BIODIVERSITY ASSESSMENT

for the,

PROPOSED NAMAQUALAND REGIONAL WATER SUPPLY SCHEME (NRWSS):

HIGH PRIORITY BULK WATER SUPPLY INFRASTRUCTURE UPGRADES FROM OKIEP TO:

CONCORDIA & CAROLUSBERG

A Biodiversity assessment of the area that will be impacted by the proposed upgrade / expansion of the two bulk water pipelines and its associated infrastructure that supply the towns of Concordia and Carolusberg from the Okiep Reservoir, Springbok, Northern Cape Province.

DATE: MARCH 2016

PREPARED BY: PB CONSULT

PREPARED FOR: ENVIROAFRICA CC

Peet Botes (Pr.Sci.Nat: 400184/05) Registered Professional Environmental and Ecological Scientist
Cell: 082 921 5949; Fax 086 611 0726; 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	**NAMAQUALAND BLOMVELD:** Least Threatened; Hardly Protected; Remaining 94% **NAMAQUALAND KLIPKOPPE SHRUBLAND:** Least Threatened; Poorly Protected; Remaining 95%
CRITICAL BIODIVERSITY AREAS (NAMAKWA DISTRICT BIODIVERSITY SECTOR PLAN)	The Terrestrial Critical Biodiversity Areas (CBA) map for the Namaqualand District Municipality shows that: • The Concordia replacement pipeline will pass near three (3) terrestrial CBA 2 areas, but will not impact on them directly. Near Okiep it appears as if the pipeline starts within the CBA, but this is not the case (urban area). The new pipeline will be located south of the existing pipeline, and will thus be further away from the CBA's than the existing pipeline. • The Carolusberg preferred option (Figure 17) will not impact on any terrestrial or aquatic CBA and will follow an existing road reserve for most of its way. • The Carolusberg alternative A2 (Figure 17) will not cross any CBA, but will be located within natural vegetation for almost its entire length. • The Carolusberg alternative A3 (Figure 17), which is also the existing line, impacts on at least one terrestrial CBA 2. • The Carolusberg alternative A4 (Figure 17) will cross right through the centre of a CBA 1 area (classified as an expert critical terrestrial area).
LAND USE AND COVER	Figure 13 shows that most of the areas involved are still remaining natural veld (light green on map). Small areas of agricultural land (yellow) may be impacted and old mining areas (dark brown) will be crossed at Okiep.
RED DATA PLANT SPECIES	Two species listed in the red list of South African Plants were encountered (Refer to Table 9). No species protected in terms of the NFA was observed within the proposed footprint. Thirty (30) species (Refer to Table 10) protected in terms of the NCNCA were encountered of which a number can be described as pioneer species, but at least 6 species are recommended for search and rescue.
IMPACT ASSESSMENT	For the Concordia replacement pipeline, please refer to Table 19. For the Carolusberg pipeline options, please refer to Table 20.
RECOMMENDATION	The preferred options for both Concordia (within the same footprint) and Carolusberg (Alternative A1) are likely to result in the least environmental impact. The fact that the pipelines will be placed above ground in the rocky sections will reduce the impact on vegetation and indigenous species significantly as a result of the much reduced construction footprint and the fact that very little of the area will be physically impacted. It is proposed that old underground pipeline structures are not to be removed. This will reduce the physical footprint of rehabilitation, but the rehabilitation of all aboveground features of the outdated pipeline infrastructure must be non-negotiable. Care must be taken when any works are done within or near any of the identified CBA areas, and watercourses. However, the No-Go option is unlikely to result in the lowest long term environmental impact. **AS A RESULT AND WITH AVAILABLE INFORMATION IT IS RECOMMENDED THAT PROJECT BE APPROVED SINCE (WITH MITIGATION) IT IS UNLIKELY TO RESULT IN IRREVERSIBLE ENVIRONMENTAL IMPACT.**

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant 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 QUALIFICATIONS & 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 and 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 Botanical, 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

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1. INTRODUCTION

Sedibeng Water Board is a bulk supplier of water to the Nama Khoi Municipal jurisdiction area. The communities that are served are Steinkopf, Okiep, Concordia, Nababeep, Bulletrap, Carolusberg, Springbok and Kleinzee with an estimate population of ±50 000. The Namakwa water scheme was constructed during the 1970's and involves extraction from the Orange River near Henkries mond, purification works at Henkries a booster pump station at Doringwater and round about 130 km's of pipeline to Springbok. The water is pumped from Henkries to Eenrietberg Reservoir from where it gravitates to the Okiep Reservoir (this pipeline is currently being refurbished and/or upgraded). All of the current pipelines have been in use well over its design period and needs to be replaced as a matter of urgency. As a result of age and weathering the pipelines are subject to ever increasing breakages, resulting in water losses, and inconsistent water supply, leaving various communities and towns without potable water on an increasing frequency.

Both the towns of Concordia and Carolusberg are supplied with freshwater from the Namaqualand Regional Water Supply Scheme (NRWSS), managed by Sedibeng Water. Both the Concordia and Carolusberg pipelines are in poor shape of repair and do not have the long term capacity to service these towns (please note that this is two separate water pipelines. As part of the larger NRWSS upgrade (currently replacing the main supply pipeline from the Orange River Raw water Pumpstation to Okiep Reservoir and Nababeep) the Sedibeng Water Board considers the upgrade of the Concordia and Carolusberg bulk water supply lines as the next highest priority infrastructure upgrade. There is no other sources of potable water are locally available it means that the current pipelines need to be in operation while the replacement is done.

In terms of the Concordia upgrade the new pipeline will be placed next to the old pipeline (so that the original pipeline can maintain water supply during construction). The new pipeline will be placed above ground within the rocky sections (which will reduce the construction disturbance footprint in these areas significantly) and below ground in sandy sections.

In terms of the Carolusberg upgrade water is presently pumped from the Okiep Reservoir "over" the mountains (the shortest route) to Carolusberg. Because the water has to be pumped from Okiep over the mountains the operational cost is ever increasing (rise in cost of electricity and difficult access). The proposed preferred new route option entails linking the Carolusberg pipeline to the Concordia pipeline (tapping water from the Concordia pipeline) and routing it around the mountains to the south of Concordia up to Carolusberg. This will reduce pumping costs and thus operational costs significantly. The terrain is also much easier to access, with existing roads, which will in term reduce maintenance costs.

Because of the enormous additional cost implications, the applicant proposes that the old underground pipelines sections will only be removed where it is necessary for construction purposes. However, all absolute aboveground structures will be removed.

Since the proposed pipelines will impact on natural vegetation a biodiversity scan was commissioned to evaluate the environmental impact of the proposed activity.

1.1 TERMS OF REFERENCE

BVi Consulting Engineers (Pty) Ltd are appointed to plan, manage and supply engineering services for the project during refurbishment of the proposed project. EnviroAfrica (Pty) Ltd was appointed by BVi Consulting Engineers (Pty) Ltd as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to perform a Biodiversity Scan of the proposed development area.

PB Consult was appointed within the following terms of reference:

- To determine the potential impact on significant biodiversity features on the hand of desktop studies, available literature/information and a field study.
- To assess habitat sensitivity and the impact on species with emphasis on protected species encountered.
- To consider short- and long-term impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.
- To make recommendations on impact minimisation in terms of the proposed project

The study includes the following:

- A brief discussion of the local environment in order to provide background on the ecological factors influencing the ecological drivers associated with the specific area.
- A brief discussion of the vegetation types expected and encountered with emphasis on protected species encountered.
- A list of plant species encountered during the site visit.
- Determination of the occurrence, or possible occurrence of threatened or sensitive plant species, and sensitive plant communities, on the basis of the field survey and records obtained from the South African National Biodiversity Institute (SANBI) and available literature.
- A quick scan of habitat sensitivity, incorporating faunal distribution based on the field survey and from available literature.
- An evaluation of the potential impact of the proposed project on habitat and species.
- A discussion of significant impacts focusing on possible mitigation and amendments to the development proposal.

2. 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.

Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), to control the sell, purchase, use and disposal of agricultural or stock remedies.

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 Act 107 of 1998 (as amended): replaces the Environmental Conservation Act (ECA) and establishes principles for decision-making on matters affecting the environment, and for matters connected therewith.

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

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

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).
- **Alien and invasive species list 2016** (GN R. 864 of 29 July 2016).

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 908 of 21 November 2014)

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): which provides for the sustainable utilization of wild animals, aquatic biota and plants.

3. DEFINITIONS & ABBREVIATIONS

3.1 DEFINITIONS

Contaminated water: means water contaminated by the activities associated with construction, *e.g.* concrete water and runoff from plant/ personnel wash areas.

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 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.

