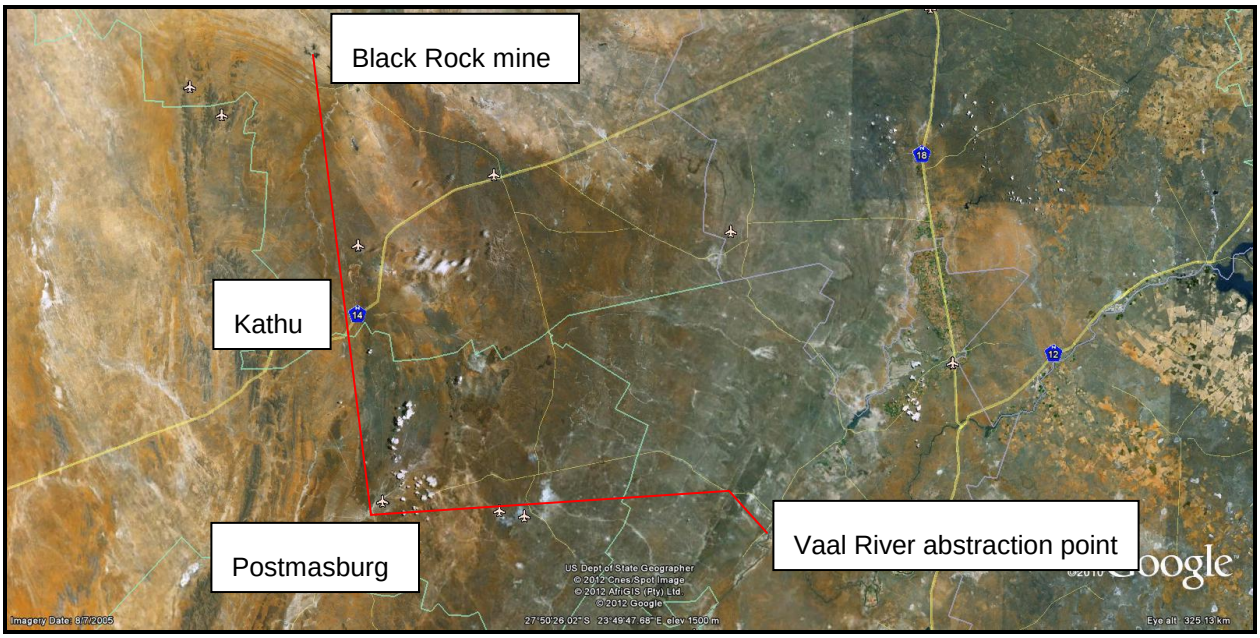

Figure 1: Satellite image of the study site (source: Google Earth).

4.2 Altitude and Geomorphology

The topography of the area is moderately steep between the abstraction point and the Kneukel pumpstation. From there the route is on the Ghaap Plateau which has a relatively flat topography and it remain moderately flat to the Black Rock mine.

4.3 Geology and Soils

The geological layers of the region consist of sedimentary layers of mudstones and calcretes maily of the Campbell Group and Astbestos Hill subgroup of the Griqualand West Supergroup (Vaalian Erathem).

Towards the northern section of the pipeline Kathu to Black Rock areas with relatively thick aeolian deposits of Kalahari sand occur. Most of the soils in the area, except those along the drainage lines, are well-drained.

4.4 Climate

The area receives between 250 and 350 and 450mm rain per annum, mainly in the form of thunderstorms during the summer months. The winters are cold and dry with frost. Average daily maximum temperatures for Postmasburg region vary between 15.0˚C (winter) and 36.2˚C (summer).

4.5 Overview of the Major Vegetation Units in the Study Area

The vegetation of the region falls within the Savanna biome. This is a broad vegetation unit which is dominated by a grasslayer and a treelayer and/or shrublayer. The Grassland biome can be subdivided into small units called bioregions. The study area falls within the Eastern Kalahari Bushveld Bioregion.

Table 3 list the codes of the relevant vegetation types present in the study area.

Table 3: Codes of vegetation types

Code	Vegetation type
SvK6	Schmidtsdrif thornveld
SvK7	Ghaap Plateau Vaalbosveld
SvK9	Kuruman Thornveld
SvK10	Kuruman Mountain Thornveld
SvK12	Kathu Bushveld
SvK14	Postmasburg Thornveld
AZ	Azonal vegetation (pans, wetlands and riparian vegetation)

Table 4 indicates which section of the pipeline falls within which vegetation type.

