BOTSWANA, MIDDELPUTS PIPELINE

PROPOSED WATER SUPPLY SCHEME

DRAFT BIODIVERSITY & BOTANICAL SCAN

A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if needed).

October 10, 2012

PREPARED BY: PB Consult

PREPARED FOR: ENVIROAFRICA CC

REQUESTED BY: KALAHARI EAST WATER USERS ASSOCIATION

Peet Botes (Pr.Sci.Nat: 400184/05) Registered Professional Environmental and Ecological Scientist
Cell: 082 921 5949; Fax 086 514 8595; Email: pbconsult@vodamail.co.za; 22 Buitekant Street, Bredasdorp, 7280.

SUMMARY - MAIN CONCLUSIONS

PREPARED BY:	PREPARED FOR:
PB Consult 22 Buitekant Street Bredasdorp 7280	EnviroAfrica CC PO Box 5367 Helderberg 7135
CONTACT PERSON	**CONTACT PERSON**
Peet Botes Cell: +(27)82 – 921 5949 Fax: +(27)86 – 415 8595 Email: pbconsult@vodamail.co.za	Mr. Bernard de Witt Tel: +(27) 21 – 851 1616 Fax: +(27) 86 – 512 0154 Email: bernard@enviroafrica.co.za

MAIN VEGETATION TYPES	**Gordonia Duneveld** (Least threatened) is described as occurring on parallel dunes about 3-8 m above the plains. Open shrubland with ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dune slopes, also with *A. mellifera* on lower slopes and *Rhigozum trichotomum* in the interdune straaten. **Southern Kalahari Mekgacha** (Least threatened) is described as sparse, patchy grass-lands, sedqelands and low herblands dominated by CA grasses (*Panicum, Eragrostis, Enneapogon, Tragus, Chloris and Cenchrus*) on the bottom of (mostly) dry riverbeds.
LAND USE AND COVER	The pipeline route covers various properties within the Duneveld region of the Kalahari. All of these properties are used mainly for livestock grazing and or game farming. No intensive farming has been observed. Natural game is still expected although not observed during the site visit. Natural vegetation forms a uniform grassy cover over most of the area with larger trees scattered throughout.
RED DATA PLANT SPECIES	None encountered or expected (Refer to endemic or protected plant species on page 26) Protected Trees: A number of *Acacia erioloba*, A. *haematoxylon* and *Boscia albitrunca* was observed (Refer to endemic or protected plant species on page 26)
IMPACT ASSESSMENT	Development without mitigation: Significance rating = 48.5% Development with mitigation Significance rating = 12.4% Where values of ≤15% indicate an insignificant environmental impact and values >15% constitute ever increasing environmental impact.

RECOMMENDATION

From the information available and the site visit, it is clear that the proposed will not be associated with irreversible species loss, habitat loss, connectivity loss or other associated impacts. However, there is a significant difference between development **without** and development **with** mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of construction.

With the available information to the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOS'

INTRODUCTION

The Middelputs area is located adjacent to the Botswana Border. The area is rural and live stock farming is the main income source. The Botswana Government identified the need for potable water for the Middelputs area as a priority. Consequently, BVi Consulting Engineers in Upington were appointed by the Kalahari East Water Users Association to investigate, design and draw up contract documents for the construction of a pipeline to extract potable water from the Kalahari-East Water Supply Scheme, to serve the Middelputs area. In order to achieve this, the D-Line of the Kalahari East Water Supply Scheme was identified as an extraction point to deliver the required 7l/s to the Middelputs area. A 250mm diameter PVC **gravity main** will be utilized. The water will flow under gravity for a distance of approximately 19 km. The gravity main will be fitted with pressure reducing and pressure relief valve combinations to improve the economy of the pipeline by enabling the use of longer lengths of lower pressure class pipe (BVi, 2011).

The route which the project will follow is adjacent to an existing pipeline for the first 14 km. This route is already a registered servitude. For the last 5 km the route will be next to a subordinate road, nr. 340. The land owners will be informed of the planned development and permission will be obtained. It is unlikely that the land use of this area will change in future.

Although it is expected that the direct impact to the environment will be minimal (since it falls within an existing servitude, next to an existing pipeline) the pipeline will be located within an area covered by natural vegetation and the possibility exists that important environmental features / species may be encountered along the route. As a result a Biodiversity Scan of the proposed route was commissioned in order to establish whether further and more in depth studies would be required.

TERMS OF REFERENCE

EnviroAfrica (Pty) Ltd was appointed by BVi Consulting Engineers (Upington) as the independent Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a Biodiversity Scan of the proposed route.

PB Consult was appointed within the following terms of reference:

- Complete a Biodiversity Scan of the proposed route in order to determine whether any significant features will be impacted as a result of the proposed development.
- Make recommendations on impact minimisation should it be required
- The study must consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant to BVi Engineers and has no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

RELEVANT QUALITFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTB and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve). In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity en environmental legal compliance audits. During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes EIA applications, biodiversity assessment, botanical assessment, environmental compliance audits and environmental control work.

Mr. Botes is also a registered Professional Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

Yours sincerely,

P.J.J. Botes *(Pr.Sci.Nat: 400184/05)*
Registered Professional Environmental and Ecological Scientist

APPLICABLE LEGISLATION

Constitution of the Republic of South Africa (1996): of special relevance in terms of environment is section 24

Conservation of Agricultural Resources Act 43 of 1983 (CARA): supports conservation of natural agricultural resources (soil, water, plant biodiversity) by maintaining the production potential of the land and combating/preventing erosion; for example, by controlling or eradicating declared weeds and invader plants.

Hazardous Substances Act 15 of 1973: to control substances that may cause injury, ill-health, or death through their toxic, corrosive, irritant, strongly sensitizing or flammable nature, or by the generation of pressure

National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA): replaces the Atmospheric Pollution Prevention Act (No. 45 of 1965)

- **Environmental Impact Assessment Regulations** (R543 of 2010): procedures to be followed for application to conduct a listed activity.

National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA): supports conservation of plant and animal biodiversity, including the soil and water upon which it depends.

- **National list of ecosystems that are threatened and in need of protection** (GN 1002 of 9 December 2011).

National Environmental Management: Protected Areas Act 57 of 2003 (as amended Act 31 of 2004) (NEMPAA): To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.

National Environmental Management: Waste Act 59 of 2008 (NEMWA): To reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

- **List of Waste Management Activities that have, or are likely to have a detrimental effect on the environment** (GN 718 of 3 July 2009): Identifies activities in respect of which a waste management license is required.

National Forests Act 84 of 1998 (as amended): supports sustainable forest management and the restructuring of the forestry sector.

- **List of protected tree species** (GN 716 of 7 September 2012)

National Heritage Resources Act 25 of 1999: supports an integrated and interactive system for the management of national heritage resources, including supports soil, water and animal and plant biodiversity.

National Veld and Forest Fire Act 101 of 1998 (NVFFA): protects soil, water and plant life through the prevention and combating of veld, forest, and mountain fires

National Water Act 36 of 1998 (NWA): promotes the protection, use, development, conservation, management, and control of water resources in a sustainable and equitable manner.

Northern Cape Nature Conservation Act 9 of 2009 (NCNCA): To provide for the sustainable utilization of wild animals, aquatic biota and plants.

DEFINITIONS & ABBREVIATIONS

DEFINITIONS

Bund: Enclosure under / around a storage facility to contain any spillage

Batch plant: a concrete or plaster mixing facility and associated equipment and materials.

Construction: means the period of the project during which the actual works are carried out, deemed to include site establishment, site preparation, the works, maintenance period and decommissioning.

Construction site: means the area influenced and affected by the construction activities or under the control of the Contractor often referred to as "the Site".

Contaminated water: means water contaminated by the Contractor's activities, *e.g.* concrete water and runoff from plant/ personnel wash areas.

Contractor: the principal persons / company and all other sub-contractors involved in the construction of the project.

Contractor's camp: means the designated and suitably demarcated areas on the Site within which all site offices and staff facilities are situated and within which equipment will be stored, for instance, borrow areas, batching plant, crusher plant, sand washing plant, workshop, offices, rest areas, ablution areas, etc., whichever is applicable.

Environment: means the surroundings within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part of the combination of the above two bullets and the interrelationships between them;
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being

Environmental Aspect: any element of any construction activity, product or services that can interact with the environment.

Environmental Control Officer: a suitably qualified environmental agent responsible for overseeing the environmental aspects of the Construction phase of the EMP.

Environmental Impact: any change to the environment, whether adverse or beneficial, wholly or partially resulting from any construction activity, product or services.

No-Go Area(s): an area of such (environmental/aesthetical) importance that no person or activity are allowed within a designated boundary surrounding this area.

Owner: the owner, or dedicated person, responsible for the management of the property on which the proposed activity (in terms of the ROD) will be performed.

Solid waste: means all solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Precautionary principle: means the basic principle, that when in doubt or having insufficient or unreliable information on which to base a decision, to then limit activities in order to minimise any possible environmental impact.

ABBREVIATIONS

BGIS	Biodiversity Geographical Information System
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
DENC	Department of Environment and Nature Conservation (Northern Cape Province)
EAP	Environmental assessment practitioner
EIA	Environmental impact assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
NCNCA	Northern Cape Nature Conservation Act 9 of 2009
NEMA	National Environmental Management Act, Act 107 of 1998
NEMAQA	National Environmental Management Air Quality Act 39 of 2004
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEMPAA	National Environmental Management Protected Areas Act 57 of 2003
NEMWA	National Environmental Management Waste Act 59 of 2008
NFA	National Forests Act 84 of 1998
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act 101 of 1998
NWA	National Water Act 36 of 1998
SANBI	South African National Biodiversity Institute
SKEP	Succulent Karoo Ecosystem Project
WWTW	Wastewater Treatment Works

REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Mem. Bot. Surv. .S. Afr*. No. 28: 1-192.

Alias, D. & Milton S. 2003. A collation and overview of research information on *Boscia albitrunca* (shepherd's tree) and identification of relevant research gaps to inform protection of the species. Research report done for the Department of Water affairs and Forestry. 18th August 2003.

BVi. 2011. Technical report and project implementation plan: Proposed water supply scheme for Botswana, Middelputs Area. Unpublished report prepared by BVi Consulting Engineers (Upington) for the Kalahari East Water Users Association (KEUWA). November 2011.

De Villiers C.C., Driver, A., Brownlie, S., Clark, B., Day, E.G., Euston-Brown, D.I.W., Helme, N.A., Holmes, P.M., Job, N. & Rebelo, A.B. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

Forsyth, G.G., FJ Kruger, F.J., & Le Maitre, D.C. 2010: National veldfire risk assessment: analysis of exposure of social, economic and environmental assets to veldfire hazards in South Africa. CSIR Report No: CSIR/NRE/ECO/ER/2010/0023/C. March 2010.

Government Notice No 1002, 9 December 2011. National list of Ecosystems that are threatened and in need of protections. In terms of section 52(1)(a) of the National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004).

Low, A.B. & Rebelo, A.(T.)G. (eds) 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Dept of Environmental Affairs and Tourism, Pretoria.

Mucina, L. & Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama, P.A. (eds) 2009. Red List of South African plants 2009. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

SANBI. 2006. South African National Botanical Institute: Biodiversity GIS Home. http://bgis.sanbi.org (as updated)

SANBI. 2012. Red List of South African Plants version 2012.1. Downloaded from Redlist.sanbi.org.

Seymour, C. & Milton, S. 2003: A collation and overview of research information on *Acacia erioloba* (Camelthorn) and identification of relevant research gaps to inform protection of the species. Research report done for the Department of Water affairs and Forestry. 31st August 2003.

Siyanda Draft EMF Report. 2008. Draft Environmental Framework report for the Siyanda District Municipality. A joined project between Siyanda District Municipality, Department of Tourism, Environment and Conservation, Department of Environmental Affairs and Tourism, Northern Cape. In association with MetroGIS & Mosakong Management. 2008.

Van Rooyen, M.W., Van Rooyen, N.; Bothma, J. du P. & Van Den Berg, H. M. 2008. Landscapes in the Kalahari Gemsbok National Park, South Africa. Koedoe [online]. 2008, vol.50, n.1, pp. 99-112. ISSN 0075-6458.

PROJECT DESCRIBTION

In order to supply water for the Botswana, Middelputs area the Kalahari East Water Supply Scheme was identified as the most viable option from which to extract the needed water. It is proposed that the pipeline will tap into the D-Line of the Kalahari East Water Supply Scheme (extraction point) to deliver the required 7l/s to the Middelputs area. A 250mm diameter PVC **gravity main** will be utilized. The water will flow under gravity for a distance of approximately 19 km. The gravity main will be fitted with pressure reducing and pressure relief valve combinations to improve the economy of the pipeline by enabling the use of longer lengths of lower pressure class pipe (BVi, 2011). The route which the project will follow is adjacent to an existing pipeline for the first 14 km (within a registered servitude). For the last 5 km the route will be next to a subordinate road, nr. 340. The pipeline will be placed underground (excavations will be needed).

It was expected that, at least for the first 14 km (along the existing pipeline), the proposed route will show signs of disturbance as a result of the construction needed for the original pipeline. However, as a result of the grassiness of the vegetation (Gordonia Duneveld, an open grassy dune veld) the proposed route showed very little of the original disturbance. In fact it was found that a number of smaller trees had already established itself within the servitude (after the original pipeline was placed).

The sandy nature of most of the substrate along most of the proposed route also mean that excavations footprint will have to be wider in order to compensate for the lower stability of the sand (caving in of the side walls). However, it also means that it will not be necessary to source foreign material as pipe-bedding material (lessening the impact). However, for approximately 1 000-1 500 m next to the subordinate road (No. 340) a calcrete sub-layer is exposed, for which sandy pipe-bedding material would have to be sourced. In this area the possibility also exist that spoil would remain, which will have to be removed.