Watercourse: in this report the author uses a very simplified classification system to define the difference between a river, a water course and an ephemeral stream as encountered in the study area.

- River: A river is a natural watercourse with a riverbed wider than 3m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Stream: A small river or natural watercourse with a riverbed of less than 3 m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Ephemeral drainage line: A very small and poorly defined watercourse, mostly on relatively flat areas, which only flows for a short period after heavy rains, usually feeding into a stream or river or dries up completely before reaching another body of water.

3.2 ABBREVIATIONS

AIP	Alien and invasive plants
AIS	Alien and invasive species
BGIS	Biodiversity Geographical Information System
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
IDP	Integrated development plan
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NDBSP	Namakwa District Biodiversity Sector Plan, 2008
NDM	Namakwa District Municipality
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
OCC	O'okiep Copper Company
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SIBIS	SANBI's Integrated Biodiversity Information System
SKEP	Succulent Karoo Ecosystem Project
WWTW	Wastewater Treatment Works

4. PROJECT DESCRIBTION

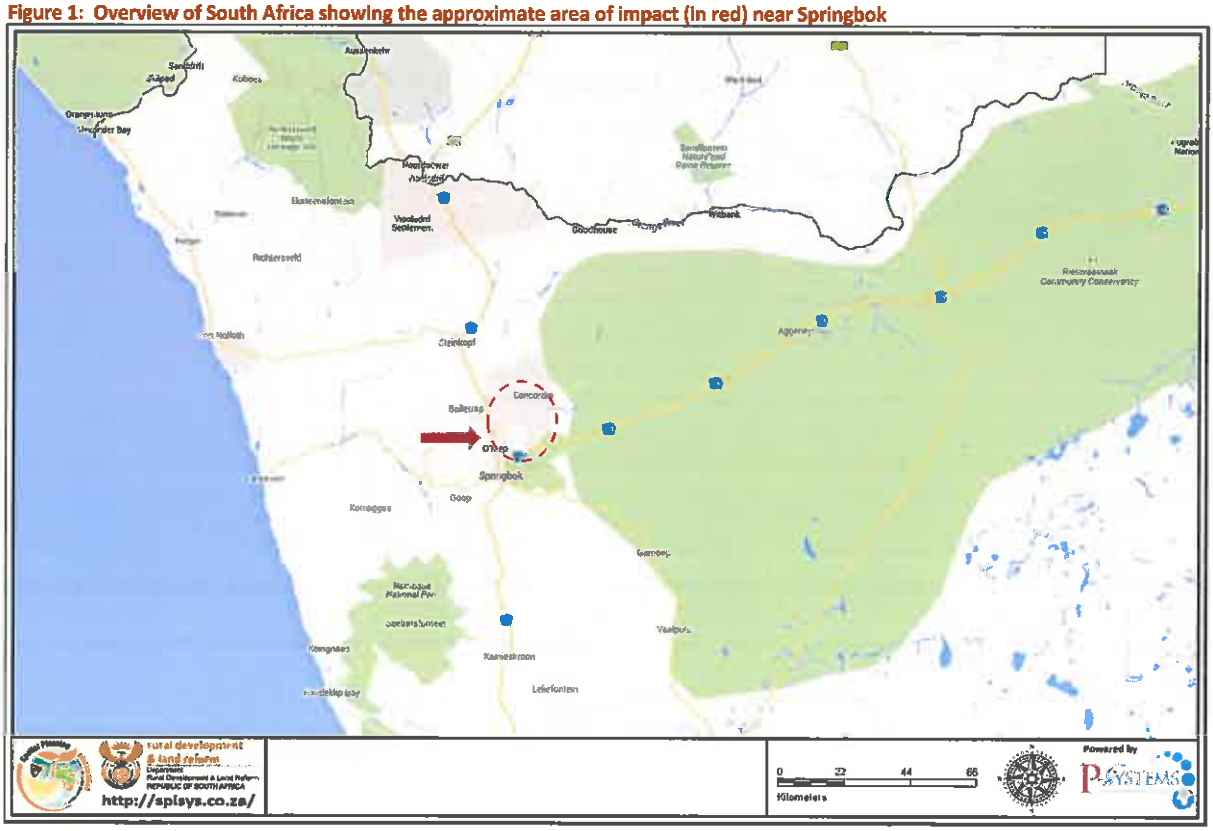
Both the towns of Concordia and Carolusberg are supplied with freshwater from the Namaqualand Regional Water Supply Scheme (NRWSS), managed by Sedibeng Water (through existing pipelines). The NRWSS entails pumping water from the Orange River Raw water Pumpstation (through a number of treatment plants) to first Eenriet Reservoir (±14km north of Steinkopf) and then to the Okiep Reservoir (at Okiep) from where it is distributed to a number of towns, including Springbok, Nababeep, Concordia and Carolusberg.

The current pipelines have been in use well over its design period and needs to be replaced as a matter of urgency. Both the Concordia and Carolusberg pipelines are in poor shape of repair and do not have the long term capacity to service these towns. As part of the larger NRWSS upgrade (currently replacing the main supply pipeline Orange River Raw water Pumpstation to Okiep Reservoir and Nababeep) the Sedibeng Water Board considers the upgrade of the Concordia and Carolusberg bulk water supply lines as the next highest priority infrastructure upgrade.

4.1 LOCATION AND LAYOUT

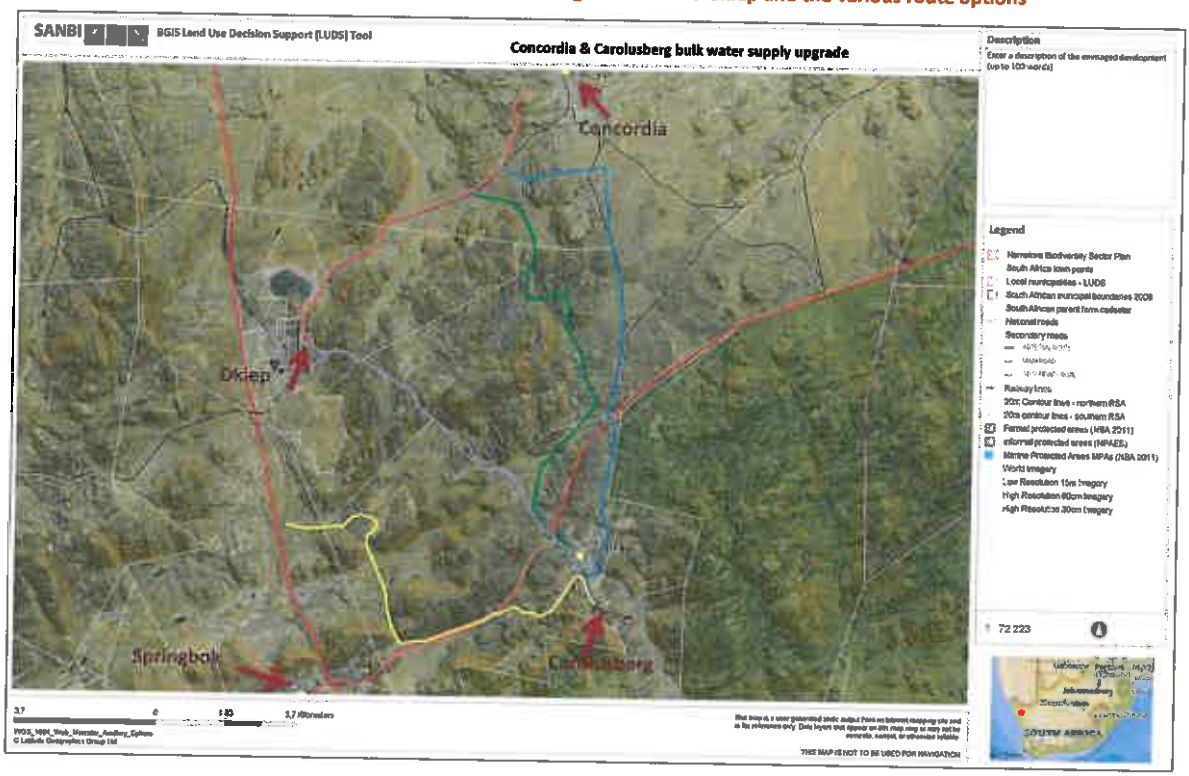
Concordia and Carolusberg are two small mining towns in close vicinity to Springbok (the principle town of the Namaqualand) and Okiep in the Northern Cape Province, Namakwa District Municipality, and Nama Khoi Local Municipality. Okiep is located just (approximately 10 km) north of Springbok, just off the N7 going north (Refer to Figure 1). Bulk water for both Concordia and Carolusberg are supplied from the Okiep Reservoir.