Table 4: Sections of the proposed Vaal-Gamagara pipeline and the various vegetation types

Section	Reference points		
	From	To	Code
1	Existing abstraction point	Kneukel pump station	SvK6
2	Kneukel pump satation	Koopmansfontein	SvK7
3	Koopmansfontein	Postmasburg	SvK7 & 10
4	Postmasburg	Gamagara River (south bank)	SvK9
5	Gamagara River (south bank)	Gamagara River (north bank)	AZ
6	Gamagara River (north bank)	Vlermuisleegte stream (south bank) (Gloria mine)	Svk12
7	Vlermuisleegte stream (south bank) (Gloria mine)	Vlermuisleegte stream (north bank) (Gloria mine)	AZ
8	Vlermuisleegte stream (north bank) (Gloria mine)	Black Rock reservoir	SvK12

The various savanna vegetation types vary mainly in structure, dominance of tree and shrub species as well as species composition. Numerous small endorheic[2] pans and drainage lines occur on the Ghaap Plateau which support hygrophilous[3] vegetation which can be regarded as typically azonal[4] (AZ) (Table 4) in character. The riparian vegetation of the Gamagara River and its tributaries also falls within the azonal vegetation category.

According to Mucina & Rutherford (2006) the Schmidtsdrif Thornveld, the Ghaap Plateau Vaalbosveld is dominated by the Vaalbos (*Tachonanthus camphoratus*) and to a lesser extent by Swarthaak (*Acacia mellifera*) other trees are the Wild Olive (*Olea europaea subsp africana*), Common Karee (*Searsia lancea*) and Buffalo Thorn (*Ziziphus mucronata*).

[2] Endorrheic means a closed drainage system (no outlet).

[3] Hygrophilous means water-loving.

[4] Azonal means a plant community which does not belong to a particular vegetation type.

The grass layer is typically sweet grassland. Grasses such as *Aristida congesta*, *Eragrostis lehmanniana, Stipagrostis uniplumis, Schmidtia pappophoroides, Enneapogon scoparius, E. desvauxii* and *Heteropogon contortus* are some of the dominant grass species.

The herbaceous layer is dominated by the abovementioned grasses as well as species such as *Elephantorrhiza elephantina, Selago densifora, Hermannia depressa, Herbmstaedtia odorata, Barleria macrostegia, Geigeria filifolia, Gisekia africana, Chrysocoma ciliaris, Felicia muricata, Jamesbrittenia aurantiaca* and *Vahlia capensis*.

The Kuruman Thornveld, Kuruman Montain Thornveld Kathu Bushveld and Postmasburg Thornveld are according to Mucina & Rutherford (2006) dominated by Swarthaak (*Acacia mellifera*) and further north also by Camel Thorn (*Acacia erioloba*), False Camel Thorn (*Acacia haematoxylon*), Sheppards Tree (*Boscia albitrunca*), Candle Thorn (*Acacia hebeclada*), Common Karee (*Searsia lancea*) and Buffalo Thorn (*Ziziphus mucronata*).

The grass layer is typically sweet grassland. Grasses such as *Aristida congesta*, *Eragrostis lehmanniana, Stipagrostis uniplumis, Schmidtia pappophoroides, Enneapogon scoparius, E. desvauxii* and *Heteropogon contortus* are some of the dominant grass species.

The herbaceous layer is dominated by the abovementioned grasses as well as species such as *Elephantorrhiza elephantina, Harpagophytum procumbens, Dicoma schinzii, Limeum fenestratum, Selago densifora, Hermannia depressa, Herbmstaedtia odorata, Barleria macrostegia, Geigeria filifolia, Gisekia africana, Chrysocoma ciliaris, Felicia muricata, Jamesbrittenia aurantiaca* and *Vahlia capensis*.

The Azonal communities which will be affected by the proposed pipeline are a few small pans on the Ghaap Plateau, the Steenboks River between Kneukel pumpstation and Koopmansfontein and the Gamagara River just south of Dingle as well as a tributary of the Gamagara River east of the Gloria mine. These azonal areas support typical wetland species such as the sedges *Scirpoides nodosus, Juncus rigidus, Cyperus bellus, Cyperus eragrostis* and the grasses *Micanthus capensis, Agrostis lachnantha, Eragrostis micrantha, Leptochloa fusca* are some of the dominant grass species. Prominent forbs include *Berula erecta, Ranunculus multifidus, Rumex crispus,* and *Kniphofia ensifolia* and others.

Infractructure:

Figure 2: Fiew of the interior of the existing abstraction point in the Vaal River.