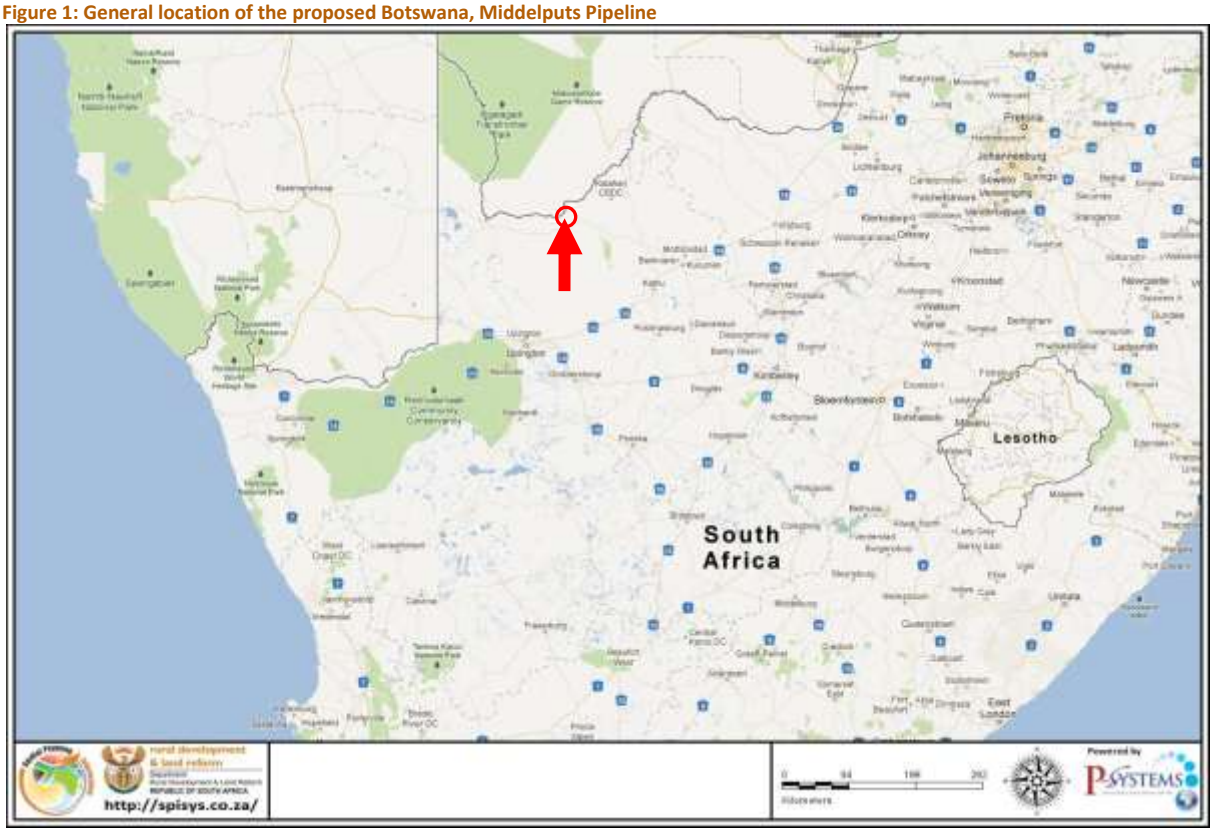
DESCRIPTION OF ENVIRONMENT

The aim of this description is to put the study area in perspective with regards to all probable significant biodiversity features which might be encountered within the study area. The study area has been taken as the proposed site and its immediate surroundings. During the desktop study any significant biodiversity features associated with the larger surroundings was identified, and were taken into account. The desktop portion of the study also informs as to the biodiversity status of such features as classified in the National Spatial Biodiversity Assessment (2004) as well as in the recent National list of ecosystems that are threatened and in need of protection (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. It also aims to take Municipal Environmental Management Frameworks (EMF's) and Municipal Critical Biodiversity Areas (CBA's) into account where applicable.

LOCATION & LAYOUT

The proposed Botswana, Middelputs Pipeline will be located in the Northern Cape Province, //Khara Hais Local Municipality (Siyanda District Municipality), near the Botswana border, approximately 40 km north-west of the small town of Van Zylsrus (Figure 1).

Figure 1: General location of the proposed Botswana, Middelputs Pipeline



From West to East, the pipeline will extract water from the D-Line at the location where the farms Re/556, Re/172 and 1/174 meets. It will then cross the Farm 1/174 then Farm Re/175, onto the Remainder of Farm 176 at the corner between Re/176 and Portion 2 of Farm 176, running in a straight line till it meets the R340,

where it will turn north, remaining on the Farm 176. Running for most of the part on Re 176 crossing over to Re 177 and back to 176 just before it end on Portion 1 of the Farm 176 (Refer to Figure 2).

Figure 2: First portion of the proposed route for the Botswana, Middelputs Pipeline (indicating the farm numbers)

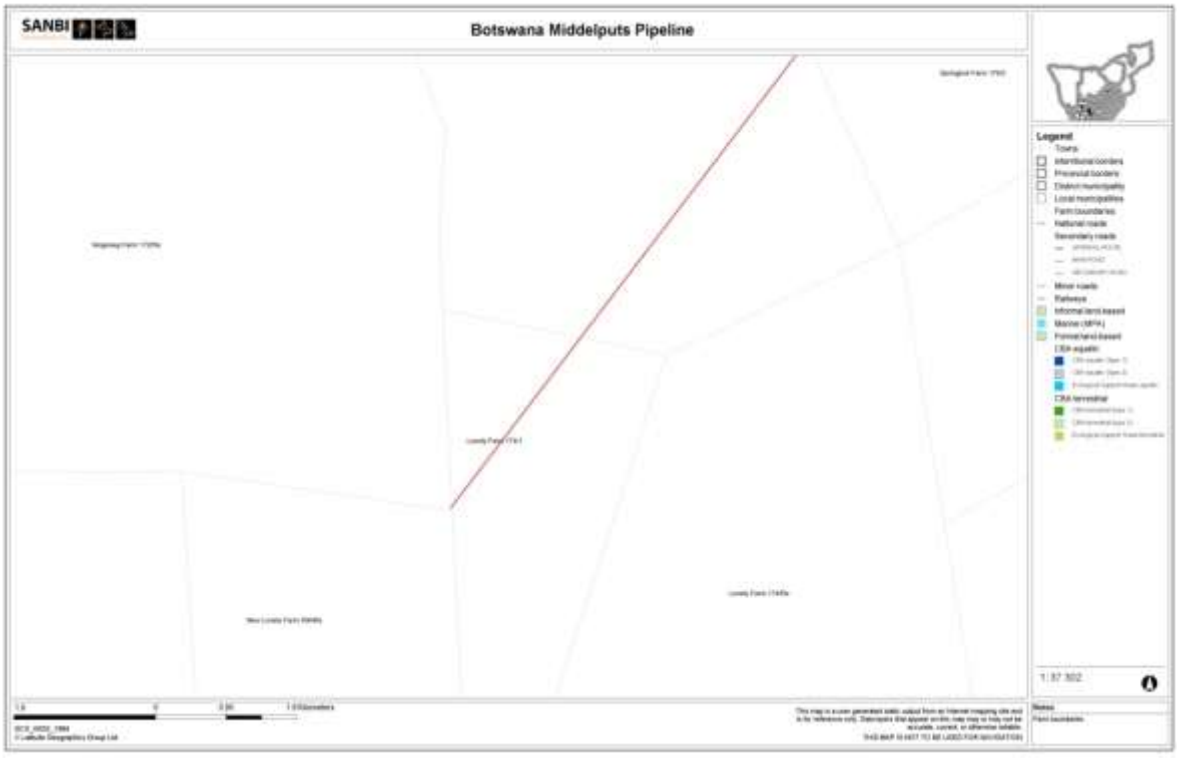


Figure 3: Second portion of the proposed route for the Botswana, Middelputs Pipeline (indicating the farm numbers)

Figure 4: An overview of the proposed route location

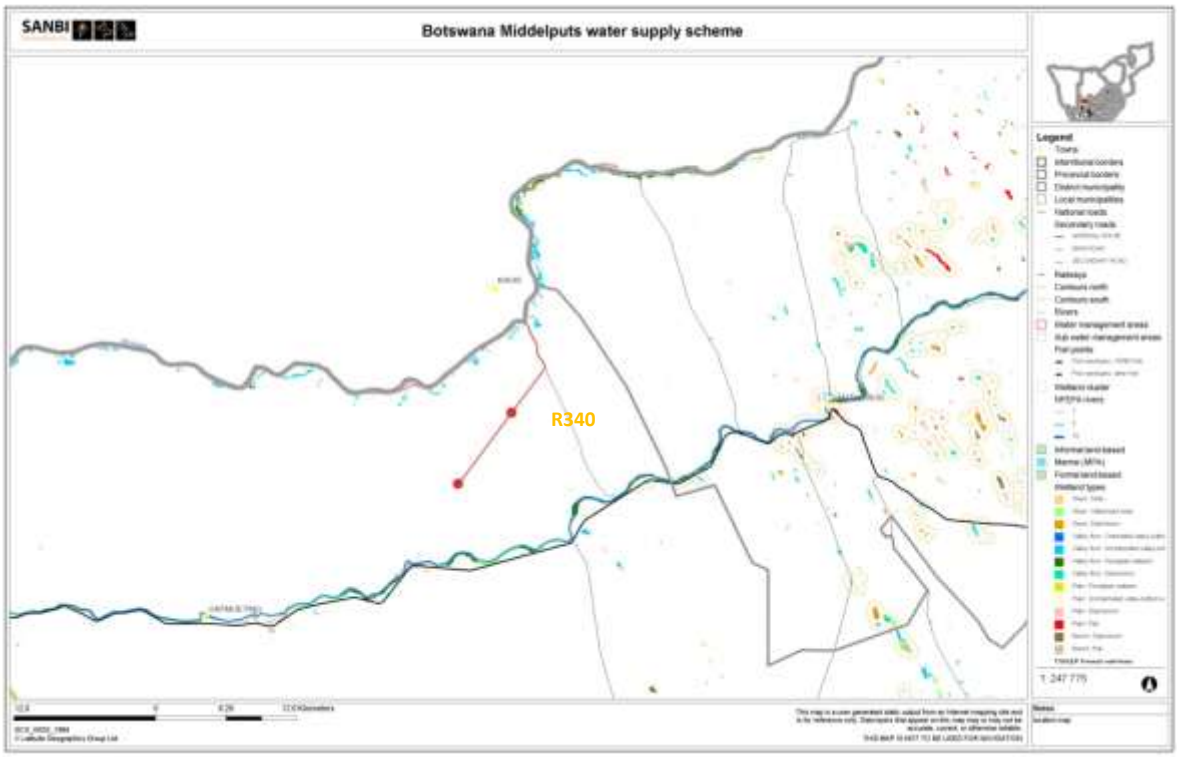


Table 1: GPS coordinates describing the route (WGS 84 format)

DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
Starting Point	S26 48 06.2 E21 46 54.1	889 m
Intersection with R304	S26 50 36.7 E21 47 58.4	937 m
End Point	S26 56 53.1 E21 43 19.6	941 m
Proposed Construction camp Location	S26 50 37.1 E21 47 58.7	938 m

METHODS

Desktop studies were conducted, coupled by a physical site visit during September 2012. The timing of the site visit was reasonable in that essentially all perennial plants were identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

The survey was conducted by walking through the site (Refer to **Error! Reference source not found.**) and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

Please note that between waypoint "*031 Acac haem*" and waypoint "*037 Acac haem*" a large number of juvenile *Acacia haematoxylon* individuals were encountered, a number of which will be impacted by the proposed construction. However, there was so many of these juvenile trees that it did not make sense to plot

them all with separate GPS waypoints. In addition the surrounding veld showed exactly the same distribution of these species.

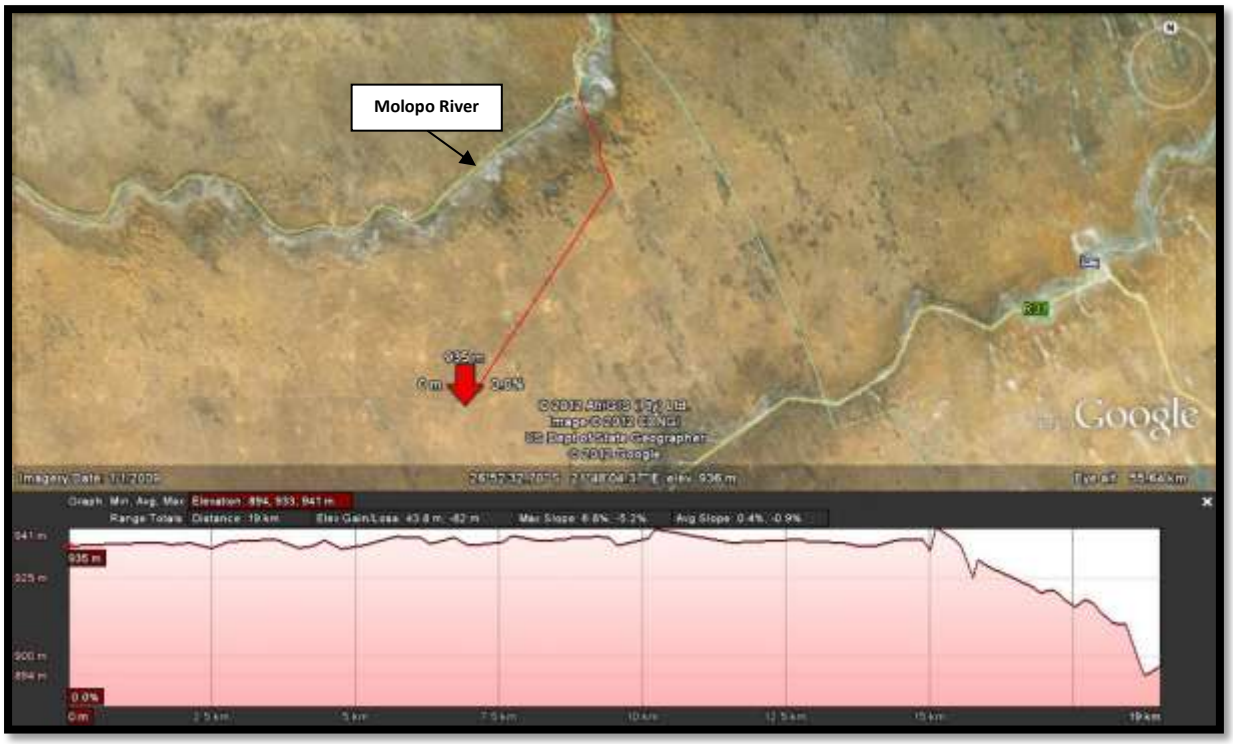
Figure 5: Garmin map showing the route evaluated during the biodiversity scan.

TOPOGRAPHY

The proposed follows a typical undulating Duneveld landscape, which remains almost at the same mean altitude until it reaches the banks of the small valley in which the Molopo River sometimes flow. Elevation data in Table 1 and Figure 6, shows that the mean elevation of the route remains almost level (undulating plains) from the starting point in the west till it intersects with the R304. Once it reaches the banks of the shallow valley (towards the Molopo) it shows a sudden descent into the valley. Elevation varies from 935 m (at the starting point) to approximately 890 m in the valley bottom an average slope of 0.4% and an elevation loss of approximately 40 m.

Except for the Molopo River (where the proposed pipeline stops), which will have to be crossed to make the connection to Botswana, no other natural watercourses or drainage lines have been encountered along the route.

Figure 6: Google image showing very little difference in elevation until it reaches the shallow valley near the Molopo River



CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. As one of the larger towns, in this area, the climate information for Kuruman was used for this study. Kuruman normally receives about 266 mm of rain per year, with most rainfall occurring mainly during summer. It receives the lowest rainfall (0 mm) in June and the highest (58 mm) in February. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Kuruman range from 17.5°C in June to 32.6°C in January. The region is the coldest during June when the mercury drops to 0°C on average during the night (www.saexplorer.co.za).

The graphs underneath indicate the average climate data for Kuruman (giving an average for the Northern Cape region) (Figure 7 to Figure 10).