Figure 1: Overview of South Africa showing the approximate area of impact (in red) near Springbok



Concordia was originally established as a Rhenish mission station in 1852 and copper mining began in 1853 through to 1933 in the area. The Boers used Concordia as their headquarters during the Anglo Boer war whilst Okiep was under siege. Today some of the magnificent examples of Cornish stone masonry still exist in addition to the original granary which was used as a hospital by the Boer commandos during the Anglo Boer war. Concordia is located approximately 18 km northwest of Springbok. Carolusberg is located approximately 9 km east of Springbok, just south of the N14 to Aggeneys. The old mineshaft dug by Simon van der Stel way back in 1685 can still be seen at Carolusberg (Refer to Figure 2).

Figure 2: A map showing the towns of Concordia and Carolusberg in relation to Okiep and the various route options



4.2 CONCORDIA UPGRADE

The Concordia pipeline upgrade entails the replacement of the existing pipeline with a new and larger pipeline (the Red line in Figure 2) in the same basic footprint (only one route alternative). The new pipeline will be:

- Approximately 8.2 km in length;
- With a maximum diameter of 0.35 m;
- It will pass through the urban edge of Okiep and Concordia (land owned by Nama Khoi Municipality) as well as land owned by the O'okiep Copper Company (OCC) and cross the Concordia commonage (owned by the Nama Khoi Municipality);
- It will cross a number of small seasonal streams / drainage lines within the same footprint as the original pipeline;
- It will cross natural veld (not listed in terms of NEMBA), within the existing servitude;
- It runs mostly parallel to the Okiep to Concordia tarred road, BUT NOT within the road reserve;

- The pipeline passes close to a type 2 CBA (as identified within the Namakwa Biodiversity Sector Plan) but is unlikely to interfere with any CBA;
- The new pipeline will be placed next to the old pipeline (so that the original pipeline can maintain water supply during construction);
- The new pipeline will be placed above ground within the rocky sections and below ground in sandy sections (in order to reduce construction cost as well as environmental impact);
- Placing the pipeline above ground will be more visual, but will result in a much reduced footprint and a very low physical disturbance.
- Because of the enormous additional cost implications, the applicant proposes that the original pipeline will only be removed where it is necessary for construction purposes. However, all absolute aboveground structures will be removed.
- Please note that large sections of the original pipeline are expected to still be asbestos or asbestos cement pipelines, which will need special handling and disposal (and which will increase the upgrade costs significantly).

Figure 3: Google image showing the pipeline route from Okiep to Concordia reservoir

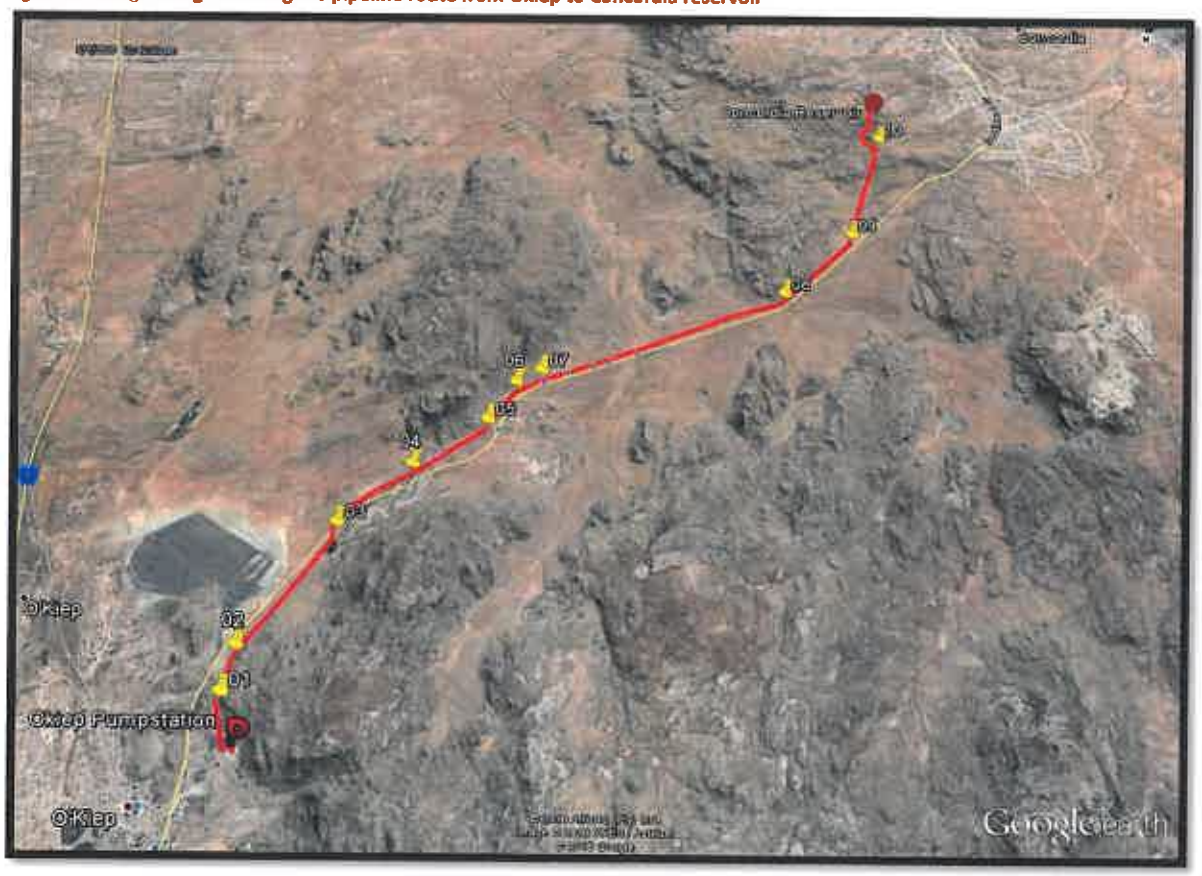


Table 1: Co-ordinates for the Concordia pipeline route as shown in Figure 3

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Starting point (Okiep Reservoir)	29°35'33.52"S	17°53'13.06"E
• Point 01 Okiep	29°35'23.68"S	17°53'6.05"E
• Point 02 Okiep	29°35'11.71"S	17°53'9.66"E
• Point 03 Road crossing	29°34'46.26"S	17°53'27.89"E

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Point 04 Entering CBA	29°34'30.71"SS	17°53'45.43"E
• Point 05 CBA area	29°34'19.75"S	17°54'4.86"E
• Point 06 Exiting CBA	29°34'8.95"S	17°54'11.89"E
• Point 07	29°34'5.03"S	17°54'18.68"E
• Point 08	29°33'40.67"S	17°55'29.20"
• Point 09	29°33'21.06"S	17°55'51.46"E
• Point 10 Rocky section	29°32'47.92"S	17°56'3.92"E
• End point (Concordia Reservoir)	29°32'33.77"S	17°56'4.98"E

4.3 CAROLUSBERG UPGRADE

In terms of the Carolusberg upgrade water is presently pumped from the Okiep Reservoir "over" the mountains (the shortest route) to Carolusberg (the purple line in Figure 2). Because the water has to be pumped from Okiep over the mountains the operational cost is ever increasing (rise in cost of electricity and difficult access).

4.3.1 ALTERNATIVE A1 – THE PREFERRED ROUTE

Figure 4: Google image showing the Concordia pipeline (Red) and the preferred (new) route option (Blue) for the Carolusberg pipeline

The proposed preferred new route option (blue line in Figure 2 and Figure 3) entails linking the Carolusberg pipeline to the Concordia pipeline (tapping water from the Concordia pipeline) and routing it around the mountains to the south of Concordia up to Carolusberg. This will reduce pumping costs and thus operational

costs significantly. The terrain is also much easier to access, with existing roads, which will in term reduce maintenance costs.