Figure 3: An access road already exist along the entire pipeline route. The structure on the right is an airvalve on the existing pipeline.

Figure 4: The Kneukel pumpstation. Additional pumps will be installed for the new pipeline.

Figure 5: The Trewil pumpstation. Additional pumps will be installed for the new pipeline.

Figure 6: The reservoirs west of Lime Acres. Additional reservoirs will be installed for the new pipeline.

Figure 7: The Sishen pumpstation. Additional pumps will be installed for the new pipeline.

Figure 8: The reservoirs north of Kathu.

Figure 9: The reservoirs near Gloria mine.

Figure 10: The reservoirs near Black Rock mine.

Figure 11: All along the existing pipeline one can find these rock dumps containing spoil material excavated from the pipeline trench. With the new pipeline it will also be the case.

Vegetation types along the route:

Figure 12: A view of the Ghaap Plateau Vaalbosveld (The existing pipeline is to the right of the Telkom line).

Figure 13: A view of the Kathu Bushveld vegetation (Red line indicates the existing pipeline).

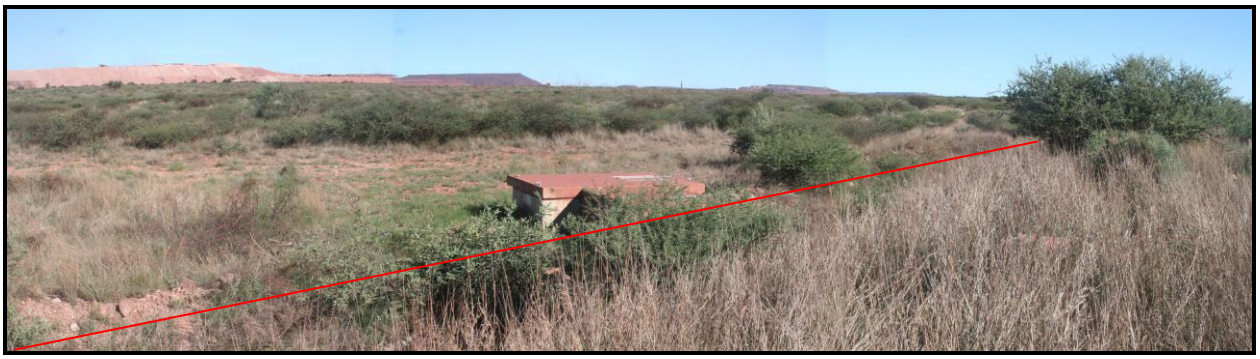

Figure 14: A view of the Kuruman Thornveld vegetation (Red line indicates the existing pipeline).

Figure 15: A view of the Kuruman Thornveld vegetation (Red line indicates the existing pipeline).

Figure 16: A view of the Kathu Bushveld vegetation.

Sensitive habitats and protected species:

Figure 17: View of a pan on the Ghaap Plateau.

Figure 18: View of a drainage line (green area) on the Ghaap Plateau.

Figure 19: A view of the Steenboks River wetland vegetation. (Red line indicates the existing pipeline).

Figure 20: A view of the Gamagara River riparian vegetation (Red line = existing pipeline)