Figure 7: Kuruman average minimum and maximum temperatures (www.weather-and-climate.com)

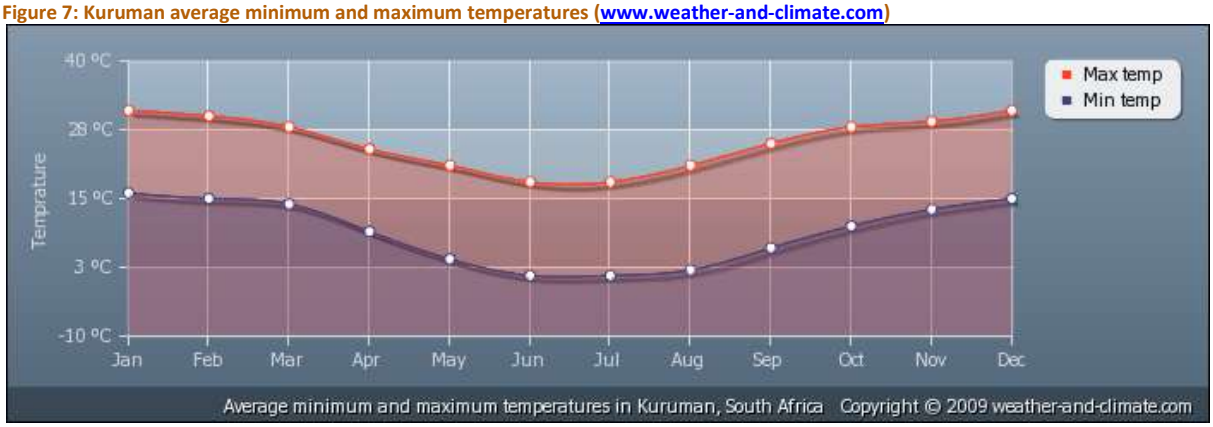


Figure 8: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

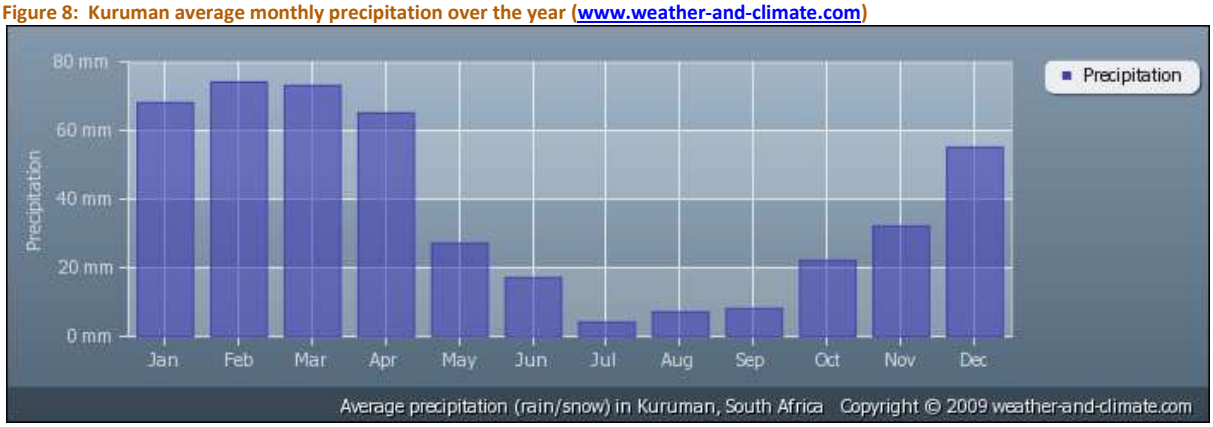


Figure 9: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

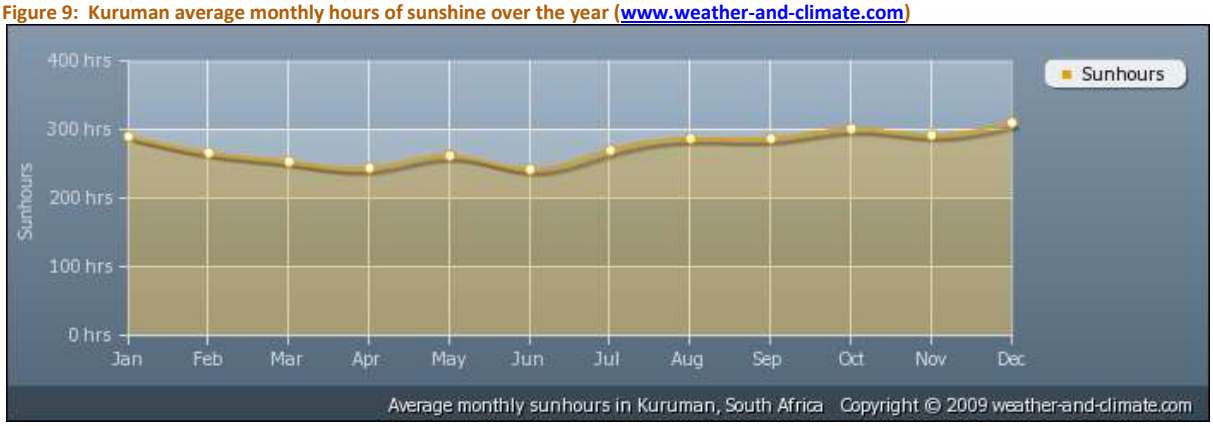
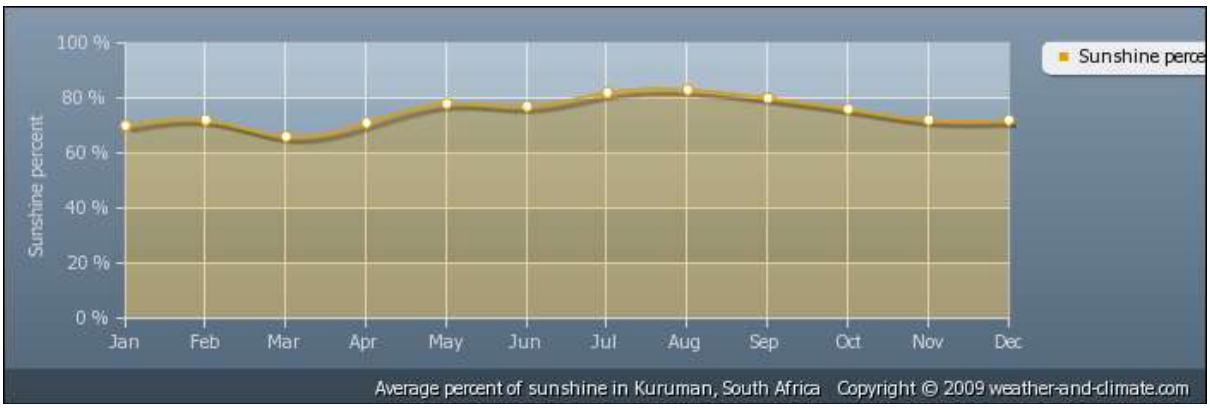


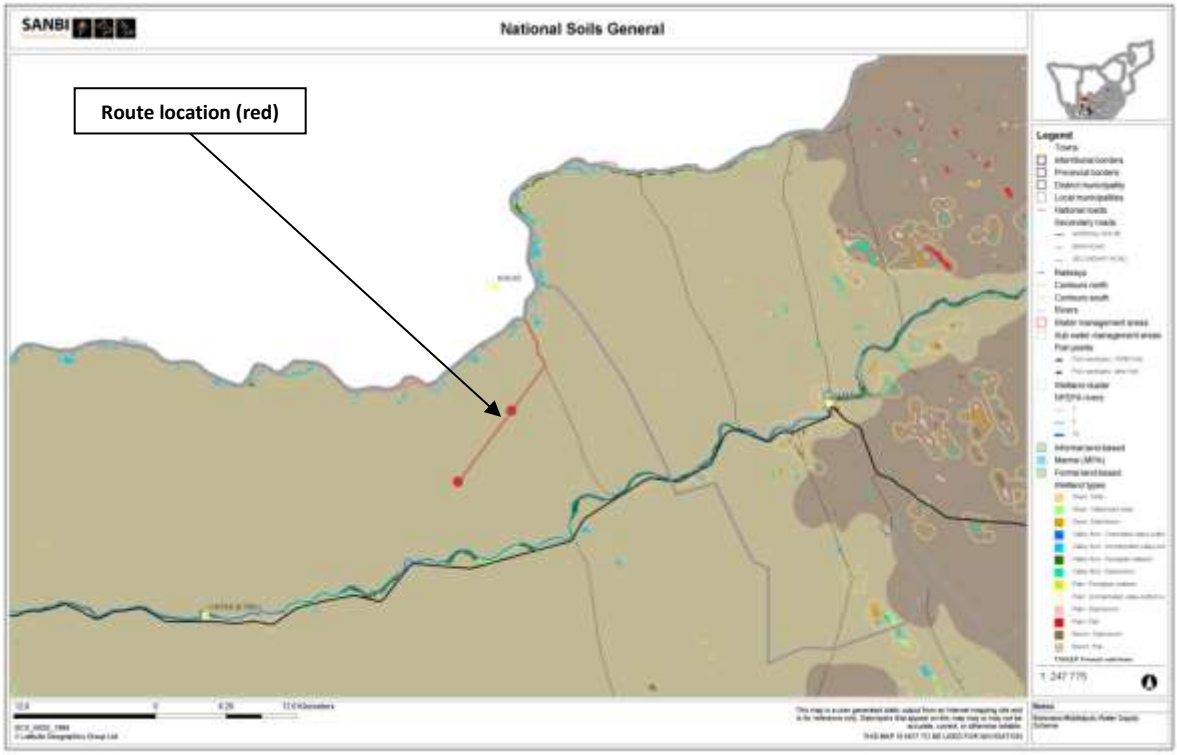
Figure 10: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)



GEOLOGY & SOILS

According to Mucina and Rutherford (2006) and the SANBI Biodiversity Geographical Information System, the geology and soils for this area is described as aeolian sand underlain by superficial silcretes and calcretes of the Cenozoic Kalahari Group. Mostly fixed parallel sand dunes with Af land type almost exclusively (Mucina & Rutherford, 2006).

Figure 11: General soil map for the area covered by the proposed route (SANBI BGIS)



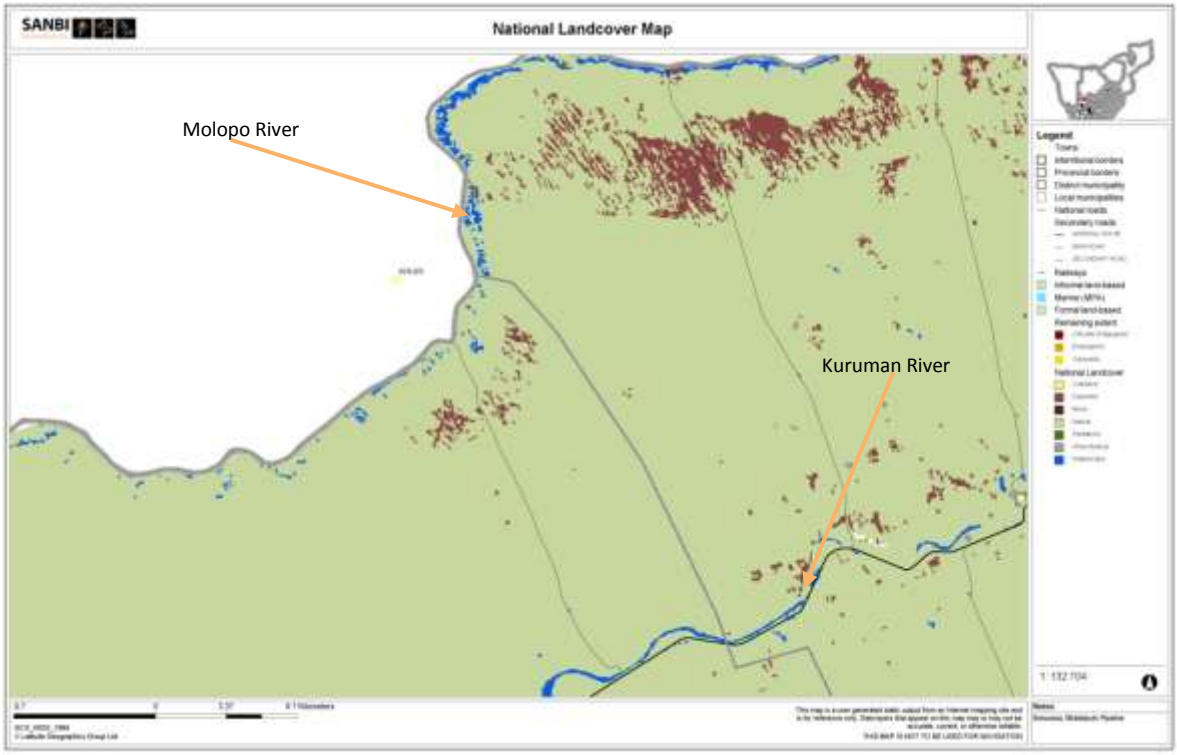
No special soils or geology features (e.g. quartz patches or broken veld), which could support special botanical features, were observed during the site visit (or are expected). However, next to the Molopo Valley the pipeline calcrete outcrop in which the vegetation is reduced to a low shrubby veld with markedly less grass cover.

LANDUSE AND COVER

The pipeline route covers various properties within the Duneveld region of the Kalahari. All of these properties are used mainly for livestock grazing and or game farming. No intensive farming has been observed (probably as a result of the lack of irrigation water). Natural game is still expected although not observed during the site visit. Natural vegetation forms a uniform grassy cover over most of the area with larger trees scattered throughout. The main biodiversity features of this area are the undisturbed (or mostly undisturbed) remaining natural veld, the Molopo River and the number of protected trees observed (e.g. *Acacia erioloba, Acacia haematoxylon* and *Boscia albitrunca*). The possibility exists that other protected species may also be present, although none was observed at the time of the site visit.

Refer to the Landuse map of South Africa underneath (Figure 12) indicating remaining natural vegetation in green, river systems and wetlands in blue and degraded areas in brown expected in this area.

Figure 12: National land cover map indicating the Landcover expected



BROAD SCALE VEGETATION TYPES EXPECTED

In accordance with the 2006 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) two broad vegetation type is expected in the proposed area and its immediate vicinity, namely Gordonia *Duneveld* and *Southern Kalahari Mekgacha* on the bottom of the dry riverbeds (Refer to Figure 13).

According to the 2004 National Spatial Biodiversity Assessment (NSBA), both Gordonia Duneveld and Southern Kalahari Mekgacha were classified as "Least Threatened". Recently the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), was promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. According to this National list, both **Gordonia Duneveld and Southern Kalahari Mekgacha remains classified as Least Threatened**.