Table 2: Co-ordinates for the preferred Carolusberg pipeline replacement route as shown in Figure 4

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Starting point	29°33'22.87"S	17°55'50.22"E
• Point 11 (Start of rocky section)	29°33'34.98"S	17°56'9.09"E
• Point 12 (on top of rocky section)	29°33'31.59"S	17°56'17.75"E
• Point 13 (turning south towards Carolusberg)	29°33'26.10"S	17°57'6.31"E
• Point 14	29°34'6.16"S	17°57'18.37"E
• Point 15	29°34'50.87"S	17°57'32.33"E
• Point 16	29°35'32.11"S	17°57'36.76"E
• Point 17 (crossing underneath N14)	29°36'26.88"S	17°57'23.05"E
• Point 18	29°36'37.76"S	17°57'29.23"E
• Point 19	29°37'34.14"S	17°57'19.27"E
• Point 20	29°37'49.08"S	17°57'25.42"E
• Point 21	29°38'14.39"S	17°57'14.73"E
• Point 22	29°38'18.96"S	17°57'18.73"E
• Point 23	29°38'24.82"S	17°57'6.03"E
• End point (Carolusberg Reservoir)	29°38'41.20"S	17°57'16.18"E

The proposed new Carolusberg pipeline will tap into the Concordia line just south of Concordia and will then cross over a small koppie towards the main gravel road connecting Concordia and Carolusberg. The line will then follow the road (placed within the road reserve wherever possible) all the way (and under the N14) to the Carolusberg Reservoir. The proposed pipeline will be:

- Approximately 12.7 km in length;
- With a maximum diameter of 0.25 m;
- It will pass over the Concordia commonage (mostly within the existing road reserve) into the urban edge of Carolusberg;
- It will cross a number of small seasonal drainage lines within the road reserve;
- It will cross natural veld (not listed in terms of NEMBA), within the road reserve;
- It is not expected to impact on any CBA or ESA (as identified within the Namakwa Biodiversity Sector Plan), but may pass within close proximity;
- The new pipeline will be placed above ground within the rocky sections and below ground in sandy sections (in order to reduce construction cost as well as environmental impact);
- Once the new pipeline is in operation all off the above ground sections of the original pipeline will be removed. In order to reduce costs the below ground sections will not be removed, but physical rehabilitation of significant remaining footprints will be done. It will result in a reduced construction footprint, which will reduce environmental disturbance significantly;

Please note that sections of the original pipeline are expected to still be asbestos or asbestos cement pipelines, which will need special handling and disposal (and which will increase the upgrade costs significantly if it has to be removed).

4.3.2 ALTERNATIVE A2

This route (which was the original preferred route from an engineer perspective) will follow the lay of the land (keeping to low lying sections) through natural veld (including CBA's) towards Carolusberg (refer to the green line in Figure 2). From a biodiversity perspective the impact on undisturbed natural veld would most likely be the biggest of all the options considered. It is also likely to impact on a number of land users and is likely to cross an area with existing mining rights. However, because of the potential overlap into areas considered for mining further options was investigated, leading to current preferred route.

Figure 5: Google image showing Alternative A2 for the Carolusberg new pipeline route in green

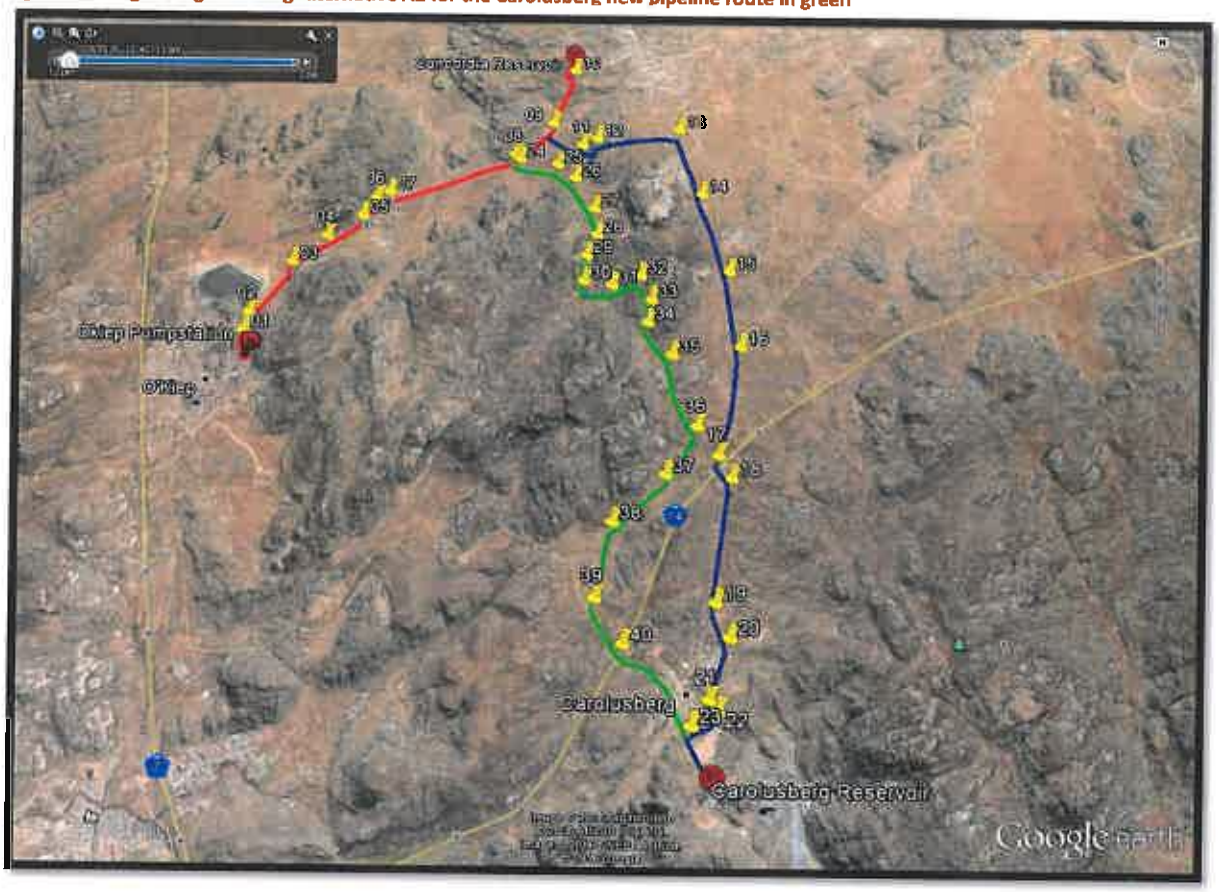


Table 3: Co-ordinates for Alternative A2 of the Carolusberg pipeline replacement route as shown in Figure 5

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Starting point	29°33'40.67"S	17°55'29.20"
• Point 24	29°33'43.33"S	17°55'32.43"E
• Point 25	29°33'46.79"S	17°55'54.78"E
• Point 26	29°33'55.41"S	17°56'5.44"E
• Point 27	29°34'14.04"S	17°56'16.66"E
• Point 28	29°34'30.52"S	17°56'18.48"E
• Point 29	29°34'42.21"S	17°56'12.73"E
• Point 30	29°34'56.92"S	17°56'11.59"E
• Point 31	29°34'59.73"S	17°56'27.22"E
• Point 32	29°34'54.40"S	17°56'42.91"E
• Point 33	29°35'7.92"S	17°56'48.74"E
• Point 34	29°35'19.89"S	17°56'46.89"E
• Point 35	29°35'36.58"S	17°56'59.78"E
• Point 36	29°36'12.85"S	17°57'12.36"E

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Point 37	29°36'35.98"S	17°56'55.72"E
• Point 38	29°36'58.32"S	17°56'28.41"E
• Point 39	29°37'32.33"S	17°56'19.99"E
• Point 40	29°37'51.44"S	17°56'33.23"E
• End point (Carolusberg Reservoir)	29°38'41.20"S	17°57'16.18"E

4.3.3 ALTERNATIVE A3

The second alternative route for the Carolusberg pipeline is described underneath (refer to Figure 6). The proposed line will tap-off from the existing Springbok bulk water supply line, just north of the Springbok Industrial area. It will follow the existing tar road up to Point 43. It will then run through natural veld within a CBA (at the back of the Springbok industrial area) and through a narrow valley (Farm Melkboschkuil) up to the N14. It will then follow the N14 to Point 47 where it will jump south of the N14 and follow existing tracks towards Carolusberg and on to the Carolusberg Reservoir.