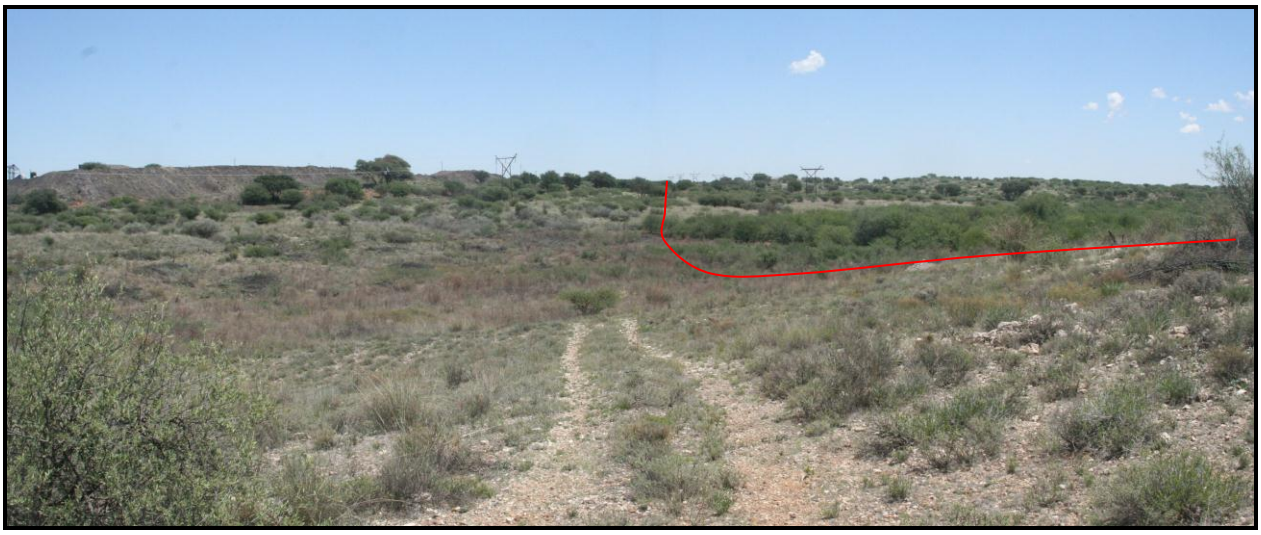

Figure 21: A view of the Vlermuisleegte stream near Gloria mine. (Red line indicates the existing pipeline).

Figure 21: False Camel Thorn (*Acacia haematoxylon*).

Figure 21: Camel Thorn (*Acacia erioloba*).

4.6. Plant Species of Importance

4.6.1 Red Listed species

No Red Data speces were found along the proposed pipeline route.

4.6.2 Protected species in terms of the Provincial ordinance

No protected speces were found along the proposed pipeline route.

4.6.3 Protected species in terms of the Forest Act

False Camel Thorn and camel Thorn were found in the Kathu Bushveld along the last section of the route (Gamagara River to Black Rock mine).

Permits have to be obtained for the individual tree that will be affected by this pipeline development.

4.7 Overview of the Important Animal Communities in the Study Area

The vegetation is relatively homogenous for large sections of the study area. No areas of faunal significance or sensitivity within the natural habitat were observed within the study area. This is probably due the the close proximity of the residential area as well as the mine.

Table 5: Vertebrates that could occur in the area.

Order	Family	Scientific name	Common name
Phylum Vertebrata; Class Amphibia			
Anura			
	Breviceptidae	*Poyntonophrynus vertebralis*	Southern Pygmy Toad
	Bufonidae	*Amietophrynus rangeri*	Raucous Toad
		Amietophrynus gutteralis	Gutteral Toad
		Vandijkophrynus gariepensis	Karoo Toad
	Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina
	Pipidae	*Xenopus laevis*	Common Platanna
	Pixycephalidae	*Cacosternum boettgeri*	Boettger's Caco
		Amietia fuscigula	Cape River Frog
		Amieta angolensis	Common River Frog
		Pixycephalus adspersus	Giant Bullfrog
		Tomopterna cryptotis	Tremolo Sand Frog
		Tomopterna tandyi	Tandy's Sand Frog
Phylum Vertebrata; Class Reptilia			
Testudines	Testudinidae	*Geochelone pardalis*	Leopard Tortoise
		Homopus femoralis	Greater Padloper
		Psammobates oculiferus	Kalahari Tent Tortoise
	Trionychidae	*Pelomedusa subrufa*	Marsh Terrapin
Squamata	Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Blind Snake
	Leptotyphlopidae	*Leptotyphlops scutifrons*	Peter's Thread Snake

Order	Family	Scientific name	Common name
	Leptotyphlopidae	*Lycodonomorphus rufulus*	Common Brown Water Snake
	Atractaspidae	*Atractaspis bibronii*	Bibron's burrowing Asp
	Colubridae	*Lamprophis fuliginosus*	Brown House Snake
		Lamprophis aurora	Aurora House Snake
		Lycophidion capense	Cape Wolf Snake
		Pseudaspis cana	Mole Snake
		Prosymna sundevallii	Sundevall's Shovel-snout
		Psammophylax rhombeatus	Rhombic Skaapsteker
		Psammophis notostrictus	Karoo Sand Snake
		Psammophis leightonii	Cape Fork-marked Snake
		Psammophis crucifer	Cross-marked Snake
		Dasypeltis scabra	Common Egg Eater
		Crotaphopeltis hotamboeia	Red-lipped Snake
		Telescopus semiannulatus	Eastern Tiger Snake
	Elapinae	*Elapsoidea boulengeri*	Boulenger's Garter Snake
		Elapsoidea sundevallii	Sundevall's Garter Snake
		Naja nivea	Cape Cobra
		Hemachatus haemachatus	Rinkhals
	Viperidae	*Bitis arietans*	Puff Adder
	Amphisbaenidae	*Zygaspis quadrifrons*	Cape Spade-snouted Worm Lizard