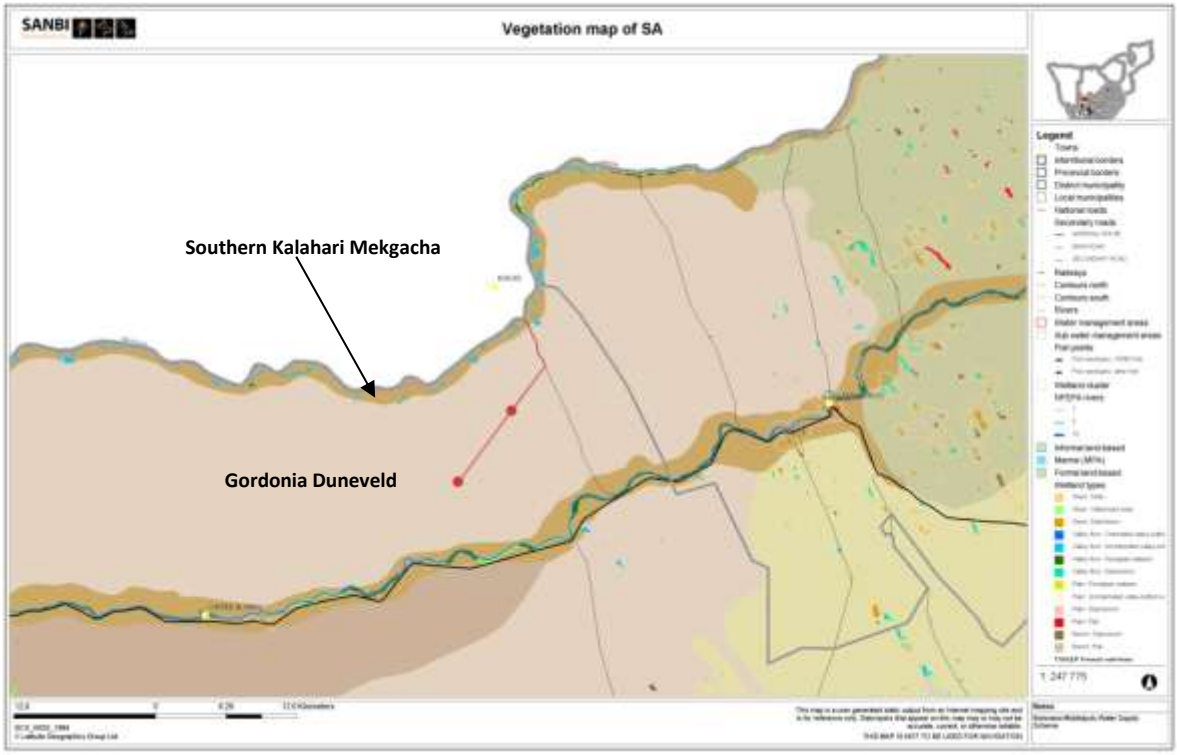
Table 2: Vegetation status according to the 2004 National Spatial Biodiversity Assessment

Vegetation type	National Status 2011	Remaining	Conservation target	Formally conserved
Gordonia Duneveld	Least Threatened	99.8 %	16 %	14.2 %
Southern Kalahari Mekgacha	Least Threatened	98.3 %	24%	17.5 %

According to Mucina & Rutherford (2006), Gordonia Duneveld is found in the Northern Cape Province along the larger part of the South African side of the Kgalagadi Transfrontier Park south of the Molopo River (west of Van Zylsrus, interleaving with Kalahari Karroid Shrubland in the west and south at altitudes varying from

1 100 -1 500 m. Southern Kalahari Mekgacha is found in both the Northern Cape and the North-West Provinces in valleys (including beds and adjacent slopes) of the intermittent rivers draining the dry savannah south of the Bakalahari Schwelle in the South African part of the Kalahari Region at altitudes ranging from 850 m to 1 100 m, with a few occurrences as high as 1 500 m.

Figure 13: Vegetation map of SA, Lesotho and Swaziland (2006)



Gordonia Duneveld

Gordonia Duneveld is described as occurring on parallel dunes about dunes about 3-8 m above the plains. Open shrubland with ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dune slopes, also with *A. mellifera* on lower slopes and *Rhigozum trichotomum* in the interdune straaten.

According Mucina & Rutherford (2006), important taxa include the following: Small Tree: *Acacia mellifera* subsp. *detinens;* Tall Shrubs: *Grewia flava* and *Rhigozum trichotomum*; Low Shrubs: *Aptosimum albomarginatum*, *Monechma incanum* and *Requienia sphaerosperma*; Succulent Shrubs: *Lycium bosciifolium*, *L. pumilum* and *Talinum caffrum;* Graminoids: *Schmidtia kalahariensis*, *Brachiaria glomerata*, *Bulbostylis hispidula*, *Centropodia glauca* (Kalahari-Gha Grass), *Eragrostis lehmanniana*, *Stipagrostis ciliata*, *S. obtusa* and *S. uniplumis*; Herbs: *Hermbstaedtia fleckii*, *Acanthosicyos naudinianus*, *Hermannia tomentosa*, *Limeum arenicolum*, *L argute-carinatum*, *Oxygonum dregeanum* subsp. *canescens* var. *canescens*, *Sericorema remotiflora*, *Sesamum* triphyllum and *Tribulus zeyheri*.

Biogeographically important taxa (Kalahari endemics) include: Tall Shrub: *Acacia haematoxylon*; Graminoids: *Stipagrostis amabilis*, *Anthephora argentea* and *Megaloprotachne albescens*; Herbs: *Helichrysum arenicola*, *Kohautia ramosissima* and *Neuradopsis austro-africana*.

Photo 1: Natural veld in the study area, note the grassy cover and scattered small trees (*Acacia haematoxylon*)

Southern Kalahari Mekgacha

Southern Kalahari Mekgacha is described as sparse, patchy grass-lands, sedqelands and low herblands dominated by CA grasses (*Panicum, Eragrostis, Enneapogon, Tragus, Chloris and Cenchrus*) on the bottom of (mostly) dry riverbeds. Low shrublands are found in places with patches of taller shrubland (with *Schotia afra*) on the banks of the rivers. Relatively tall *Acacia erioloba* trees can form a dominant belt along some of the rivers, for example the middle and lower reaches of the Kuruman River In some other rivers the taller trees are scattered. The term 'mekgacha' (singular 'mokgacha') is of Setswana origin and means 'dry (river) valley'. Mekgacha are considered to be remnants of an ancient extensive riverine system of the 'Kalahari River', which drained the Kalahari Basin and used the current lower Orange River channel from Kakamas downstream.

Important taxa in the Dry river bottoms include the following: Tall Shrubs: *Lebeckia linearifolia*, *Sisyndite spartea* and *Deverra denudata* subsp. *aphylla;* Herbs: *Amaranthus dinteri* subsp. *dinteri*, A. *praeter-missus*, *A. schinzianus*, *Boerhavia repens*, *Chamaesyce inaequi- atera*, *Cucumis africanus*, *Geigeria ornativa*, *G. pectidea*, *Heliotropium lineare*, *Indigofera alternans*, *I. argyroides*, *Kohautia cynanchica*, *Lotononis platycarpa*, *Osteospermum muricatum*, *Platycarpha carlinoides*, *Radyera urens*, *Stachys spathulata*, *Tribulus terrestris*; Succulent Herb: *Zygophyllum simplex*.; Graminoids: *Cenchrus ciliaris*, *Chloris virgata*, *Enneapogon desvauxii*, *Eragrostis annulata*, *E. bicolor*, *Odyssea paucinervis*, *Panicum coloratum*, *Eragrostis porosa*, *Panicum impeditum*, *Sporobolus nervosus*;

Rocky slopes of river canals Tall Tree: *Acacia erioloba*; Low Shrubs: *Aptosimum lineare*, *Pechuel-Loeschea leubnitziae*; Graminoids: *Setaria verticillata*, *Enneapogon scaber*, *Oropetium capense*, *Stipagrostis uniplumis*, *Tragus racemosus*; Herb: *Dicoma capensis*.

The mekgacha are under strong utilisation pressure, both from wildlife (to graze and for salt licks) and domestic animals (grazing, browsing and animal penning). Alien woody Prosopis species occur as invasive plants in places.

Photo 2: The vegetation next to the Molopo River (Note *Acacia erioloba* in the background and *Parkinsonia africana* in the foreground)

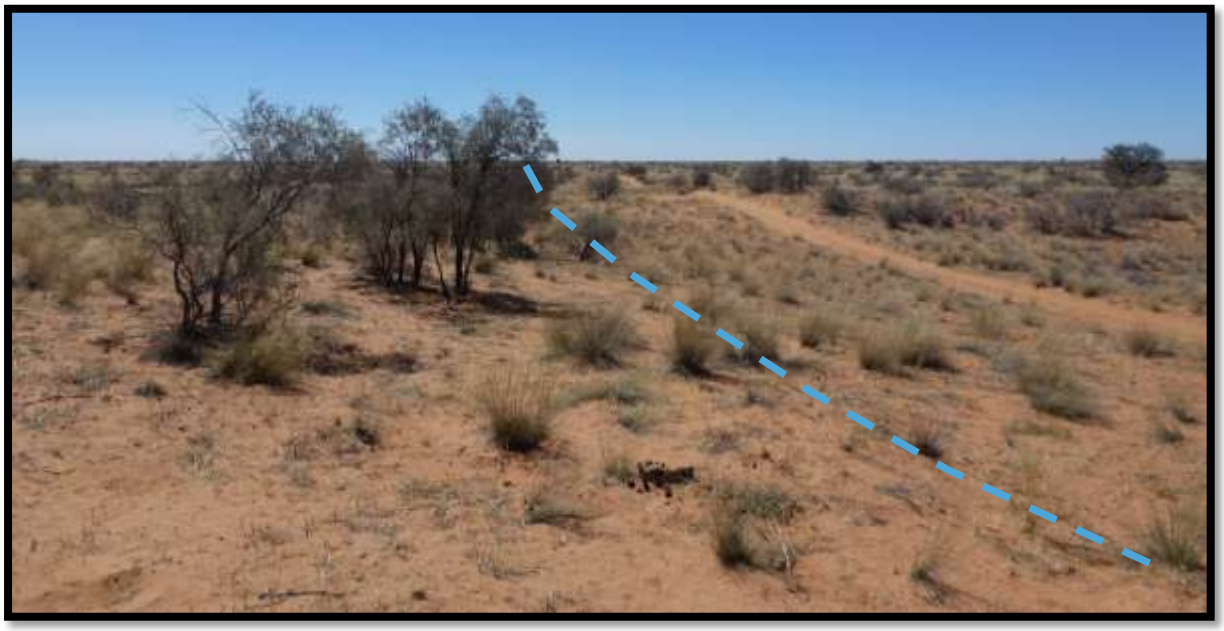
VEGETATION ENCOUNTERED

The following is a discussion of the vegetation and other significant environmental features encountered along the proposed pipeline route. The author did not attempt to identify all species along the route but rather concentrated on identifying and marking protected plant species or any other biodiversity feature of significance. However, in doing so notes was taken of some of the most common species found along the route. Overall the vegetation encountered conforms to that of Gordonia Duneveld inland from the Molopo River (with a large patch of calcrete outcrops encountered just south of the Molopo River valley next to the R340) with Southern Kalahari Mekgacha within the Molopo River valley (as indicted on the vegetation map of SA).

From the extraction point it is proposed that the pipeline will follow within the existing servitude (approximately 4 m north of the existing pipeline). Please note, that although the area must have been

disturbed during the installation of the original pipeline, very little of this disturbance remains to be seen (the only indication being the occasional view of pressure relieve- or reducing valves and the access road for inspection purposes). From the extraction point until it reaches the R340 the existing pipeline runs just south of the twee-spoor dirt track (inspection track). It is proposed that the new pipeline should be located north of the existing pipeline (at a minimum distance of at least 4 m away), which will mean that the inspection tract may also have to be removed. During the site visit the idea of locating the pipeline just north of the existing tract was also mentioned, meaning (that wherever possible) the existing dirt track will not have to be moved and will give a better vantage over both pipelines. Most importantly though is that it should in theory reduce the construction footprint considerably.

Photo 3: Note this picture was taken from the extraction point looking west to east with the proposed pipeline (blue) to the north



Picture 3 and 4 give a fair representation of what the vegetation and landscape looks like for most of the first 7 to 8 km of the proposed road, being slightly undulating sandy dunes covered by a sparse to medium grassy layer with small trees and scattered throughout the landscape (shrubs occasionally). The vegetation layer varies between 40 – 50%, dominated by the grassy bottom layer which included *Stipagrostis*, *Eragrostis* and *Enneapogon* species. The top layer is usually a sparse layer of small to medium trees, which is distributed throughout the landscape. Along this portion of the proposed pipeline route the shrub *Acacia haematoxylon* (Grey Camelthorn) is the most conspicuous and widespread woody species on the grassy dunes and in the valleys (occasionally reaching the status of a smallish tree).

Medium sized individuals of the protected *Acacia erioloba* (Camelthorn) are sometimes present (becoming more prominent as one move further east along the proposed route), but is not impacted by the proposed pipeline route.

The Grey Camelthorn- as well as the Camelthorn tree exhibits distinctive high quality red heartwood and similar to *A. erioloba* it is a used as a firewood as well as fodder (especially the pods). Both species holds

economic significance in the southern Kalahari region. Grey Camelthorn wood is regarded as the second best source of firewood (after *Acacia erioloba*) in the region where fuel wood is scarce. As a result both these trees had been utilised extensively in the past and are now protected species tree species in South Africa in terms of National Forests Act (GN 716 of 7 September 2012).

Photo 4: Note picture was taken from east to west (pipeline towards the north of the road), approximately 3 km from extraction point

Approximately 8 km east of the extraction point (starting point), the landscape and vegetation changes slightly in that the dunes became slightly more enhanced and are spaced closer together. Although *Acacia haematoxylon* is still common, a number of *Acacia erioloba* trees were also observed in close proximity of the proposed route and shrubs like *Rhigozum trichotomum* sometimes dominate the vegetation within the interdune straaten. Photo 5 shows one of the straaten between dunes overgrown with *Rhigozum trichotomum*, also note the *Acacia erioloba* in the background and to the right of the photo.

Photo 5: Interdune straaten dominated by *Rhigozum trichotomum*

As one move further east (towards the R340) the occurrence of *Acacia erioloba* became more regular (but with *Acacia haematoxylon* still very much present. In addition single individuals of the Sheppard's tree (*Boscia albitrunca*) can also be observed (although they should not be impacted by the proposed route). Photo 6 shows a typical view of the landscape as one move further east along the pipeline route (note that the straaten are almost absent as the dunes are spaced closer together).

Photo 6: A view of the landscape (east to west) approximately 10 km east of the extraction point (note the dune stabilisation methods)

It was also noted that as one move further east (10 – 14 km east of the extraction point) the presence of Gha grass (*Centropodia glauca*) and both small and tall Bushman Grass (*Stipagrostis obtusa* and *S. ciliata*) became more prominent. This could be a factor of a slight change in habitat or climate but it could also indicate better grazing patters as these species are all considered indicator species of veld in a relative good condition. Other shrub/tree species that had been encountered in this area includes *Acacia mellifera* (Blackthorn) and a *Lycium* species.

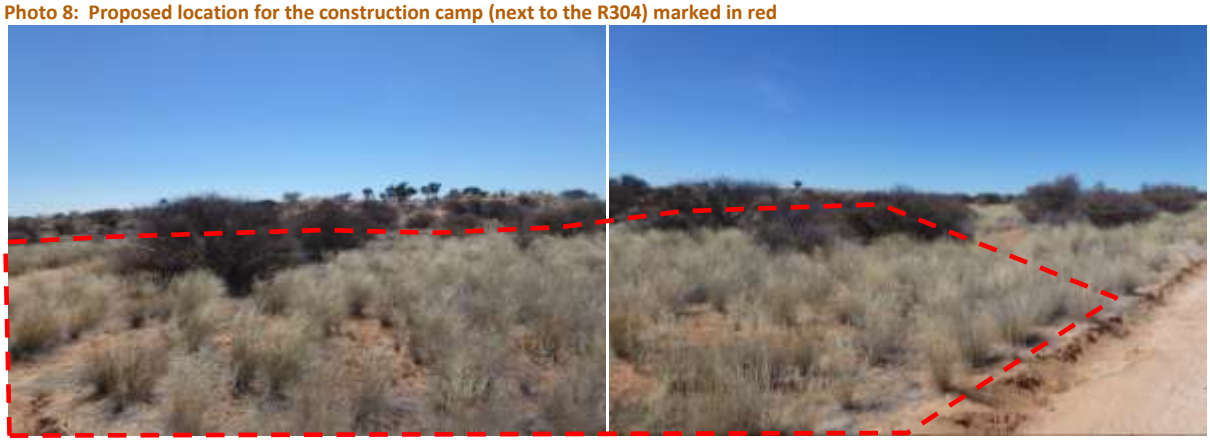
Photo 7 shows a mature *Acacia erioloba* (Camelthorn) tree found along the proposed route. The slow-growing Camelthorn grows well in poor soils and in harsh environmental conditions. However, they will take up to 10 years before starting to flower, and only by age 20, will produce regular large pod crops (Seymour & Milton, 2003). It is this of great important that especially mature seed producing individuals are protected. Most benefits brought by *A. erioloba* are not immediately apparent, and it is only when they are large, years after establishment, that they begin to appreciably affect soil quality, produce large patches of shade, and produce pods, gum, and fuel wood. Large trees also diminish nutrient leaching, increase nutrient levels beneath their canopies (owing to nutrient cycling and concentration of livestock dung), mitigate soil degradation, prevent soil erosion on steep slopes, sequester carbon and replenish organic matter. Pod production is linearly related to tree size, so as trees become older, they become more valuable as a source of seed and forage, as livestock relish eating the pods (Seymour and Milton, 2003).