Figure 6: Google image showing Alternative A3 for the Carolusberg new pipeline route in yellow

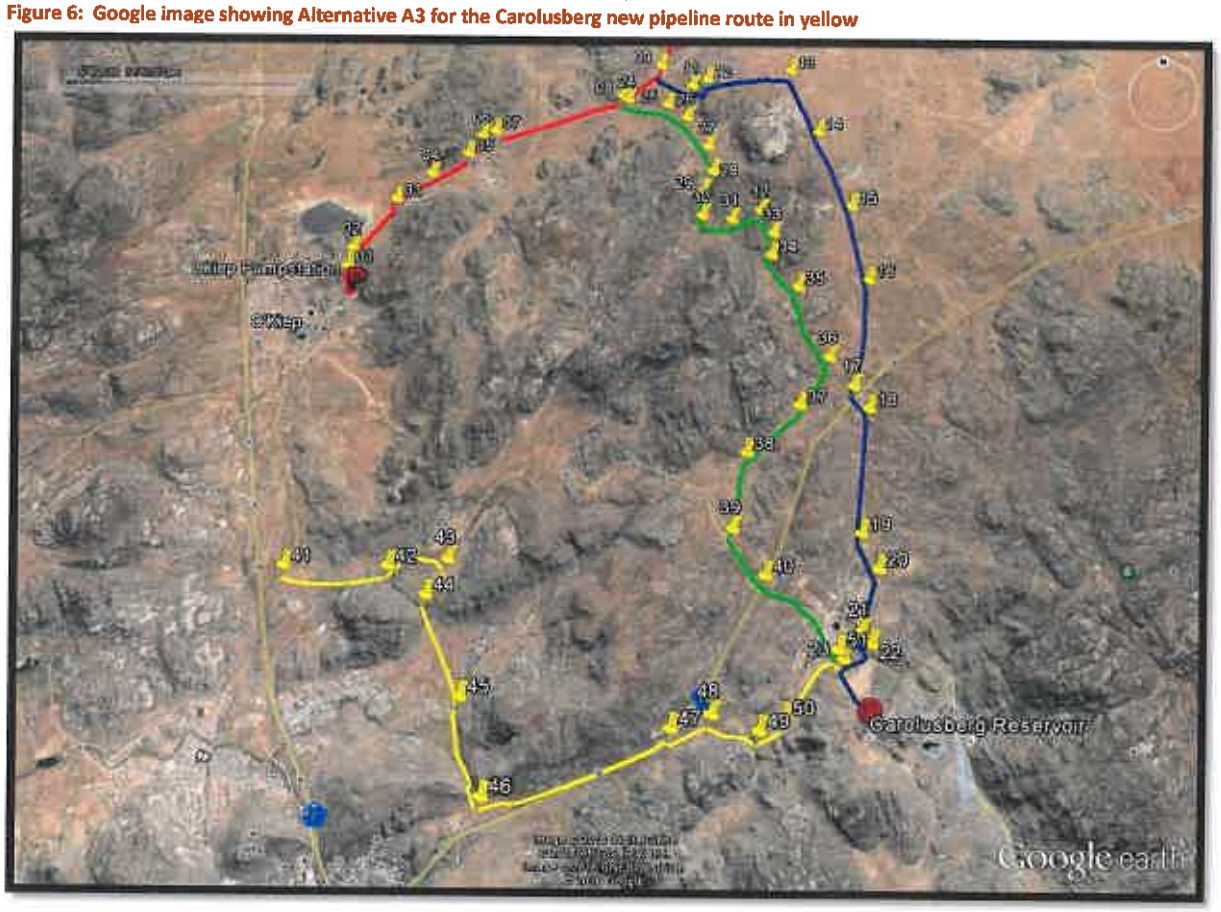


Table 4: Co-ordinates for Alternative A3 of the Carolusberg pipeline replacement route as shown in Figure 6

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Point 41 (Connecting point)	29°37'47.05"S	17°52'54.57"E
• Point 42	29°37'47.67"S	17°53'43.06"E
• Point 43	29°37'45.29"S	17°54'10.43"E
• Point 44	29°37'59.67"S	17°54'1.35"E
• Point 45	29°38'39.07"S	17°54'19.49"E

ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Point 46	29°39'15.16"S	17°54'31.07"E
• Point 47	29°38'50.88"S	17°55'49.89"E
• Point 48	29°38'45.75"S	17°56'7.25"E
• Point 49	29°38'51.43"S	17°56'27.77"E
• Point 50	29°38'46.84"S	17°56'38.57"E
• Point 51	29°38'21.20"S	17°57'4.19"E
• End point (Carolusberg Reservoir)	29°38'41.20"S	17°57'16.18"E

4.3.4 ALTERNATIVE A4

As a last resort the existing pipeline route can also be considered as an alternative (refer to . However, as mentioned before, the energy needed to pump the water along this route (over the mountains as to around the mountains) is much more than for any of the other route options. Coupled with maintenance cost (difficult access) this option has been calculated as the most expensive long term option of the 4 routes evaluated. It will make poor financial sense to maintain this route option.

Figure 7: Google image showing Alternative A4 (the existing line) for the Carolusberg pipeline route in black

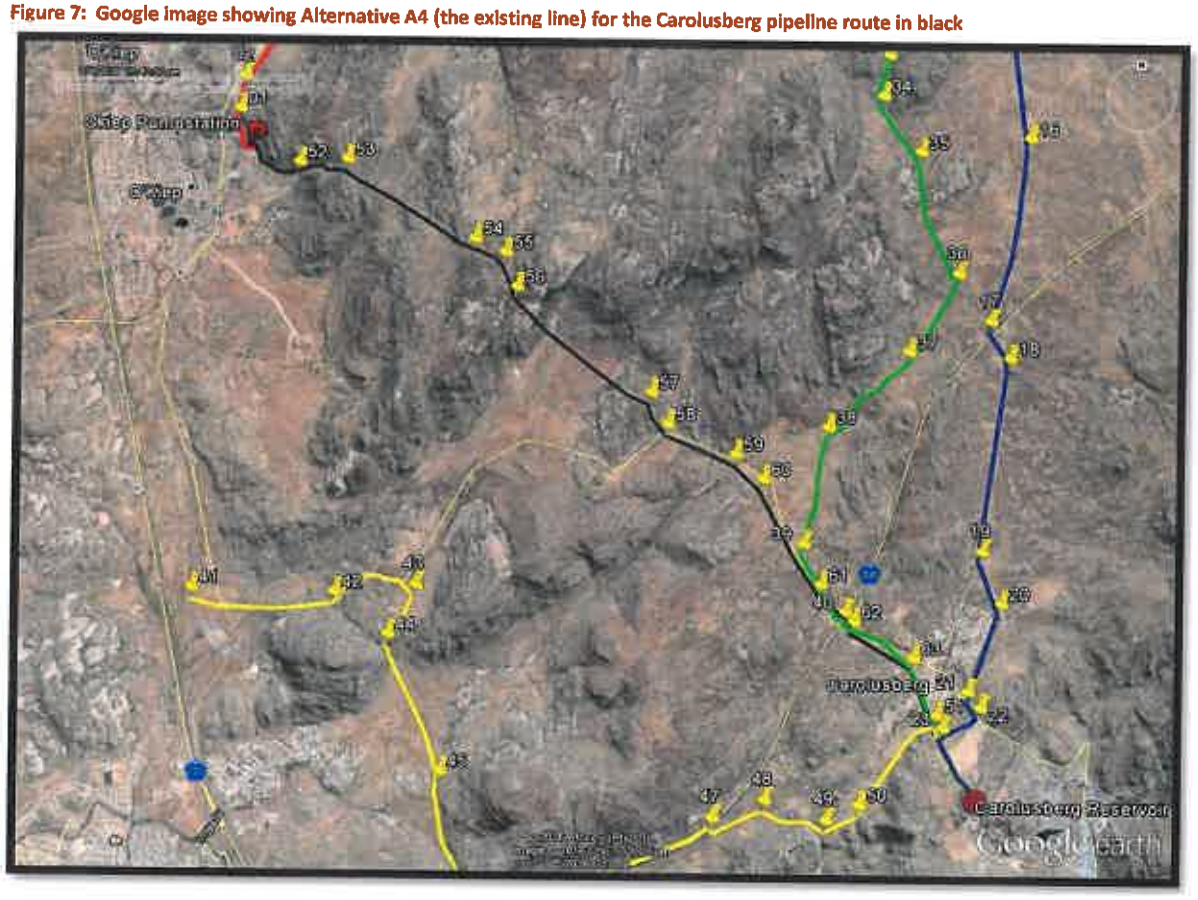


Table 5: Co-ordinates for Alternative A4 of the Carolusberg pipeline replacement route as shown in Figure 7