Order	Family	Scientific name	Common name
	Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink
		Mabuya capensis	Cape Skink
		Mabuya striata	Striped Skink
		Mabuya sulcata	Western Rock Skink
		Mabuya variegate	Variegated Skink
	Lacertidae	*Ichnotropis squamulosa*	Common Rough-scaled Lizard
		Nucras intertexta	Spotted Sandveld-Lizard
		Pedioplanis lineocellata	Spotted Sand lizard
		Nucras holubii	Holub's Sandveld Lizard
		Gerrhosaurus flavigularis	Yellow-throated Plated Lizard
		Cordylus polyzonus	Karoo Girdled Lizard
	Varanidae	*Varanus albigularis*	Rock Monitor
		Varanus niloticus	Water Monitor
	Agamidae	*Agama aculeate*	Ground Agama
		Agama atra	Southern Rock Agama
		Agama hispida	Southern Spiny Agama
	Chamaeleonidae	*Chamaeleo dilepis*	Flap-neck Chameleon
	Gekkonidae	*Lygodactylus capensis*	Cape Dwarf Gecko
		Pachydactylus bibronii	Bibron's Thick-toed Gecko
		Pachydactylus capensis	Cape Thick-toed Gecko
		Pachydactylus mariquensis	Marico Thick-toed Gecko
Phylum Vertebrata; Class Mammalia			
Insectivora	Erinaceidae	*Atelerix frontalis*	Hedgehog
	Soricidae	*Suncus varilla*	Lesser Dwarf Shrew

Order	Family	Scientific name	Common name
		Crocidura cyanea	Reddish-grey musk shrew
		Elephantulus myurus	Rock Elephant Shrew
		Chlorotalpa sclateri	Sclater's Golden mole
Rodentia	Bathyergidae	*Cryptomys hottentotus*	Common Molerat
	Muridae	*Tatera leucogaster*	Bushveld Gerbil
		Mastomys coucha	Multimammate Mouse
		Saccostomys campestris	Pouched Mouse
		Graphyurus murinus	Woodland dormouse
		Otomys angolensis	Angoni vlei rat
		Otomys iroratus	Vlei rat
		Rabdomys pumilio	Striped mouse
		Mus musculus	House mouse
		Mus minutoides	Pygmy mouse
		Mastomys natalensis	Multimammate mouse
		Aethomys namaquensis	Namaqua rock mouse
		Aethomys chrysophilus	Red veld rat
		Rattus rattus	House rat
		Desmodillus auricularis	Short-tailed gerbil
		Gerbillus paeba	Hairy-footed gerbil
		Tatera leucogaster	Bushveld Gerbil
		Tatera brandsii	Highveld Gerbil
		Mastomys albicaudatus	White-tailed mouse
		Malacothrix typical	Large-eared mouse
		Dendromys melanotis	Grey climbing mouse
	Sciuridae	*Xerus inauris*	Cape Ground Squirrel
	Pedetidae	*Pedetes capensis*	Spring Hare
	Hystricidae	*Hystrix africaeaustralis*	South African Porcupine
Lagomorpha	Leporidae	*Lepus saxatilis*	Scrub Hare
Carnivora		*Lepus capensis*	Cape Hare
	Canidae	*Canis mesomelas*	Black-backed Jackal
		Vulpes chama	Cape Fox

Order	Family	Scientific name	Common name
		Otocyon megalotis	Bad-eared Fox
	Herpestidae	*Suricata suricata*	Meerkat
		Cynictis penicillata	Yellow mongoose
		Galerella sanguinea	Slender Mongoose
	Mustelidae	*Ictonix striatus*	Zorilla
		Poecilogale albinucha	Striped Weasel
	Viverridae	*Genetta genetta*	Common genet
	Felidae	*Caracal caracal*	Caracal
		Felis nigripes	Black-footed Cat
		Felis sylvestris	Wild Cat
Tubulidentata	Orycteropidae	*Orycteropus afer*	Aardvark
Artiodactyla	Bovidae	*Raphicerus campestris*	Steenbok
		Sylvicapra grimmia	Common Duiker

4.7.1 Animal Species of Importance

4.7.1.1 Red Listed Fauna Species

The World Conservation Organization (IUCN) has three threatened categories, namely Critically Endangered (CE), Endangered (EN) and Vulnerable (VU). Species that have been evaluated according to the IUCN criteria and do not fall into one of the threatened categories can be classified as Least Concern (LC), Near Threatened (NT) or Data Deficient (DD). Species classified as Least Concern have been evaluated and do not qualify for the Critically Endangered, Endangered, and Vulnerable or Near Threatened categories. Species that are widespread and abundant are normally included in this category. Table 6 lists red data species found in habitat typical of the study area and surrounding areas.