Photo 7: A majestic individual of Acacia erioloba encountered within the proposed route (to be protected)

Photo 8 gives a view of the proposed location for the construction camp (located just east of the R340, where the R340 and the pipeline route from the extraction point intersect for the first time). It was chosen for its logical and practical location with regards to access to both parts of the pipeline route. It is also easier to access the pipeline route towards the extraction point from the east because of the dune formations.

On inspection it was established that the location was also fortuitously chosen with respect to vegetation, since it is located upon a relative flat area (interdune straaten) overgrown with *Acacia mellifera* and although *Acacia erioloba*, *A. haematoxylon* and *Boscia albitrunca* are found in the surrounding area, none has been observed within the proposed construction site location. The specific location of the site must, however, be overseen by the ECO and must not reach onto the dunes in the background of Photo 8, since a number of *Acacia erioloba* species were encountered on these dunes.

Photo 8: Proposed location for the construction camp (next to the R304) marked in red



Acacia mellifera had been suggested as very good dune packing material for dune stabilising purposes. *Acacia mellifera* is often regarded as an indicator of bush encroachment (resulting more often than not from poor veld management). Branches and stems of *Acacia mellifera* harvested from this site could thus be used to good effect for dune stabilisation along the route.

Photo 9: A mature *Boscia albitrunca* tree located within the proposed pipeline location (next to the R340).

Photo 9 show a beautiful full grown Sheppard's tree encountered within the proposed route location (however, all intentions are to protect this specific tree if at all possible). According to Alias & Milton (2003) *Boscia albitrunca* as it is a keystone species in arid southern Africa, where it primarily provides browse to livestock and game, shade and food and shelter to other animals including invertebrates and birds. The laws of numerous African traditions strictly prohibit destruction of this tree. The wood is not favoured as a fuel wood and has no commercial value, although it is sometimes used in rural areas for making household items such as tables, chairs, spoons and dishes.

This species is under threat, however, owing to intense use of its branches to supplement livestock feed, particularly in times of drought. Its nutritious foliage suggests that this species obtains nutrients from ground water and perhaps also from the concentration of nutrients beneath its canopy because of animal activities. It therefore contributes to nutrient cycling in mainly oligotrophic sands, as well as performing other ecological services such as reducing nutrient leaching, mitigating soil degradation, preventing soil erosion, sequestering carbon and replenishing organic matter.

In addition, it is often the only available dense shade tree in the hot arid environment of the south-western regions of its distribution. This species is observed to establish beneath other large trees within its environment, primarily *A. erioloba*, which serve as resting and perch sites for animals and birds, making the species dependent on large tree species in arid savannah. Therefore, threats to species that provide these micro-sites also constitute a threat to *B. albitrunca*. Within the arid Kalahari, indiscriminate removal of Camelthorn (*Acacia erioloba*) trees could reduce the availability of suitable germination sites (Alias & Milton, 2003).

Photo 10: A view of the R340 (nnw-ese) indicating landscape and vegetation (note *A. mellifera* and *A. haematoxylon*)

Photo 10 -11 give an overview of the landscape and vegetation encountered along the first 3.5 km of the proposed route from where it intersects with the subordinate road R340 and then turn north-north-west, following the R340. Along this portion of the pipeline will be located to the east of the R340, which runs approximately parallel with the dunes of this area (situated within one of the interdune straaten).

Photo 11: A view of the proposed pipeline route along the R340 (nnw-ese), note the *Boscia albitrunca* and *A. erioloba* individuals

Since the route runs within the straaten the vegetation is slightly more uniform and has a larger woody component. Apart from the grasses (which still dominates) *Acacia erioloba*, *A. haematoxylon*, *Boscia albitrunca*, *Lycium* specie, *Rhigozum trichotomum* and *Acacia mellifera* are were all encountered and although still scattered it was more densely located than for the previous portion of the proposed route. While evaluating the proposed route it became clear that a number of these tree species might potentially be impacted. However, through micro-layout adjustments it might be possible to minimise the impact on *Acacia*

erioloba and *Boscia albitrunca*, but a number of the above and a larger number of youngish *Acacia haematoxylon* most likely be impacted (even if only their root system).

Photo 12: Shows the landscape encountered along the calcrete outcropping

Photo 12 gives an overview of the approximately 900 m portion of the proposed pipeline going through the calcrete outcrop just north of the Molopo River. The vegetation component differs markedly from that of the sandy dunes just south there-of. The grassy component is almost gone and vegetation takes the form of a very low shrubland. No Acacia erioloba, A. haematoxylon, or Boscia albitrunca individuals were encountered within the proposed footprint. According to Van Rooyen *et. al*. (2008) calcrete outcrops, terraces and floodplains along the Auob and Nossob rivers and at pans where whitish calcareous and compact sandy soils occur are characterised by a specific plant assemblage.

Scattered individuals of *Acacia erioloba*, *A. mellifera*, *Boscia albitrunca*, *Lycium bosciifolium* and *Grewia flava* can occur in this unit, which is dominated by dwarf shrubs such as *Rhigozum trichotomum*, *Monechma genistifolium* subsp. *australe*, *Zygophyllum pubescens*, *Ehretia alba*, *Leucosphaera bainesii*, *Plinthus cryptocarpus*, *Salsola tuberculata* and *Aizoon schellenbergii*. The grass layer is poorly developed and is characterised by *Enneapogon desvauxii*, *E. scaber*, *Stipagrostis hirtiglumma*, *Cenchrus ciliaris*, *Fingerhuthia africana*, *Stipagrostis ciliata*, *S. obtusa* and *Schmidtia kalahariensis*. Other prominent dwarf shrubs, forbs and succulents are *Indigofera auricoma*, *Barleria rigida*, *Chamaesyce glanduligera*, *Ptycholobium biflorum*, *Tribulus zeyheri*, *Cleome angustifolia*, *Adenium oleifolium* and *Euphorbia braunsii*.

Photo 13 shows a view of the Molopo River valley indicating the proposed pipeline route. The landscape is characterised by scattered large *Acacia erioloba* and single individuals of *Boscia albitrunca* on white to red sands in the dune valley near the Molopo River. The most noteworthy woody species encountered were *Acacia erioloba*, *A. haematoxylon*, *A. mellifera*, *A. hebeclada* and *Boscia albitrunca* with a single individual of *Parkinsonia africana* also observed. Various grass species were also prominent including *Stipagrostis*,

Schmidtia and *Eragrostis* species. Although the probability exists that the some of these species may be impacted, it should be relatively easy to avoid significant tree species through micro-layout adjustments.

Photo 13: A view over the Molopo River valley, giving an indication of the landscape and vegetation encountered

Flora

The following is a checklist of plant species that might be encountered in quadrant in which the proposed pipeline will be located. The checklist was obtained from the SABIF website (www.sabif.ac.za).

Table 3: Checklist of species that might be encountered along the pipeline route (SABIF website)

FAMILY NAME	SPECIES NAME
ACANTHACEAE	*Monechma genistifolium subsp. australe*
AIZOACEAE	*Plinthus sericeus*
AIZOACEAE	*Trianthema triquetra subsp. triquetra var. triquetra*
AMARANTHACEAE	*Amaranthus dinteri subsp. dinteri var. a*
AMARANTHACEAE	*Hermbstaedtia fleckii*
AMARANTHACEAE	*Sericorema remotiflora*
AMARYLLIDACEAE	*Nerine laticoma*
APOCYNACEAE	*Pergularia daemia subsp. daemia*
ASTERACEAE	*Chrysocoma obtusata*
ASTERACEAE	*Dimorphotheca polyptera*
ASTERACEAE	*Felicia clavipilosa subsp. clavipilosa*
ASTERACEAE	*Hirpicium echinus*
ASTERACEAE	*Nolletia arenosa*
ASTERACEAE	*Pentzia calcarea*
ASTERACEAE	*Senecio sisymbriifolius*
ASTERACEAE	*Verbesina encelioides var. encelioides*
BIGNONIACEAE	*Rhigozum trichotomum*
BORAGINACEAE	*Heliotropium ciliatum*
CHENOPODIACEAE	*Chenopodium botryodes*
CHENOPODIACEAE	*Chenopodium hederiforme var. dentatum*
CHENOPODIACEAE	*Salsola aphylla*
CYPERACEAE	*Bulbostylis hispidula subsp. pyriformis*
EUPHORBIACEAE	*Chamaesyce inaequilatera*
EUPHORBIACEAE	*Euphorbia inaequilatera var. inaequilatera*
FABACEAE	*Acacia erioloba E.Mey. x A. haematoxylon Willd.*
FABACEAE	*Acacia haematoxylon*
FABACEAE	*Crotalaria sphaerocarpa subsp. sphaerocarpa*

FAMILY NAME	SPECIES NAME
FABACEAE	*Crotalaria virgultalis*
FABACEAE	*Indigofera alternans var. alternans*
FABACEAE	*Indigofera charlieriana var. charlieriana*
FABACEAE	*Prosopis glandulosa var. torreyana*
FABACEAE	*Requienia sphaerosperma*
FABACEAE	*Senna italica subsp. arachoides*
FABACEAE	*Wiborgia monoptera*
GISEKIACEAE	*Gisekia pharnacioides var. pharnacioides*
IRIDACEAE	*Gladiolus scullyi*
LAMIACEAE	*Acrotome inflata*
MALVACEAE	*Grewia flava*
MALVACEAE	*Hermannia comosa*
MALVACEAE	*Hermannia modesta*
MALVACEAE	*Hermannia sp.*
MALVACEAE	*Hermannia tomentosa*
MALVACEAE	*Pavonia senegalensis*
MESEMBRYANTHEMACEAE	*Mesembryanthemum nodiflorum*
MOLLUGINACEAE	*Limeum arenicolum*
MOLLUGINACEAE	*Limeum sulcatum var. robustum*
MOLLUGINACEAE	*Limeum viscosum subsp. viscosum var. glomeratum*
MOLLUGINACEAE	*Limeum viscosum subsp. viscosum var. viscosum*
PEDALIACEAE	*Sesamum triphyllum var. triphyllum*
PHYLLANTHACEAE	*Phyllanthus loandensis*
POACEAE	*Anthephora argentea*
POACEAE	*Aristida meridionalis*
POACEAE	*Aristida stipitata subsp. spicata*
POACEAE	*Brachiaria glomerata*
POACEAE	*Brachiaria marlothii*
POACEAE	*Eragrostis brizantha*
POACEAE	*Eragrostis lehmanniana var. lehmanniana*
POACEAE	*Eragrostis trichophora*
POACEAE	*Eragrostis truncata*
POACEAE	*Megaloprotachne albescens*
POACEAE	*Schmidtia kalahariensis*
POACEAE	*Schmidtia pappophoroides*
POACEAE	*Stipagrostis ciliata var. capensis*
POACEAE	*Stipagrostis obtusa*
POACEAE	*Stipagrostis uniplumis var. uniplumis*
POACEAE	*Tragus racemosus*
POLYGONACEAE	*Oxygonum delagoense*
RICCIACEAE	*Riccia albolimbata*
SCROPHULARIACEAE	*Aptosimum albomarginatum*
SCROPHULARIACEAE	*Aptosimum elongatum*
SCROPHULARIACEAE	*Aptosimum junceum*
SCROPHULARIACEAE	*Aptosimum lineare var. lineare*
SCROPHULARIACEAE	*Peliostomum leucorrhizum*
SOLANACEAE	*Lycium villosum*
SOLANACEAE	*Solanum namaquense*
THYMELAEACEAE	*Gnidia polycephala*
ZYGOPHYLLACEAE	*Tribulus terrestris*
ZYGOPHYLLACEAE	*Tribulus zeyheri subsp. zeyheri*
ASTERACEAE	*Geigeria ornativa subsp. ornativa*
FABACEAE	*Calobota linearifolia*

ENDEMIC OR PROTECTED PLANT SPECIES

According to Mucina & Rutherford (2006), the following biogeographically important taxa (Kalahari endemics) may be encountered namely: Tall Shrub: *Acacia haematoxylon*; Graminoids: *Stipagrostis amabilis*, *Anthephora argentea* and *Megaloprotachne albescens*; Herbs: *Helichrysum arenicola* and *Kohautia ramosissima*.

The National Forests Act of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species. In accordance with GN 716 of 7 September 2012 three listed protected species were encountered within the study area (Refer to Table 3). Also refer to Table 4 for location data on the individual trees encountered.

Table 4: Protected tree species with a geographical distribution that may overlap the broader study area

SPECIES NAME	COMMON NAME	TREE NO.	DISTRIBUTION
Acacia erioloba	Camel Thorn Kameeldoring	168	In dry woodlands next to water courses, in arid areas with underground water and on deep Kalahari sand
Acacia haematoxylon	Grey Camel Thorn Vaalkameeldoring	169	In bushveld, usually on deep Kalahari sand between dunes or along dry watercourses.
Boscia albitrunca	Shepherds-tree Witgat/Matopie	130	Occurs in semi-desert and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils.

In addition to the above the Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, which also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act.

Please note that this study never intended to be full botanical assessment. However, a scan of significant species was done during the site visit, and even though the author does not claim that all species encountered were identified, no herb-, bulbaceous- or succulent species were encountered (most of the Schedule 1 & 2 protected species falls within one of the above categories). Thus although none of these protected species were encountered a botanical scan of the final route layout should be done, and as a pre-cautionary measure all viable herb-, bulbs- and succulent plant species encountered within the footprint should be removed and replanted through a dedicated search and rescue operation.

Endemic or protected plant species encountered

During the site visit, a number of *Acacia erioloba, A. haematoxylon* and *Boscia albitrunca* individuals were encountered scattered throughout the landscape. Those likely or with a change of being impacted as a result of the proposed activity were marked with a GPS (Refer to Figure 14 and Table 4).

However, note that due to the large number of immature/small *Acacia haematoxylon* individuals encountered along the first 10 km of the pipeline (from the starting or extraction point eastwards), only larger individuals of this species was referenced with GPS waypoints (larger than 1 m in height). However, all *Acacia erioloba* and *Boscia albitrunca* species which might be impacted by the proposed pipeline route were GPS referenced. It was also evident that through micro-layout adjustments of the final route it will be possible to miss almost all *Acacia erioloba* and *Boscia albitrunca* individuals, but a number of young *Acacia haematoxylon* species will most probably be impacted.