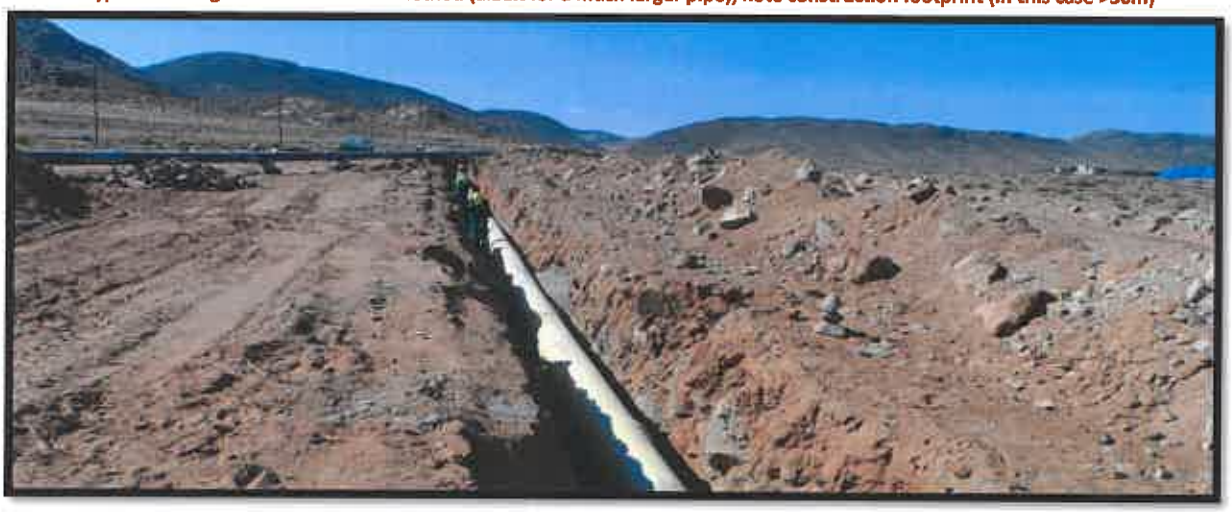
ALTERNATIVE:	LATITUDE (S):	LONGITUDE (E):
• Starting point (Okiep Reservoir)	29°35'33.52"S	17°53'13.06"E
• Point 52	29°35'40.62"S	17°53'27.83"E
• Point 53	29°35'40.58"S	17°53'44.79"E
• Point 54	29°36'4.63"S	17°54'29.15"E
• Point 55	29°36'8.78"S	17°54'39.34"E

• Point 56	29°36'18.77"S	17°54'43.43"E
• Point 57	29°36'48.84"S	17°55'28.46"E
• Point 58	29°36'57.91"S	17°55'34.19"E
• Point 59	29°37'6.47"S	17°55'57.28"E
• Point 60	29°37'13.67"S	17°56'6.63"E
• Point 61	29°37'44.08"S	17°56'25.76"E
• Point 62	29°37'54.61"S	17°56'36.54"E
• Point 63	29°38'4.99"S	17°56'56.64"E
• End point (Carolusberg Reservoir)	29°38'41.20"S	17°57'16.18"E

4.4 CONSTRUCTION METHOD

The towns of Concordia and Carolusberg are supplied with freshwater from the Namaqualand Regional Water Supply Scheme (NRWSS), managed by Sedibeng Water. The pipelines supplying these towns have been in use well over its design period (subject to continual failings) and needs to be replaced as a matter of urgency. They also do not have the long term capacity to service these towns. Sedibeng Water Board considers the upgrade of the Concordia and Carolusberg bulk water supply lines as their next highest priority infrastructure upgrade (after replacement of the main line from Henkries to Okiep). It is thus very important to note that the "No-Go Alternative" will not result in a *status quo* or no impact. It will only mean that the capacity of the two pipelines cannot be expanded. It is very likely that both these pipelines will have to be replaced in any case, as part of maintenance as a result of the many failures. This will mean that the pipeline will be replaced as emergency repairs or in sections over a period time, without any environmental control, which might result in a much higher overall environmental impact over which there will be very little control.

Photo 1: Typical below ground construction method (albeit for a much larger pipe), note construction footprint (in this case >30m)



The underground sections (sandy sections) of the pipeline will be placed approximately 1 meter underground and will go under the river bed level where crossings of rivers or streams might be encountered (Photo 1). The only visible part of the pipeline will be valve chambers, air vents and scour valves. Using the current construction method as an indicator it is expected that the construction footprint will be approximately 20 – 25 wide.

Photo 2: Typical aboveground construction method for the pipeline

The above ground sections (Photo 2) will be done in a similar way as the many of the original pipeline sections was done, where the pipeline is placed on small concrete pedestals. These pedestals rarely needs to be anchored and is cast to allow for height differences. Using this method means that the construction footprint will be very, small, temporary and should not result in any permanent impact (only single plants impacted *vs.* a 30 m construction corridor).

5. METHODS USED FOR 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

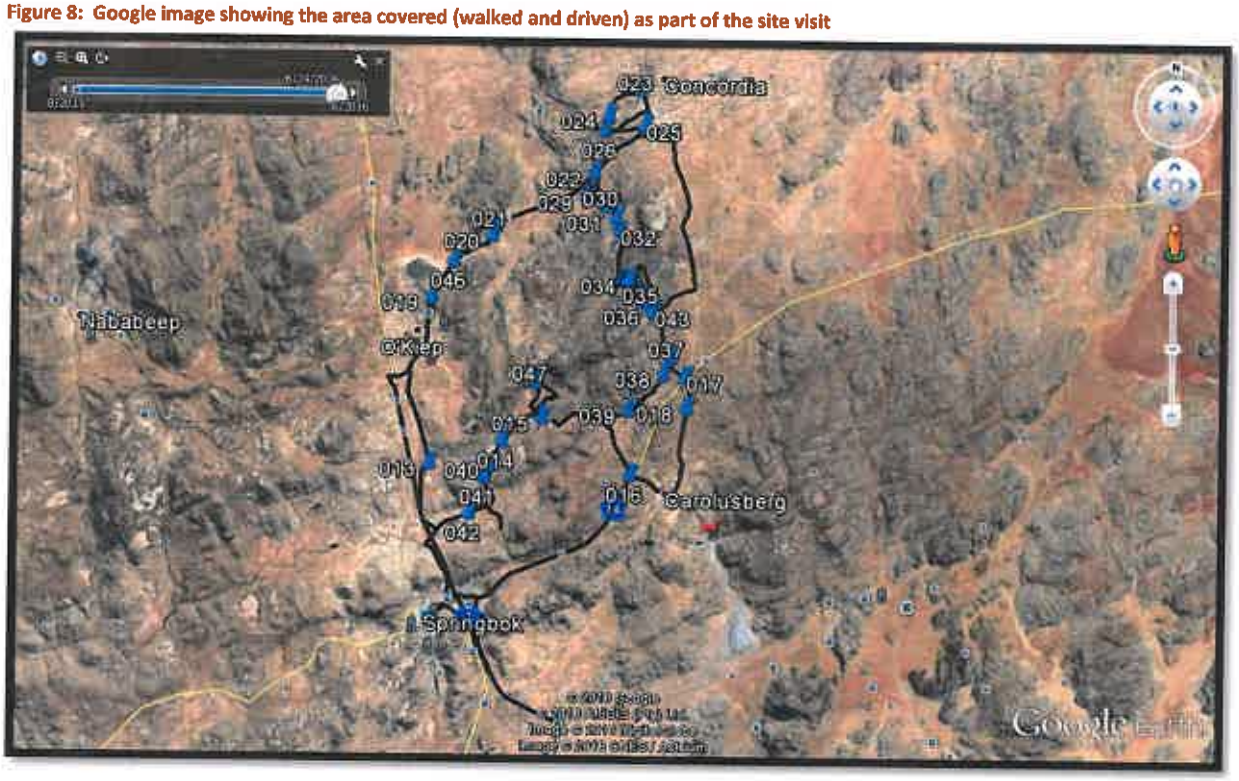
5.1 SITE VISIT

The aim of the desktop studies was to put the study area in perspective with regards to expected significant biodiversity features which may be encountered within the study area. For the initial desktop study the following were taken into account:

- SANBI: Biodiversity GIS Home. http://bgis.sanbi.org (as updated);
- Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006);
- National Spatial Biodiversity Assessment 2004 and 2011;
- The Namakwa District Critical Biodiversity Areas Sector Map;
- The Namakwa District Biodiversity Sector Plan, 2008;
- Fynbos Forum Ecosystem Guidelines for Environmental Assessment (De Villiers, 2005);
- The 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.

An initial site visit was done on the 23rd of July 2015. The main site visit was done during the first week of August (2015) followed by a further site visit on the 20th of April 2016 (to cover the new preferred route option). The site visit compromises walking and driving the various route options and its immediate surroundings, examining and photographing any area of interest. During the site visit and subsequent desktop studies, a fairly good understanding of the environment was achieved. The timing of the site visit was very good in that essentially all perennial plants where 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.