Table 6: Red Listed fauna species for the region

Scientific name	Common name	Threatened Status
Atelerix frontalis	South African Hedgehog	NT
Poecilogale albinucha	African Weasel	DD
Pedetes capensis	Spring Hare	VU

Scientific name	Common name	Threatened Status
Mastomys albicaudatus	White-tailed mouse	VU

Most of the above-mentioned species are habitat specialists and are restricted to specific sensitive habitat types (ridges, seasonal pans, etc.). The study site does not cater for unique and specialized habitats. Only a few Red Data species would frequent this site.

4.7.1.2 Birds

The savanna biome has a relatively high bird diversity in comparison to those of the grassland biome. In this area a relatively low number of Red Data species. The Martial Eagle, Secretary Bird, Black Harrier, Ludwig's Bustard and Kori Bustard are the prominent ones. Other raptors that occur in the area are the migratory Steppe Buzzard and Booted Eagle.

4.7.2 Description of Important Bird Habitats in the Study Area

Much of the distribution and abundance of the bird species in the study area can be explained by the description of vegetation types above, it is even more important to examine the micro habitats available to birds. These are generally evident at a much smaller spatial scale than the vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. The following can be described here:

- Streams: A non-perennial stream runs through the site (Gamagara River and Vlermuisleegte stream).

- Wetlands (pans) and man-made dams: Both wetlands and streams are of particular importance for birds in The Study Area, as the area is relatively arid. A few small seasonal pans occur in the area.

5 IMPACT IDENTIFICATION AND ASSESSMENT OF SITE

5.1 ABOVE THE 1:100 – YEAR FLOODLINE

5.1.1 Site preference rating (SPR)

Table 7: Site preference ranking for section 1

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value	3		
VEGETATION CONDITION			
Percentage ground cover	3		
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing		2	
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	12	12	0
TOTAL		24	

In view of the score (24) in Table 7 [Site Preference Rating (SPR)], section 1 is accaptable for development (also see Table 1).

Table 8: Site preference ranking for section 2

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value		2	

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
VEGETATION CONDITION			
Percentage ground cover		2	
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing	3		
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	9	14	0
TOTAL		23	

In view of the score (23) in Table 8 [Site Preference Rating (SPR)], section 2 is accaptable for development (also see Table 1).

Table 9: Site preference ranking for section 3

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value	3		
VEGETATION CONDITION			
Percentage ground cover	3		
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing		2	
Significance of erosion impacts		2	

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	12	12	0
TOTAL		24	

In view of the score (24) in Table 9 [Site Preference Rating (SPR)], section 3 is accaptable for development (also see Table 1).

Table 10: Site preference ranking for section 4

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value	3		
VEGETATION CONDITION			
Percentage ground cover	3		
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing		2	
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	12	12	0
TOTAL		24	

In view of the score (24) in Table 10 [Site Preference Rating (SPR)], section 4 is accaptable for development (also see Table 1).

Table 11: Site preference ranking for section 5

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value		2	
VEGETATION CONDITION			
Percentage ground cover		2	
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing	3		
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	9	14	0
TOTAL		23	

In view of the score (23) in Table 11 [Site Preference Rating (SPR)], section 5 is accaptable for development (also see Table 1).

Table 12: Site preference ranking for section 6

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value		2	
VEGETATION CONDITION			
Percentage ground cover		2	

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing	3		
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	9	14	0
TOTAL	23		

In view of the score (23) in Table 12 [Site Preference Rating (SPR)], section 6 is accaptable for development (also see Table 1).

Table 13: Site preference ranking for section 7

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value		2	
VEGETATION CONDITION			
Percentage ground cover		2	
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing	3		
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Sub total	9	14	0
TOTAL		23	

In view of the score (23) in Table 13 [Site Preference Rating (SPR)], section 7 is accaptable for development (also see Table 1)

Table 14: Site preference ranking for section 8

VEGETATION CHARACTERISTICS	LOW (3)	MEDIUM (2)	HIGH (1)
Habitat diversity: Species composition / richness		2	
Presence of rare and endangered species	3		
Ecological function		2	
Uniqueness / conservation value		2	
VEGETATION CONDITION			
Percentage ground cover		2	
Vegetation structure		2	
Negative impact due to the infestation with exotic weeds and invader plants or encroachers		2	
Negative impact due to grazing or browsing	3		
Significance of erosion impacts		2	
TERRESTRIAL ANIMAL CHARACTERISTICS			
Presence of rare and endangered species	3		
Sub total	9	14	0
TOTAL		23	

In view of the score (23) in Table 14 [Site Preference Rating (SPR)], section 8 is accaptable for development (also see Table 1).