Figure 14: An overview of the route indicating the location of significant plant species encountered during the site visit

Table 5: A list of protected species encountered during the site visit, referenced by GPS waypoints (WG84 format)

Waypoint no.	SPECIES NAME	COMMON NAME	NUMBER OF TREES	LOCATION
001	*Acacia erioloba*	Camelthorn	single	S26 48 07.1 E21 46 54.0
002	*Acacia erioloba*	Camelthorn	single	S26 48 06.8 E21 46 55.6
003	*Acacia erioloba*	Camelthorn	single	S26 48 07.0 E21 46 55.7
004	*Acacia erioloba*	Camelthorn	single	S26 48 07.1 E21 46 55.1
005	*Acacia erioloba*	Camelthorn	single	S26 48 08.1 E21 46 54.4
006	*Acacia erioloba*	Camelthorn	single	S26 48 08.6 E21 46 53.7
007	*Acacia haematoxylon*	Grey Camelthorn	single	S26 48 06.1 E21 46 54.5
008	*Acacia haematoxylon*	Grey Camelthorn	single	S26 48 15.5 E21 47 00.5
009	*Boscia albitrunca*	Sheppard's tree	single	S26 48 16.3 E21 47 01.8
010	*Acacia erioloba*	Camelthorn	single	S26 48 17.4 E21 47 02.5
011	*Boscia albitrunca*	Sheppard's tree	Immature	S26 48 21.2 E21 47 03.2
012	*Acacia erioloba*	Camelthorn	single	S26 48 48.5 E21 47 13.4
013	*Acacia erioloba*	Camelthorn	single	S26 48 51.9 E21 47 15.1
014	*Acacia haematoxylon*	Grey Camelthorn	single	S26 49 16.2 E21 47 28.6
015	*Boscia albitrunca*	Sheppard's tree	single	S26 49 20.2 E21 47 30.8
016	*Boscia albitrunca*	Sheppard's tree	single	S26 49 28.4 E21 47 35.6
017	*Boscia albitrunca*	Sheppard's tree	X 2 individuals	S26 49 40.5 E21 47 35.0
018	*Boscia albitrunca*	Sheppard's tree	single	S26 49 41.3 E21 47 35.1
019	*Acacia erioloba*	Camelthorn	single	S26 49 48.5 E21 47 36.1
020	*Boscia albitrunca*	Sheppard's tree	Clump (x8)	S26 49 51.7 E21 47 36.6
021	*Acacia haematoxylon*	Grey Camelthorn	X 3 Immature	S26 50 07.4 E21 47 42.4
022	*Acacia haematoxylon*	Grey Camelthorn	single	S26 50 16.7 E21 47 49.1
023	*Acacia haematoxylon*	Grey Camelthorn	single	S26 50 17.6 E21 47 49.5
024	*Acacia erioloba*	Camelthorn	Immature	S26 50 21.5 E21 47 51.3
025	*Acacia erioloba*	Camelthorn	X 2 individuals	S26 50 22.5 E21 47 51.8
026	*Acacia erioloba*	Camelthorn	X 2 individuals	S26 50 32.4 E21 47 55.8
030	*Boscia albitrunca*	Sheppard's tree	single	S26 50 37.5 E21 47 57.4
031	*Acacia haematoxylon*	Grey Camelthorn	single	S26 50 46.9 E21 47 51.2
032	*Acacia erioloba*	Camelthorn	X 2 individuals	S26 51 47.0 E21 47 07.2
036	*Acacia erioloba*	Camelthorn	single	S26 54 02.2 E21 45 27.7
037	*Acacia erioloba*	Camelthorn	single	S26 56 52.6 E21 43 19.7

FINE-SCALE MAPPING (CBA'S)

Although a draft version of the Siyanda District Municipal, Environmental Management Framework (EMF) is available it has not been approved or published. No fine-scale mapping is as yet available for this area and as a result no critical biodiversity areas or biodiversity support areas has been promulgated for this area.

However, the proposed priorities for conservation in the Siyanda District is depicted on Maps 12a (a copy given in a Figure 15) and 12b, based on local occurrence, the national conservation target, the national ecosystem status and the national protection level of the vegetation types. A proposal is made for the prioritisation of vegetation types in the Siyanda District.

The landcover of the Siyanda district reflects the results of the 2000 national landcover determination and is depicted on Map 13 from which it is evident that most of the area is in a natural state and the most significant spatial impact on the environment has come from mining which occupies an area of almost 7% of the total area. The land cover data unfortunately does not give a proper evaluation of the agricultural use along the Orange River.

A sensitivity index is shown on Map 14 of the Draft EMP. The main factors that were used to compile the index include the following:

- The erosion potential of soil where soils with a high erosion potential were awarded a sensitivity of 1;
- The conservation priority of veld types for veld types with a medium conservation priority were awarded a sensitivity count of 1 those with a high conservation priority were awarded a count of 2 and those with a very high conservation priority were awarded a count of 3;
- Topographical areas with a high variance in shape and form were awarded a sensitivity count of 1;
- All watercourses, drainage lines and pans (including a 32m buffer on either side) were awarded a sensitivity count of 2; and
- All transformed areas were awarded a sensitivity count of -1.

Environmental control zones are depicted on Map 15 of the EMF. The purpose of environmental control zones is to indicate areas that require a specific type or regime of control due to unique environmental elements that occur in these areas. It may or may not be linked to the application of EIA legislation and should be dealt with at a more strategic level where it should serve as a guide for decision-making and planning.

Summary of findings according to the EMF

According to the Siyanda Environmental Management Framework the proposed pipeline falls within the following categories according to the various maps.

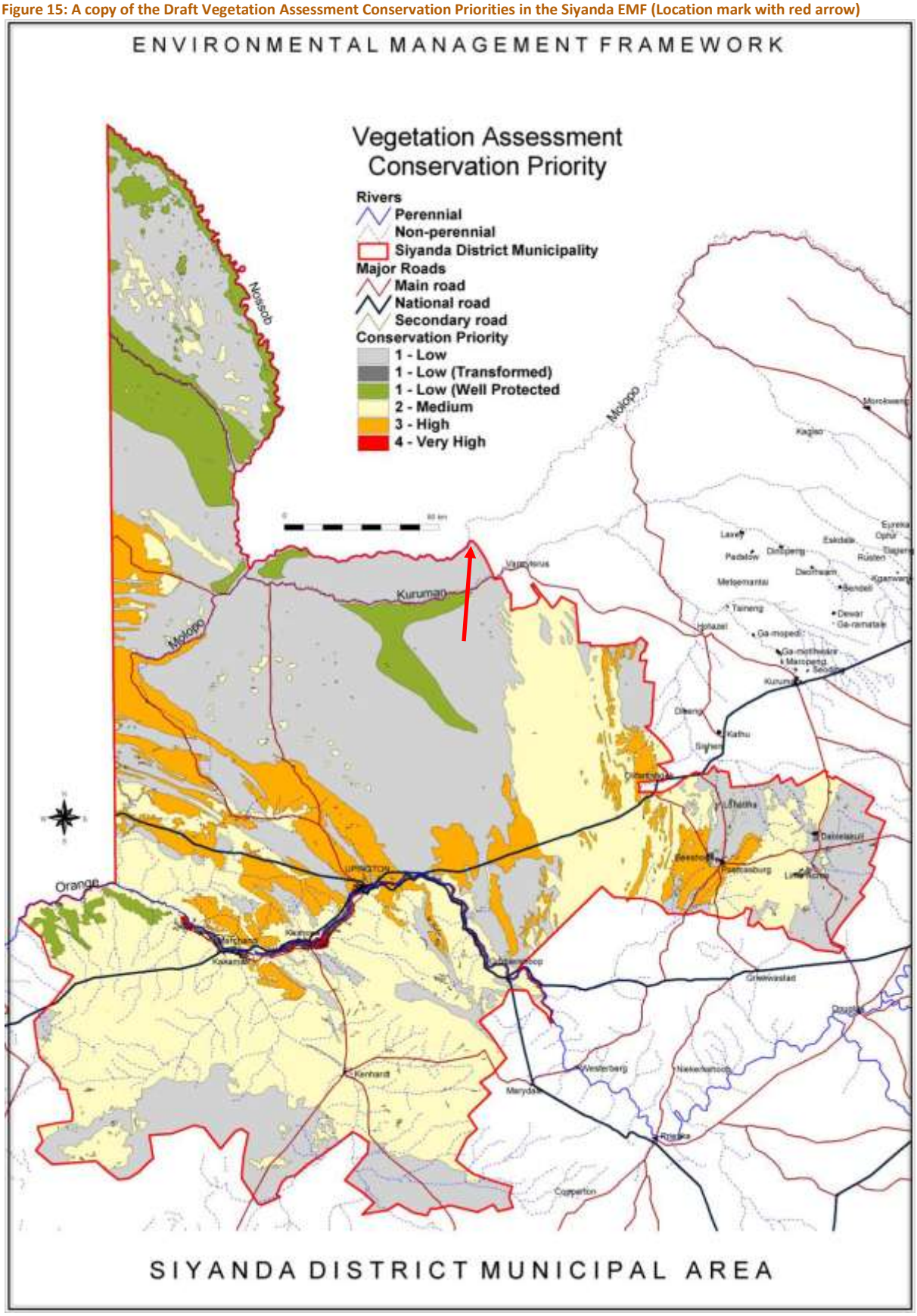
Conservation priority areas: According to Map 12a the proposed pipeline route falls within an area regarded as having a Low (1) conservation priority. According to Map 12b, the route also does not fall within a proposed conservation area.

Landcover: According to Map 13 of the Draft EMF, it would seem as if the proposed route falls within the area marked as woodland, which covers approximately 6.829% of the Municipal area.

Sensitivity Index: According to Map 14 of the Draft EMF, the proposed area falls within an area identified as of very low environmental sensitivity (1) in an index which starts at Transformed and then are given values of 0-8 (8 being of high environmental sensitivity).

Control Zones: According to Map 15, the proposed pipeline location falls within a control zone 2 area, which is a potential wind erosion area.

Figure 15: A copy of the Draft Vegetation Assessment Conservation Priorities in the Siyanda EMF (Location mark with red arrow)



Key Environmental issues identified in the EMF

The following are considered to be the main environmental issues that may cause negative impacts and have to be addressed in the EMF:

- The conservation of the remaining Lower Gariep Alluvial Vegetation along the Orange River;
- the protection of vegetative groundcover across the area against overgrazing and other activities such as 4x4 and quad bike driving;
- the effect that inappropriate irrigation may have on the salination of soil in places;
- the provision of services, especially water to small populations in remote areas that may be unsustainable over the long term;
- the extensive use of firewood for cooking and heating that may be a threat to especially the protected Camel Thorn trees in places; and
- the rehabilitation of mining areas, especially along scenic routes that may have potential for further tourism development.

According to the EMF maps and the summary underneath the main environmental issues identified for the broad scale area would be the erosion factor. Please note that although the EMF does not indicate any CBA or ecological support area next to the Molopo River, almost all fine scale Municipal CBA maps adopt the principle of establishing ecological support areas next to river systems. If this holds true it is expected that an ecological corridor will be established next to the Molopo River.

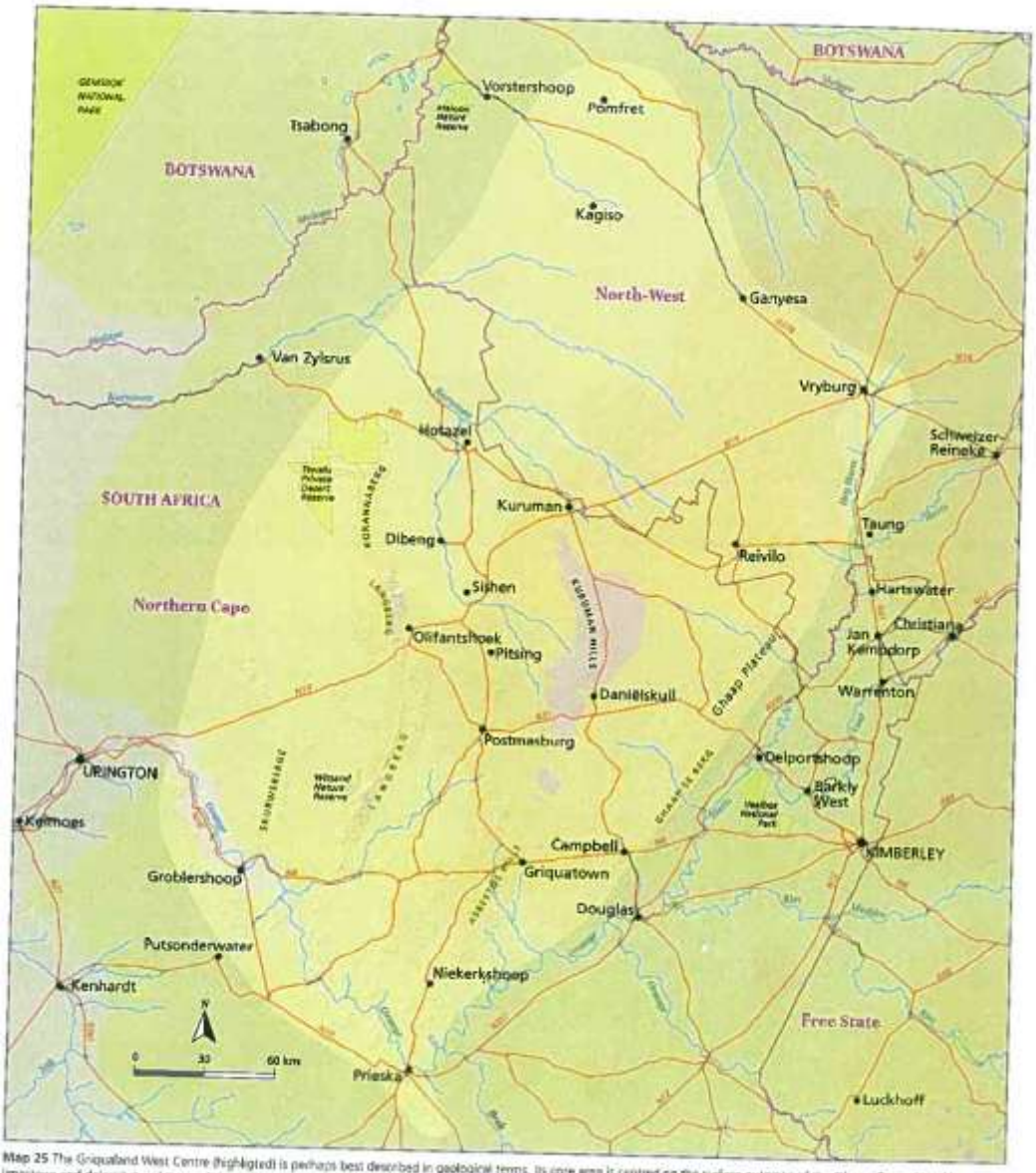
GRIQUALAND WEST CENTRE OF ENDEMISM

The following is an extract from Van Wyk & Smith (2001) in their review of regions of floristic endemism in southern Africa. The Griqualand West Centre of endemism (GWC) was named after Griqualand West in the Northern Cape Province and was first proposed in 1997. The core area of the GWC coincides with the surface outcrops of the Ghaap Group, an Olifantshoek Supergroup. However, in floristic terms the boundaries of the centre are rather diffuse, as several of the GWC floristic elements spill over onto related substrates.

Much of the GWC is dominated by the Ghaap Plateau (130 km wide), bounded to the east by the Harts River and in the west by the Asbestos and Kuruman Hills, extending from the confluence of the Orange and Vaal Rivers northwards to Vryburg. The western portion is hilly to mountainous and characterized by the north-south trending ridges of the Korannaberg and Langberg (Refer to Figure 16 underneath).