Figure 8: Google image showing the area covered (walked and driven) as part of the site visit



6. DESCRIPTION OF ENVIRONMENT

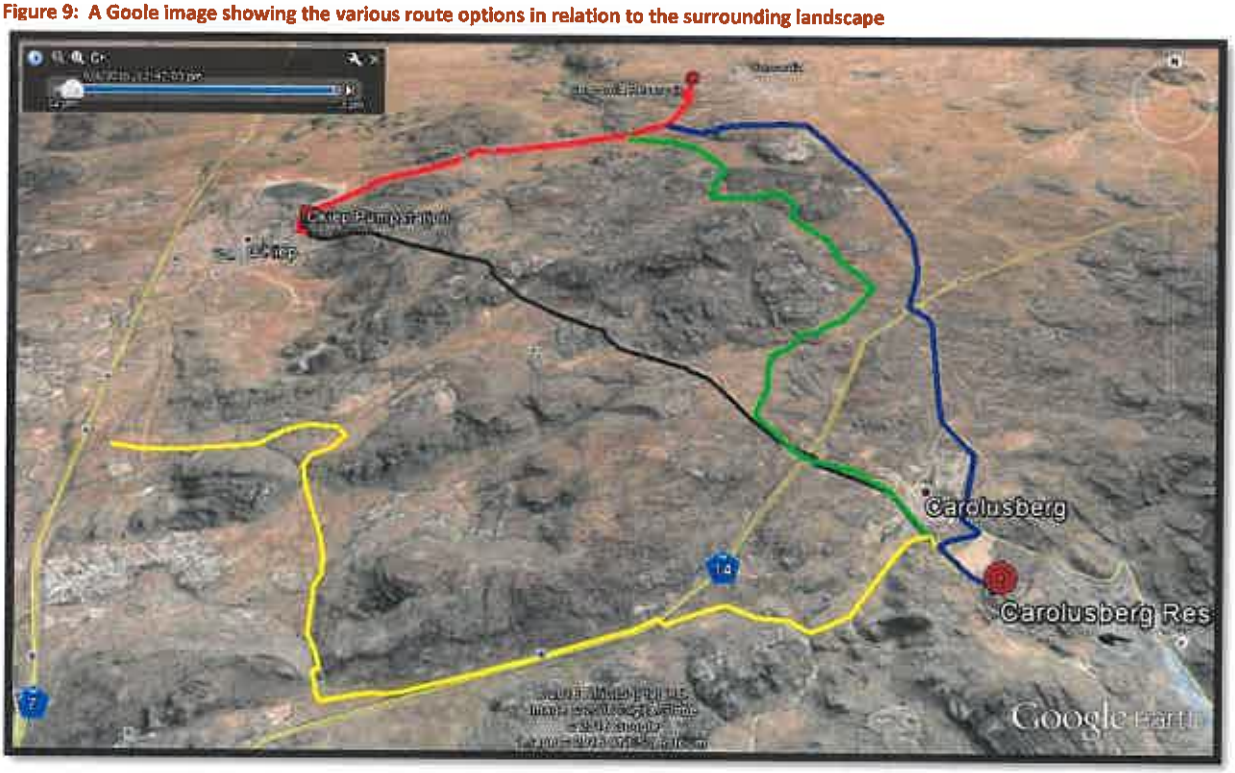
The aim of this description is to put the study area in perspective with regards to all probable significant biodiversity features which might be encountered within the study area. The study area covers the preferred routes, all alternative routes and its immediate surroundings.

6.1 TOPOGRAPHY

Route descriptions for the various routes are given under to project description (Par. 4.2 and 4.3). The following is a very cryptic summary of the topography of the site on hand of the gradient for associated with each route option:

- Concordia Pipeline: The route has a total length of approximately 8.2 km with an average slope of 4.8% and a maximum slope of 18.2% as it rises towards the Concordia Reservoir.
- Carolusberg Pipeline (A1): The preferred route will have total length of approximately 12.7 km with an average slope of 2.3% (one steep section at the start with a maximum slope of 22.7%).
- Carolusberg Pipeline (A2): The first alternative route will have total length of approximately 12.4 km with an average slope of 4.2% and a maximum slope of 19.3%.
- Carolusberg Pipeline (A3): The second alternative route will have total length of approximately 10.8 km with an average slope of 4.7% and a maximum slope of 13.2%.
- Carolusberg Pipeline (A4): The existing route has total length of approximately 9.4 km with an average slope of 6.3% and a maximum slope of 32.5%.

Figure 9: A Goole image showing the various route options in relation to the surrounding landscape



6.2 CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. The Springbok area receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid) and because it receives most of its rainfall during winter it has a Mediterranean climate.

Figure 10: Average monthly precipitation over the year (www.weather-and-climate.com)

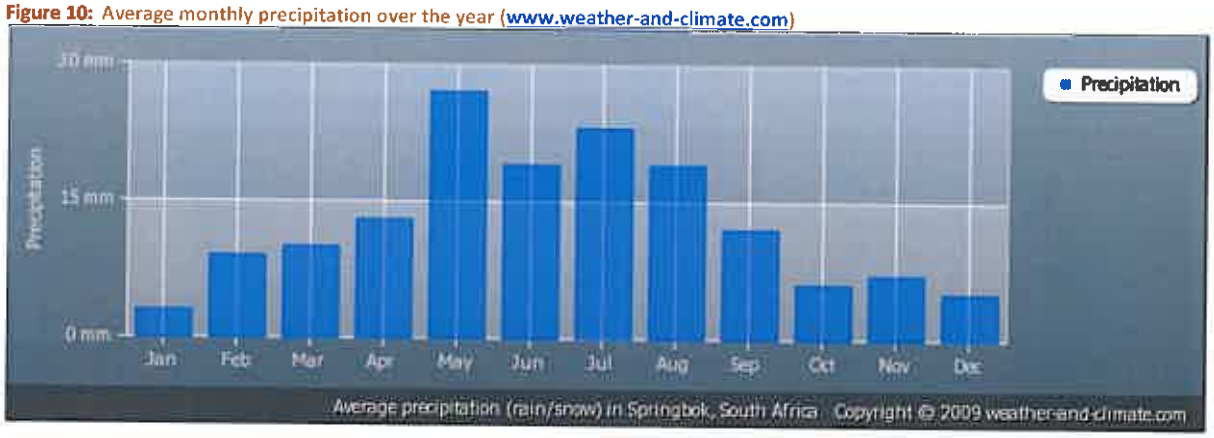
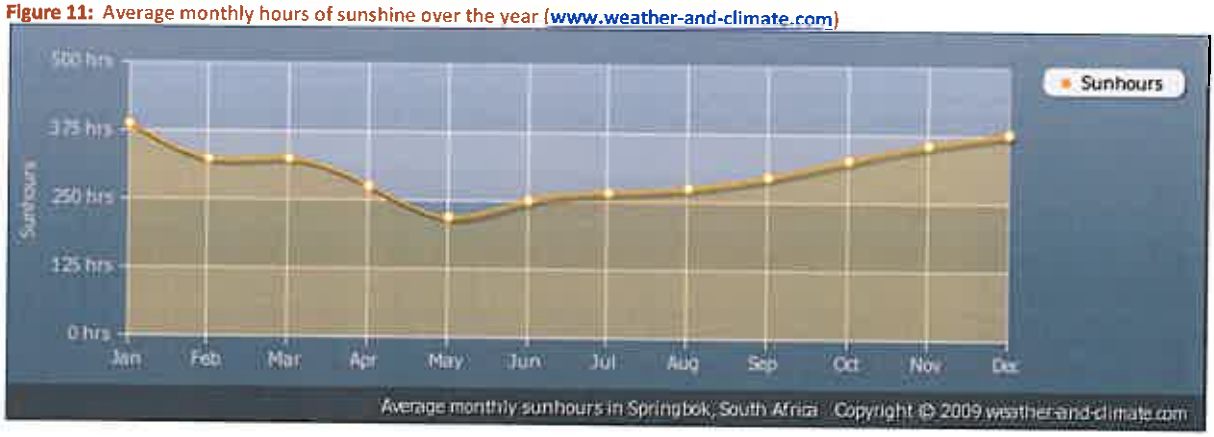


Figure 10 shows the average rainfall values for Springbok per month. It receives the lowest rainfall in January and the highest May to June. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Springbok range from 16.5°C in July to 28.3°C in February. The region is the coldest during July when the mercury drops to 3.8°C on average during the night. Figure 11 gives the average monthly hours of sunshine over the year (www.weather-and-climate.com).

Figure 11: Average monthly hours of sunshine over the year (www.weather-and-climate.com)



NB: According to the Namakwa District Biodiversity Sector Plan (2008), the climate will change drastically over the next millennium. Effects of global climate change lead scientists to the conclusion that the entire Succulent Karoo will most likely experience increased temperatures. It is projected that a 2°C increase in temperature in the area will lead to a 10% reduction in rainfall – a significant loss in an area that is already severely water restricted. This decrease in rainfall is projected to result in a 35% decrease in livestock carrying capacity over the coming 200 years. These projections point to the need for the development of alternative economic opportunities in the area, in order to successfully cope with the changes that are already underway.