5.2 WETLANDS

5.2.1 Overview

Isolated pockets of wetland plants were detected along the route. These include pans, drainage lines and seasonal streams. The soils in these areas also indicate signs of wetness.

A riparian area, in terms of the National Water Act (Act 36 of 1998) is "the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas (Fig 17, 18, 19, 20 & 21).

5.2.2 Present Ecological State

The Present Ecological State assessment determines the level of disturbance to or modification of a wetland relative to its natural state or reference condition. Wetlands are rated on a scale of A to F, with A being a natural or un-impacted wetland and F being a completely modified and disturbed wetland. The Wet-Health assesses the following four factors that influence the "health" or condition of wetlands and in this particular application pans or depressions:

- hydrology,
- geomorphology,
- vegetation and
- water quality.

5.2.2.1 **Hydrology** is defined in this context as the distribution and movement of water through a wetland and its soils. This module focuses on changes in water inputs as a result of changes in catchment activities and characteristics that affect water supply and its timing (extrinsic), as well as on modifications within the wetland that alter the water distribution and retention patterns within the wetland, intrinsic factors.

5.2.2.2 **Geomorphology** is defined in this context as the distribution and retention patterns of sediment within the wetland. This module focuses on evaluating current geomorphic health through the presence of

indicators of excessive sediment inputs and/or losses for clastic (minerogenic) and organic sediment (peat).

5.2.2.3 Vegetation is defined in this context as the structural and compositional state of the vegetation. This module evaluates changes in vegetation composition and structure as a consequence of current and historic conditions

5.2.2.4 Water Quality is largely self-explanatory and reflects the changes in quality as a consequence of changes in land use or as a direct result of activities within the wetland itself that could lead to changes in the quality of the water flowing through and within the wetland. In this case water quality is not applicable because these systems are non-perennial.

Table 15: Impact scores and Present Ecological State categories

Description	Combined Impact Scores	PES Category
Unmodified, natural	0 – 0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1 – 1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2 – 3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitats has taken place.	4 – 5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	6 – 7.9	E

Description	Combined Impact Scores	PES Category
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 -10	F

5.2.3 Hydrology

5.2.3.1 Streams and riparian zone

The streams are non-perennial and from the site retains most of the water that flows from the catchment. Currently the hydrology of the streams can be regarded as largely natural.

This represents a significant departure from the "natural"; equivalent a PES category, B/C.

5.2.3.2 Drainage lines

The hydrology of the drainage lines, that cross the pipeline route, are unchanged from the natural state. There is sporadic surface flow during the raining season. Subsurface flow is taking place after enough rain has fallen.

Evaluated from a purely hydrological perspective the drainage lines would be scored in the range 0 -0.9 reflecting a system that is unmodified and natural (PES category - A).

5.2.4 Geomorphology

5.2.4.1 Streams and riparian zone

The construction of the existing pipeline, from a geomorphological perspective, altered the riparian zone slightly, but over time the impact scar restored itself to a large extent resulting in an impact score of 2.7, equivalent to a PES category of C.

5.2.4.2 Drainage lines

Same as above.

5.2.5 Vegetation

5.2.5.1 Streams and riparian zone

The vegetation associated with the riparian zone has changed in response to the seasonal floods, which is a natural phenomenon. The calculated impact score for the riparian zone was 1.5 placing the riparian zone in a B category.

5.2.5.2 Drainage lines

Same as above.

5.2.6 Water Quality

No historical water quality data are available and no water was present in the seasonal streams, making an assessment of this parameter impossible.

5.3 Summary PES

The overall PES of both the drainage lines and streams and riparian area on the site is a **B *category***, reflecting systems that are largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place over time.

5.4 Functional Assessment

The tool "WET-Ecoservices" is generally applied to evaluating the role the wetlands play in the landscape. These wetlands are largely intact and provide the typical services of wetlands. This can also be applied to the drainage lines as well. However it is also recognised that the vegetation plays a role in providing habitat for rodents and birds, as well as the vegetation itself. The vegetation assists in binding the soil in times of episodic rainfall events.