The vegetation types in the GWC are exceptionally rich in plant species and species diversity might count under some of the highest in the country (Van Wyk & Smith, 2001).

Figure 16: A copy of the map published in Van Wyk & Smith – indicating the distribution range of the GWC



Map 25 The Griqualand West Centre (highlighted) is perhaps best described in geological terms. Its core area is centred on the surface outcrops of the Ghaap Group (notably limestone and dolomite) and those of the Olifantshoek Supergroup (notably quartzite).

According to this map the proposed pipeline route will not impact on the Griqualand West Centre of endemism.

FAUNA AND AVI-FAUNA

The proposed construction of the pipeline is not expected to have a permanent impact or a long duration impact on wildlife or avi-fauna and as such it was not deemed necessary to evaluate wildlife extensively in this report. However, it is a known fact that many animal and bird species associate with large *Acacia erioloba* as well as *Boscia albitrunca* trees and the removal of mature trees of these species will have an impact on such wildlife (even though very localised). It was also clear to see that although the area is not managed as a

conservation area, the property still supports a number of smaller game species, birds and other fauna (apart from the cattle being grazed on the land).

Mammals: The route falls within the distribution range of approximately 50 mammal species indicating moderate diversity. Human activity in the area is low and it is likely that a fair representation of these mammals may be found on the property. However, the short term temporary impact should not pose any significant impact on these species and as a result the impact is deemed negligible.

Reptiles: The route falls within the distribution range of approximately 30 reptile species, indicating low diversity. As a result of the open planes on site the reptile composition is likely to be dominated by species which inhabit open areas, such as snakes, lizards and geckos. Given the short term temporary nature of the impact, the impact on reptiles should be negligible.

Amphibians: The route falls within the distribution range of approximately 10 amphibian species. However, no suitable breeding places were observed near the pipeline route and it is highly unlikely that the proposed development will have any significant impact on amphibian species. In addition, most amphibians require perennial water and will thus not be affected at all.

Avi-fauna: The route falls within the distribution range of approximately 200 bird species known from the broad area. Apart from the possible impact on mature trees (mentioned above) the temporary nature of the proposed activity is not expected to have a significant impact on avi-fauna. However, it remains important that all larger indigenous trees must be protected wherever possible in order to minimise the possible impact (although localised) on bird species.

RIVERS AND WETLANDS

Rivers maintain unique biotic resources and provide critical water supplies to people. South Africa's limited supplies of fresh water and irreplaceable biodiversity are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement, because they link different valleys and mountain ranges. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors.

With the exception of the Orange River all the rivers in the Siyanda District Municipal area are non-perennial rivers and the last recordings of flows in the lower reaches of the Molopo and Kuruman Rivers were in 1933 and again in the 1974/5 and 1975/6 season. The Molopo River is one of the main rivers in Southern Africa. It has a length of approximately 960 kilometres and a catchment area of 367,201 sq km with Botswana, Namibia and South Africa sharing roughly about a third of the basin each. The river runs usually west to attach to the

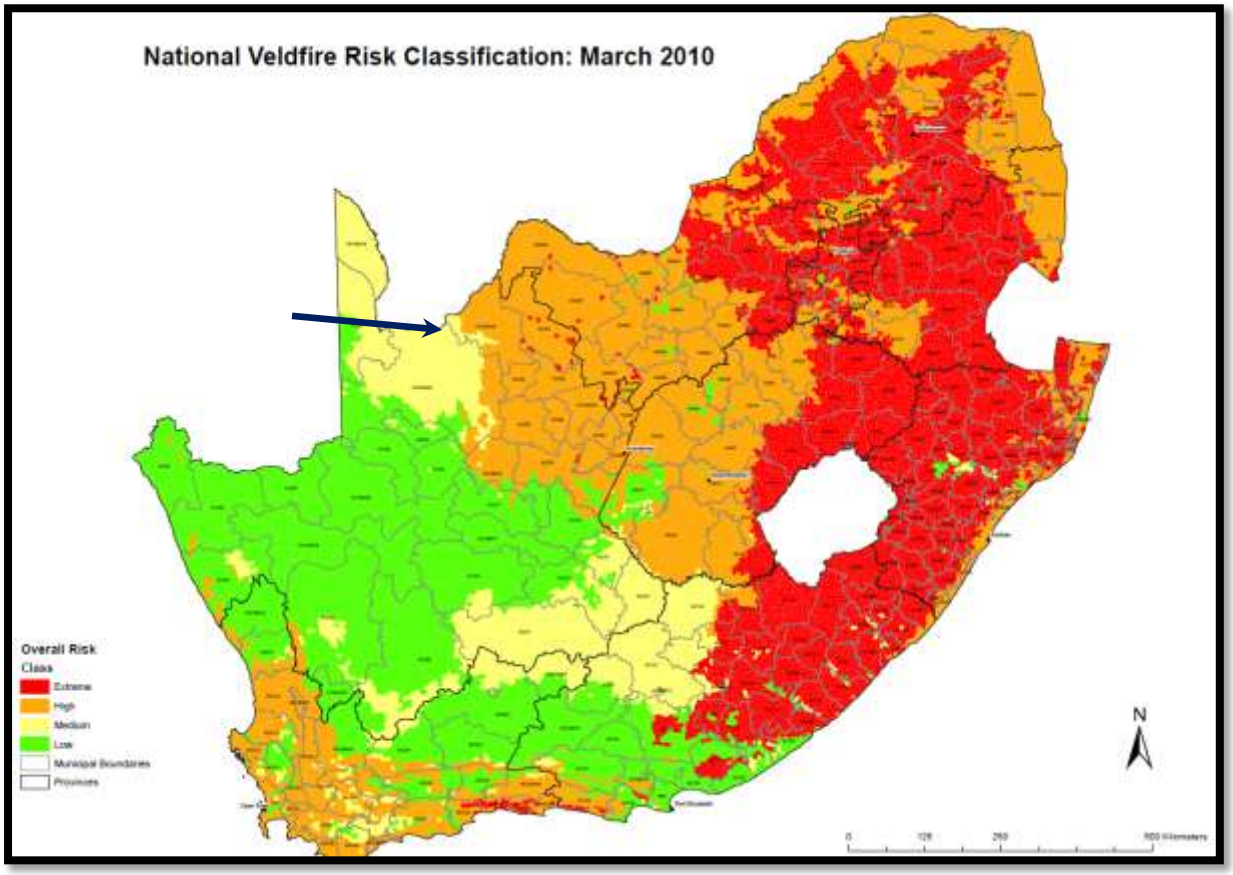
Orange River close to the south eastern boundary of Namibia. It also acts as a border between South Africa and Botswana in the north-western part of South Africa.

The proposed project ends within the Molopo River valley (and eventually will cross the Molopo River when the connection to Botswana is made. It will thus definitely impact on the Molopo River. However due to the nature of the proposed project (placement of an underground pipeline), the fact that the river is non-perennial (mostly dry), the short construction period (duration of impact) and the temporary nature of the impact, it is highly unlikely that the proposed project will a significant impact on the river system or its ecology.

VELD FIRE RISK

Gordonia Duneveld is part of the Savanna Biome (Mucina & Rutherford, 2006) which is prone to veldfires. According to Forsyth (2010), the main fire issue relates to its effects on the number and size of woody plants in the savanna mixture, which in turn determines the productivity and quality of the grasses. Frequent, high-intensity fires suppress trees and thus promote grasses, while protection from fire, and lower intensity fires (often associated with high levels of grazing, and correspondingly lower grass fuel loads) allows woody plants to increase, the widespread "bush encroachment" phenomenon. According the revised veldfire risk classification of March 2010 (Forsyth, 2010) in terms of the National Veld and Forest Fire Act 101 of 1998, the site is located in an area classified as a "Medium Fire Risk" area.

Figure 17: South African National Veldfire Risk Classification (March 2010)



The purpose of the revised fire risk classification is to serve as a national framework for implementing the National Veld and Forest Fire Act, and to provide a basis for setting priorities for veldfire management interventions such as the promotion of and support to Fire Protection Associations. In the fire-ecology types and municipalities with High to Extreme fire risk, comprehensive risk management strategies are needed.

Although, the fire risk is not considered high or extreme it is still important that during construction and operation the site must adhere to all the requirements of the local Fire Protection Association (FPA) if applicable, or must adhere to responsible fire prevention and control measures.

INVASIVE ALIEN INFESTATION

Although infestations of invading alien vegetation occur along some watercourses, and are particularly serious in parts of the Molopo River catchment (according to the Siyanda EMF), no problem plants were observed within the study area.

SIGNIFICANT BIODIVERSITY FEATURES ENCOUNTERED

The table underneath gives a summary of biodiversity features encountered during the site visit and a short discussion of their possible significance in terms of regional biodiversity targets.

Table 6: Summary of biodiversity features encountered on Erf 1654, Botswana, Middelputs Pipeline and their possible significance

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING
Geology & soils	Geology & soils vary slightly in the larger study area, with deeper sandy soils along most of the route, with calcrete outcrops near and within the Molopo River.	No special features have been encountered on the final solar location (e.g. true quartz patches or broken veld).
Land use and cover	Natural veld utilised for stock grazing.	The property is used for cattle grazing as well as for natural grazing by remaining smaller game and other fauna.
Vegetation types	Gordonia Duneveld. Southern Kalahari Mekgacha	Both are considered "Least threatened". However, the remaining natural veld shows good connectivity with the surrounding areas.
Endemic or protected plant species	No endemic species was observed, but a number of the protected tree species (Refer to Table 5).	Micro-layout adjustments to the final route layout would reduce the impact on protected species significantly.
Mammal or bird species	Bird and small game can be expected in the larger area.	Apart from the possible impact on mature trees, which will impact on wildlife the temporary nature of the proposed activity is not expected to have a significant impact on fauna or avi-fauna.
Rivers & wetlands	The proposed project ends within the Molopo River valley and will have an impact on the river system.	However due to the nature of the proposed project (placement of an underground pipeline), the fact that the river is non-perennial (mostly dry), the short construction period (duration of impact) and the temporary nature of the impact, it is highly unlikely that the proposed project will a significant impact on the river system or its ecology.
Invasive alien infestation	No alien invasive trees were observed.	No impact.
Erosion	The Siyanda EMF recognised the larger area as falling within an area subject to erosion.	During the rehabilitation special emphasis will have to be placed on the prevention of erosion (especially wind erosion) as it will most likely be one of the most important long term challenges of the project.

In summary, the whole of the pipeline route falls within remaining natural vegetation, with very good connectivity with the surrounding natural veld. The impact on populations of individual species is regarded as medium low (possible impact on protected species), the impact on sensitive habitats is regarded as medium low (Molopo River system), the impact on ecosystem function is regarded as very low (but erosion prevention measures must be assured), cumulative impact on ecology is regarded as very low and finally the impact on economic use of the vegetation is regarded as very low.

BIODIVERSITY ASSESSMENT

Biological diversity, or biodiversity, refers to the variety of life on Earth. As defined by the United Nations Convention on Biological Diversity, it includes diversity of ecosystems, species and genes, and the ecological processes that support them. Natural diversity in ecosystems provides essential economic benefits and services to human society—such as food, clothing, shelter, fuel and medicines—as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development. Biodiversity is under threat in many areas of the world. Concern about global biodiversity loss has emerged as a prominent and widespread public issue.

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development.

As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), with emphasis on:

- Significant ecosystems
    - Threatened or protected ecosystems
    - Special habitats
    - Corridors and or conservancy networks
- Significant species
    - Threatened or endangered species
    - Protected species

METHOD USED

During May 2001, Van Schoor published a formula for prioritizing and quantifying potential environmental impacts. This formula has been successfully used in various applications for determining the significance of environmental aspects and their possible impacts, especially in environmental management systems (e.g. ISO 14001 EMS's). By adapting this formula slightly it can also be used successfully to compare/evaluate various environmental scenario's/options with each other using a scoring system of 0-100%, where any value of 15% or less indicate an insignificant environmental impact while any value above 15% constitute ever increasing environmental impact.

Using Van Schoor's formula (adapted for construction with specific regards to environmental constraints and sensitivity) and the information gathered during the site evaluation the possible negative environmental impact of the activity was evaluated.

Underneath follows a short description of Van Schoor's formula. In the formula the following entities and values are used in order to quantify environmental impact.

***S* = [(*fd* + *int* + *sev* + *ext* + *loc*) x (*leg* + *gcp* + *pol* +*ia* + *str*) x *P*]** (as adapted for construction activities)

Where

S = Significance value

fd = frequency and duration of the impact

int = intensity of the impact

sev = severity of the impact

ext = extent of the impact

loc = sensitivity of locality

leg = compliance with legal requirements

gcp = conformance to good environmental practices

pol = covered by company policy/method statement

ia = impact on interested and affected parties

str = strategy to solve issue

P = probability of occurrence of impact

Criteria

The following numerical criteria for the above-mentioned parameters are used in the formula.

fd = frequency and duration of the impact					
low frequency ; low duration	1	medium frequency; low duration	1.5	high frequency ; low duration	2
low frequency; medium duration	1.5	medium frequency ; medium duration	2	high frequency ; medium duration	2.5
low frequency ; high duration	2	medium frequency ; high duration	2.5	high frequency ; high duration	3

int = intensity of the impact					
low probability of species loss; low physical disturbance	1	medium probability of species loss; low physical disturbance	1.5	high probability of species loss; low physical disturbance	2
low probability of species loss; medium physical disturbance	1.5	medium probability of species loss; medium physical disturbance	2	high probability of species loss; medium physical disturbance	2.5
low probability of species loss; high physical disturbance	2	medium probability of species loss; high physical disturbance	2.5	high probability of species loss; high physical disturbance	3

sev = severity of the impact	
changes immediately reversible	1
changes medium/long-term reversible	2
changes not reversible	3

ext = extent of the impact	
locally (on-site)	1
regionally (or natural/critical habitat affected)	2
globally (e.g. critical habitat or species loss)	3

loc = sensitivity of location	
not sensitive	1
moderate (e.g. natural habitat)	2
sensitive (e.g. critical habitat or species)	3

leg = compliance with legal requirements	
compliance	0
non-compliance	1

gcp = good conservation practices	
conformance	0
non-conformance	1

pol = covered by company policy	
covered in policy	0
not covered/no policy	1

ia = impact on interested and affected parties	
not affected	1
partially affected	2
totally affected	3

str = strategy to solve issue	
strategy in place	0
strategy to address issue partially	0.5
no strategy present	1

P = probability of occurrence of impact	
not possible (0% chance))	0
not likely, but possible (1 - 25% chance)	0.25
likely (26 - 50% chance)	0.50
very likely (51 - 75% chance)	0.75
certain (75 - 100% chance)	0.95

NATURE OF THE IMPACT

The construction of the proposed pipeline entails:

- the establishment of the final pipeline route;
- clearing of the footprint (including topsoil);
- excavation of the pipeline location;
- storing of topsoil and subsoil;
- placement of the pipeline;
- construction of small concrete / cement structures to accommodate pressure relief of pressure reduce valves; and
- rehabilitation of the construction footprint on completion of the project.

Other impacts associated with the construction phase include:

- the establishment of a construction camp and labourers facilities (including cooking and toilet facilities);
- the establishment of temporary storage areas for construction equipment and material;
- the temporary storage of fuel;

- sourcing of pipe bedding material for the portion of the pipeline going through the calcrete outcrops; and
- the disposal of any remaining clean subsoil (spoil).

Parameters of the impact

Extent of the impact:	Considered to be local (19 km with a small footprint).
Duration of the impact:	Considered to be short term and temporary (the construction period).
Probability or likelihood:	The probability or likelihood that the impact will occur if the project is approved is considered to be very likely.
Severity of the impact:	The severity of the impact is considered to be medium to low depending on the impact minimisation actions implemented.

Possible issues / impacts associated with construction

The following possible environmental impacts were identified while doing the site visit and discussing the project with the engineers and land-owners:

- Erosion (notably wind erosion) – The sandy dunes are very susceptible to disturbance and it would be imperative that the dunes are stabilised immediately after construction.
- The possible impact on protected plant species as described in the "List of protected tree species" (GN 716 of 2012) and the "Protected Species" list (Schedule 2 of the NC Nature Conservation Act 9 of 2009).
- Establishment of a construction camp and site offices as well as labourers facilities.
- Temporary storage areas (e.g. pipe's and fittings and concrete mixing material).
- Sourcing of sand for bedding material along the calcrete patch.
- Disposal of "clean spoil".

EVALUATION OF SIGNIFICANT IMPACTS

The main drivers in this vegetation type would be fire and grazing pressure (herbivore), and could largely determine plant community composition and occurrence of rare species. Grazing may be an important factor in regulating competitive interaction between plants (*Acacia mellifera* encroachment is often a sign of overgrazing or bad veld management). Certain species can act as important "nursery" plants for smaller species and are also important for successional development after disturbance. Tortoises and mammals can be important seed dispersal agents. Watercourses, wetlands, upland- down land gradients or vegetation

boundaries are all significant ecological features. It was also not evident to what extent the fire regime has been altered in order to improve grazing (if at all).

Threatened or protected ecosystems

The site visit confirmed that the vegetation conforms to Gordonia Duneveld and Southern Kalahari Mekgacha, both of which are classified as "Least Threatened". Recently the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), was promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. According to this National list, both **Gordonia Duneveld and Southern Kalahari Mekgacha remains classified as Least Threatened**.

According to the Draft Siyanda Environmental Management Framework the proposed pipeline falls within the following categories according to the various maps.

Conservation priority areas: According to Map 12a the proposed pipeline route falls within an area regarded as having a Low (1) conservation priority. According to Map 12b, the route also does not fall within a proposed conservation area.

Landcover: According to Map 13 of the Draft EMF, it would seem as if the proposed route falls within the area marked as woodland, which covers approximately 6.829% of the Municipal area.

Sensitivity Index: According to Map 14 of the Draft EMF, the proposed area falls within a area identified as of very low environmental sensitivity (1) in an index which starts at Transformed and then are given values of 0-8 (8 being of high environmental sensitivity).

Control Zones: According to Also Map 15, the proposed pipeline location falls within a control zone 2 area, which is a potential wind erosion area.

The proposed construction of the pipeline is not expected to have a permanent impact or a long term impact on wildlife or avi-fauna, apart from the possible localised impact as a result of the removal of mature indigenous trees along the pipeline route. It is a known fact that many animal and bird species associate with large *Acacia erioloba* as well as *Boscia albitrunca* trees and the removal of mature trees of these species will have an impact on such wildlife (even though very localised).

The proposed project ends within the Molopo River valley (and eventually will cross the Molopo River when the connection to Botswana is made. It will thus definitely impact on the Molopo River. However due to the nature of the proposed project (placement of an underground pipeline), the fact that the river is non-perennial (mostly dry), the short construction period (duration of impact) and the temporary nature of the impact, it is highly unlikely that the proposed project will a significant impact on the river system or its ecology.

Taking the above into account it is highly unlikely that the proposed project will have a permanent or long term effect on threatened or protected ecosystems. **The impact is thus rated as low**.

Special habitats

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats, apart from the extensive calcrete outcrops, were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems. However, any wetland or river system must also be regarded as a special habitat and the proposed project will definitely impact on the Molopo River. However due to the nature of the proposed project (placement of an underground pipeline), the fact that the river is non-perennial (mostly dry), the short construction period (duration of impact) and the temporary nature of the impact, it is highly unlikely that the proposed project will a significant impact on the river system or its ecology.

Taking the above into account it is highly unlikely that the proposed project will have a permanent or long term effect on threatened or protected ecosystems. **The impact is thus rated as low**.

Corridors and or conservancy networks

Looking at the larger site and its surroundings it shows excellent connectivity with remaining natural veld in almost all directions. Corridors and natural veld networks are still relative unscathed (apart from road networks).

The temporary nature of the project makes it highly unlikely that it will have a permanent or long term effect on corridors or conservancy networks. **The impact is thus rated as low**.

Threatened or endangered species

No threatened or endangered species were recorded during the site visit, however, this does not rule out their presence as they may be subject to seasonable rainfall and may not have been observable during the time of the site visit, since the composition of the vegetation layers will fluctuates with seasonal rainfall (Van Rooyen *et. all*, 1984, *vide* Mucina & Rutherford, 2006). However, it must be noted that the vegetation type is considered "Least Threatened" and that this classification is based on plant species diversity and turnover as well as habitat transformation. The number of species per broad geographical levels for the savannah biome is relative low (Van Rooyen, 1988, *vide* Mucina & Rutherford, 2006). It is therefore very unlikely that any red data species will be confined to the proposed site alone.

Taking the above into account it is highly unlikely that the proposed project will have a significant or long term effect on threatened or endangered species. **The impact is thus rated as low**.

Protected species

Three protected tree species in terms of the National Forests Act of 1998 (Act 84 of 1998) have been observed and are likely to be impacted during the construction namely: *Acacia erioloba* (Camel thorn) *Boscia albitrunca* (Sheppard's tree) and *Acacia haematoxylon* (Grey Camelthorn), refer to Table 4 for location data on the individual trees encountered.

In addition to the above the Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, which also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act.

Please note that this study never intended to be full botanical assessment. However, a scan of significant species was done during the site visit, and even though the author does not claim that all species encountered were identified, no herb-, bulbaceous- or succulent species were encountered (most of the Schedule 1 & 2 protected species falls within one of the above categories).

Thus although none of these protected species were encountered a botanical scan of the final route layout should be done, and as a pre-cautionary measure all viable herb-, bulbs- and succulent plant species encountered within the footprint should be removed and replanted through a dedicated search and rescue operation.

Taking the above into account it is very likely that the proposed project will have an impact protected species (especially *Acacia haematoxylon*). **The impact is thus rated as medium**.

Mitigation:

- Micro-placement adjustment of the final route must be done in consultation with a suitably qualified ECO in order to establish the best route to minimise the impact on as many of the protected tree species as possible.
- Permits must be obtained for the removal of any protected trees which cannot be avoided.

Direct impacts

As the name suggest, direct impacts refers to those impacts with a direct impact on biodiversity features and in this case were considered for the potentially most significant associated impacts (some of which have already been discussed above).

Direct loss of vegetation type and associated habitat due to construction and operational activities.

- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities. (Refer to page 41).
- Loss of local biodiversity and threatened plant species (Refer to page 43)
- Loss of ecosystem connectivity (Refer to page 44)

Loss of vegetation and associated habitat

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats, apart from the extensive calcrete outcrops, were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems. However, any wetland or river system must also be regarded as a special habitat and the proposed project will definitely impact on the Molopo River. But, due to the nature of the proposed project (placement of an underground pipeline), the fact that the river is non-perennial (mostly dry), the short construction period (duration of impact) and the temporary nature of the impact; it is highly unlikely that the proposed project will a significant impact on the river system or its ecology.

Taking the above and the temporary nature of the impact into account it is highly unlikely that the proposed project will have a permanent or long term effect on the loss of vegetation or associated habitat. **The impact is thus rated as low**.

Mitigation: The following is some mitigation which will minimise the impact of the solar plant location and operation.

- Micro-placement adjustment of the final route must be done in consultation with a suitably qualified ECO in order to establish the best route to minimise the impact on as many of the protected tree species as possible.
- Permits must be obtained for the removal of any protected trees which cannot be avoided.
- Any significant plant species that may be encountered must be identified and located (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain.
- Access roads must be clearly demarcated and access must be tightly controlled (deviations may not be allowed).
- Indiscriminate clearing of areas must be avoided (all remaining areas to remain as natural as possible).
- All topsoil (at all excavation sites) must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the access tracks to allow the vegetation to re-establish over the excavated areas.

- Rehabilitation must include sand stabilisation methods to protect the open sandy areas against wind erosion.

Indirect impacts

Indirect impacts are impacts that are not a direct result of the main activity, but are impacts still associated or resulting from the main activity. The following possible indirect impacts were associated with the proposed project:

- Erosion (notably wind erosion) – The sandy dunes are very susceptible to disturbance and it would be imperative that the dunes are stabilised immediately after construction.
- The possible impact on protected plant species as described in the "List of protected tree species" (GN 716 of 2012) and the "Protected Species" list (Schedule 2 of the NC Nature Conservation Act 9 of 2009).
- Establishment of a construction camp and site offices as well as labourers facilities.
- Temporary storage areas (e.g. pipe's and fittings and concrete mixing material).
- Sourcing of sand for bedding material along the calcrete patch.
- Disposal of "clean spoil".

Taking the above into account it is very likely that the proposed project will have indirect impacts. It is considered that indirect impacts will have a similar impact as direct impacts, which will lead to a cumulative effect on the environment. **On its own the impact is considered to be low**.

Cumulative impacts

In order to comprehend the cumulative impact, one has to understand to what extent the proposed activity will contribute to the cumulative loss of ecological function and other biodiversity features on a regional basis. Both vegetation types was classified as "Least Threatened", No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems. However, any wetland or river system must also be regarded as a special habitat and the proposed project will definitely impact on the Molopo River. But, due to the nature of the proposed project (placement of an underground pipeline), the fact that the river is non-perennial (mostly dry), the short construction period (duration of impact) and the temporary nature of the impact; it is highly unlikely that the proposed project will a significant impact on the river system or its ecology.

Taking all of the above into account it is very likely that the proposed project will have a temporary impact. If rehabilitation and impact minimisation is not implemented correctly the proposed project may even have significant long term impacts. **However, on the whole the cumulative impact is considered to be medium**. With the implementation of impact minimisation actions the impact could be reduced to medium low (taking

the temporary impact on the Molopo River system into account as well as the likelihood of impacts to protected species.

THE NO-GO OPTION

The "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. However, it will ensure that none of the potential impacts above occur. The current status quo will remain and there will be no impact (even temporarily) on the vegetation, protected species or river corridors.

The no-go option will also support the Siyanda Draft EMF in the following:

- the protection of vegetative groundcover across the area against overgrazing and other activities such as 4x4 and quad bike driving;
- the provision of services, especially water to small populations in remote areas that may be unsustainable over the long term;
- the extensive use of firewood for cooking and heating that may be a threat to especially the protected Camel Thorn trees in places; and

On the other hand the all Governments have a socio-economic responsibility to provide basic water to its entire people. Over the long term the proposed project might be the only viable solution.

QUANTIFICATION OF ENVIRONMENTAL IMPACTS

Taking all of the above discussions into account and using Van Schoor's formula for impact quantification, impacts of the following can be quantified as follows:

No development

The "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. However, it will ensure that none of the potential impacts occur. The current status quo will remain and there will be no impact (even temporarily) on the vegetation, protected species or river corridors.

On the other hand the all Governments have a socio-economic responsibility to provide basic water to its entire people. Over the long term the proposed project might be the only viable solution.

Development without mitigation

The purpose of this scenario is to illustrate, using Van Schoor's formula, the biodiversity impact should development be allowed without any mitigation measures. It is assumed that no mitigation actions will be implemented balanced against the regional context of the biodiversity associated with the area.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P] \text{ (as adapted)}$$

$$S = [(1 + 1.5 + 2 + 2 + 2) \times (1 + 1 + 1 + 2 + 1) \times 0.95] = 48.5\ \%$$

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

Development with mitigation

The purpose of this scenario is to illustrate, using Van Schoor's formula, the environmental gain should development be allowed with all proposed mitigation measures implemented.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P] \text{ (as adapted)}$$

$$S = [(1 + 1.5 + 1 + 1 + 2) \times (0 + 0 + 0 + 2 + 0) \times 0.95] = 12.4\ \%$$

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

RECOMMENDATIONS & IMPACT MINIMIZATION

Because of the identified need for service provision and the socio-economical responsibility of all Governments it is highly unlikely that the "No-Go" option will be an option. Other source or route options may be looked at, but ultimately the need for a basic water supply to the Middelputs area will remain. It is also clear that the engineers considered various options carefully before approaching the EAP with the most viable options.

With regards to the construction of the pipeline it needs to be taken into account that the installation is a temporary impact. With good environmental control the impact could be much reduced. Over the long term the placement of the pipeline will be almost negligible and with good environmental control and rehabilitation after construction the "environmental scar" should heal very fast.

Having evaluated and discussed the various biodiversity aspects associated with the project it is clear that the most significant impacts associated with the impact (even temporary) will with regards to:

- The impact on protected species.
- The impact (even temporary) on special habitats (the Molopo River)
- The possibility of wind erosion if rehabilitation is not done correctly.

Even if all mitigating options proposed in this report are implemented there will be an impact on:

- protected species (although it might be limited to young *Acacia haematoxylon* species); and
- special habitats (the Molopo River), although this impact will be reduced to a short term temporary impact.

It is, however, considered highly unlikely that the proposed project will have any significant impact on the following:

- Direct loss of vegetation type and associated habitat due to construction and operational activities.
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened plant species.
- Loss of ecosystem connectivity

Finally, when quantifying the development options, the Van Schoor's formula for impact quantification still shows a significant difference between development **without** and development **with** mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

With the available information to the author's disposal it is recommended that project be approved since it is not associated with irreversible environmental impact, provided that mitigation is adequately addresses.

IMPACT MINIMIZATION

General

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and the Biodiversity study recommendations as well as any other conditions which might be required by the Department of Environmental Affairs.
- An integrated waste management system must be implemented during the construction phase.
- All rubble and rubbish (if applicable) must be collected and removed from the site to a suitable registered waste disposal site.
- All alien vegetation should be removed from the larger property (if applicable).

Site specific

- It is a known fact that many animal and bird species associate with large *Acacia erioloba* as well as *Boscia albitrunca* trees. In fact the removal of any mature indigenous tree will have an impact on wildlife (even though very localised). Micro-placement adjustment of the final route must be thus done in consultation with a suitably qualified ECO in order to establish the best route to minimise the impact on as many of the protected tree species as possible.
- A suitably qualified ECO or botanist must walk the final route in order to determine whether any other protected or significant plant species are present within the proposed footprint.
- As a pre-cautionary measure all viable herb, bulbs and succulent plant species encountered within the footprint should be removed and replanted through a dedicated search and rescue operation.
- Permits must be obtained for the removal of any protected species which cannot be avoided.
- Only existing access roads should be used for access to the terrain. Access roads must be clearly demarcated and access must be tightly controlled (deviations may not be allowed).
- Indiscriminate clearing of areas must be avoided (all remaining areas to remain as natural as possible).
- All topsoil (the top 15-20 cm at all excavation sites), must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the approved access and maintenance tracks to allow the vegetation to re-establish over the excavated areas.
- Adequate measures must be implemented to ensure against erosion (the use of *Acacia mellifera* and even *Rhigozum trichotomum* stems might be considered for use in dune stabilisation).