5.4.1 Impacts identified & level of significance in the area below the 1:100 – year floodline

The planned activities and proposed layout will cause major impacts to the aquatic and wetland systems at the site. But these impact will be of a temporary nature and the site will stabilise over time as in the case of the construction of the previous pipeline. The results of the assessment of the impacts, associated with the proposed development and the consequence thereof for the surrounding environment as well as downstream is reflected in Table 16.

Table 16: Impacts identified & level of significance in the area below the 1:100 – year floodline.

Impacts on site	Extent	Duration	Intensity	Probability	Level of significance
Impact on natural ecosystem functioning	3	3	3	3	**12**
Destruction of habitat	2	3	3	3	**11**
Change in species composition & species richness	2	4	4	4	**14**
Impact on rare and endangered plant and animal species	2	1	1	1	**5**
Potential invasions of exotic species	2	3	1	3	**9**
Creation of an erosion potential	2	3	3	3	**11**

5.4.1.1 Impact on natural ecosystem functioning

The construction of the pipeline trench is a linear activity and will cross streams and pans usually perpendicular to the stream direction the impact will exist but will restore over time. **Impact score: 12.**

5.4.1.2 Destruction of habitat

The construction of the pipeline trench will destroy the habitat in the pipeline servitude. It is a narrow zone perpendicular to the stream direction and over time it impact will soften. The duration of the

impact of habitat destruction is therefore regarded as relatively low. **Impact score: 11.**

5.4.1.3 Change in species composition & species richness

Due to the destruction of the habitats, the current species composition will be destroyed in the pipeline servitude. Over time other species will replace the present ones. Most of them will be exotic pioneers that flourish on disturbed sites. Thus, the alteration in species composition & species richness will also be semi-permanent. **Impact score: 14.**

5.4.1.4 Impact on rare and endangered plant and animal species

This impact can be regarded as low because there were no rare and endangered habitats or species found on the site. **Impact score: 5.**

5.4.1.5 Potential invasions of exotic species

As mentioned above the disturbed areas will be invaded by exotic weeds that act as pioneer species. These species are r-strategists which produce high volumes of seed during their short lifecycle. **Impact score: 9.**

5.4.1.6 Creation of an erosion potential

The destruction of vegetation cover over large surfaces can contribute to large scale erosion if the areas are not will managed. The potential exist that some of the excavated topsoil and overburden may end up in the streams. This can be a problem but the rainfall in the region is relatively low. **Impact score: 11.**

6. CONCLUSIONS AND RECOMMONDATIONS

6.1 Conclusions

6.1.1 Terrestrial habitat

The terrestrial ecosystem is largely natural. Impacts identified & level of significance in the terrestrial area indicate that most of the identified impacts have a relatively low score between 5 and 10. The site specific rating for the terrestrial habitat is 24-25 indicating that the site is suitable for development.

6.1.2 Aquatic habitats

The overall Present Ecological State (PES) of both the drainage lines and streams and riparian area on the property is a **B category**. This indicates that the ecosystems are largely natural with impacts due to the existing pipeline and agricultural activities (cattle and game farming) in the catchment.

Impacts identified and level of significance in the area below the 1:100 – year flood line (Table 16) reveal that these habitats will be temporarilly destroyed. Over time the impact scars will restore and the systems will function relatively normal again as in the case of the existing pipeline.

6.2 Recommendations:

It is recommended that:

- The development should remain outside of the delineated wetland boundaries, unless a Water Use License is obtained that authorizes encroachment.
- Care should be taken to limit unnecessary destruction of the natural vegetation unnecessarily.
- Permits must be obtained to trim or remove False Camel thorn and Camel Thorn trees (Forest Act).
- Taller tree species (e.g. Common Karee, Sweet Thorn, Umbrella Thorn) can be planted to act as screens to soften the visual impact where necessary (eg. Pumps and reservoirs).
- All human movement and activities must be contained within designated construction areas in order to prevent peripheral impacts on surrounding natural habitat.
- No fire-wood may be collected in the veld.

- An alien control and monitoring programme must be developed starting during the construction phase and to be carried over into the operational phase.
- Lighting fires on the sites must not be allowed. The risk of accidental fires during the construction phase is considered to be high, especially during the dry months (winter and early spring).
- Fire-fighting equipment must be available on site.
- Species, especially grasses, trees and shrubs occurring in the region must be used to rehabilitate disturbed areas.

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