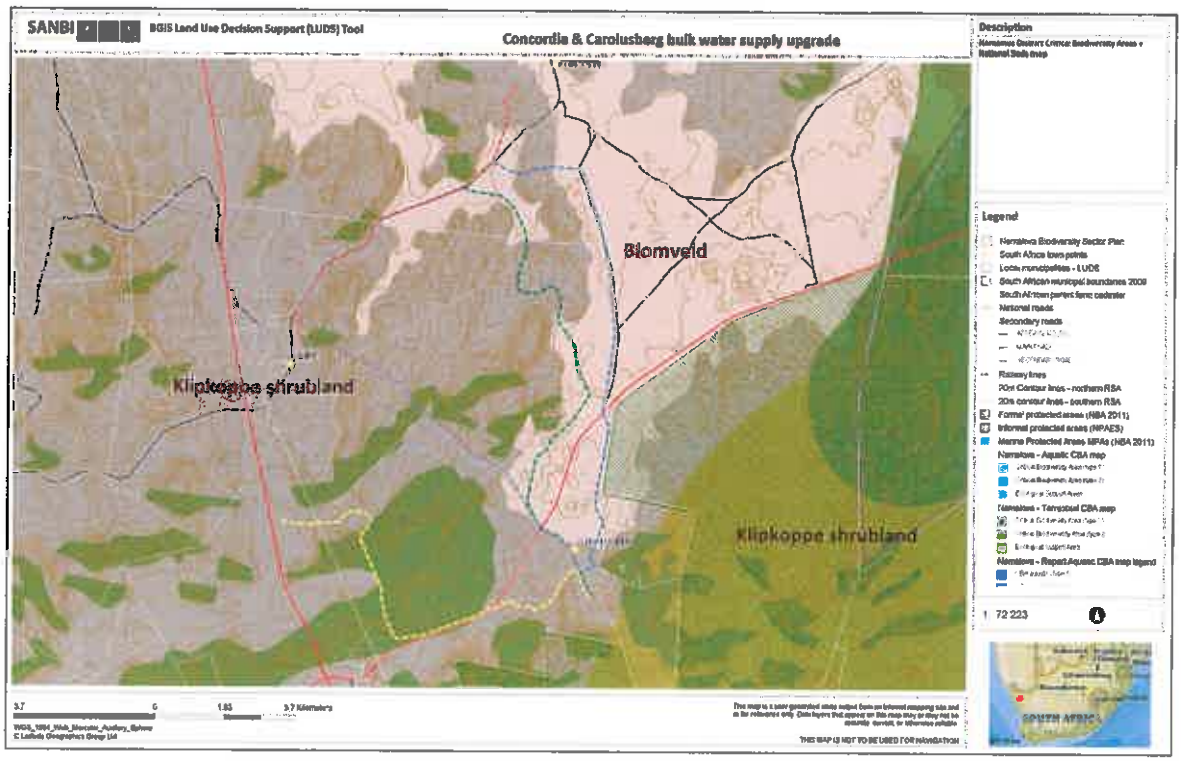
6.3 GEOLOGY AND SOILS

According to the biodiversity information on the SANBI BGIS website, only two major soil types is expected in the study area, which are also associated with the two vegetation types expected, namely Namaqualand Klipkoppe Shrubland (rocky outcrops) and the Namaqualand Blomveld.

According to Mucina & Rutherford (2006) the soils associated with Namaqualand Klipkoppe Shrubland can be described as: Mokolian granites and gneisses which forms gentle to moderate rocky slopes with rock sizes varying from medium to large with flat to gentle rock sheets as well as rock domes. The soils is described as yellow-brown to brown loamy sand, 0.15 – 0.6 m deep (refer to Figure 12).

The geology and soils associated with the Blomveld is described (Mucina & Rutherford, 2006) as soils underlain by granite-gneisses and metasediments of Mokolian age, affected by the Namaqualand Metamorphic Event. It supports relatively deep, yellow-brown, fine to coarse loamy sand derived through weathering of the granite rocks (refer to Figure 12).

Figure 12: General soils expected in the study area



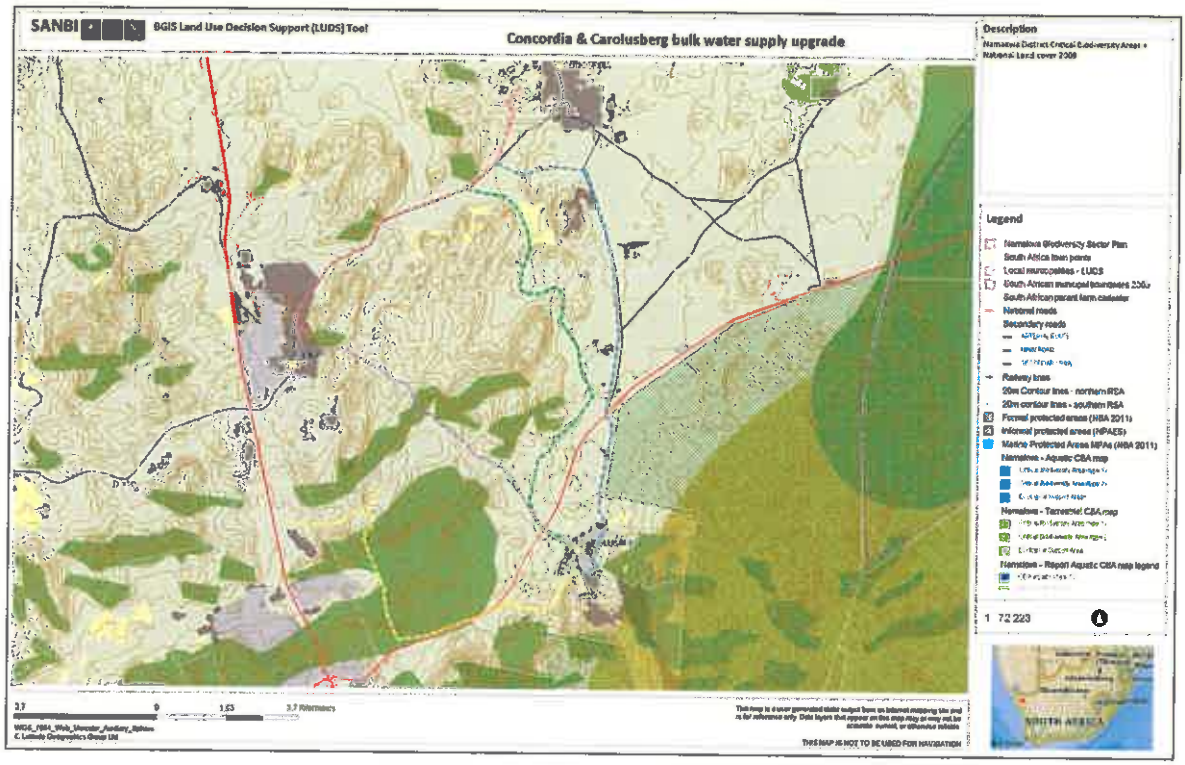
6.4 LANDUSE AND -COVER

Land use in the majority of the NDM is defined by livestock grazing and mining – the two major economic drivers in the region. Some agriculture in the form of wheat and grape cultivation occurs in areas under irrigation and dryland rooibos tea production occurs on the Bokkeveld Escarpment. Another significant economic factor for the NDM's economy is "flower" tourism that is based on Namaqualand's fantastic annual

wildflower displays that cover regions in a kaleidoscope of colour each spring. This is a distinctly seasonal aspect of the economy, lasting only eight to ten weeks, and being highly dependent on the timing and duration of the previous winter rains. However, there are indications that in recent years the regional ecotourism industry is diversifying (e.g. 4x4 and nature tourism) with greater numbers of tourists arriving throughout the year. River rafting is also a big industry on the Orange and Doring Rivers (NDBSP, 2008).

Google images of the area, confirmed by the site visit, shows that the area is still almost completely natural. Figure 13 shows that most of the areas involved are still remaining natural veld (light green on map). Small areas of agricultural land (yellow) may be impacted and old mining areas (dark brown) will be crossed at Okiep.

Figure 13: SANBI BGIS National land cover layer (2009) for the proposed site (CBA areas also indicated)



6.5 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.

According to the Namakwa District Biodiversity Sector Plan (2008), the health of the world's freshwater ecosystems has declined by 50% in the last 30 years, and up to 35% of the world's freshwater fish are now endangered, threatened or extinct. The deterioration of rivers not only results in a loss of freshwater species

but also degrades the ability of the systems to provide the goods and services that people depend on. Estimates are that freshwater use is growing at 2.5 times the rate of the human population growth rate, with water demand in developing countries increasing by 50% in the next 25 years. Water resource managers and water users alike will have to alter their practices if we are to ensure that rivers continue to support both freshwater biodiversity and human life. The scarcity of water resources is a defining feature of this arid environment. The two main river systems – the Orange River on the northern boundary, and the Oliphant's/Doring River system that flows in a north-westerly direction through the Hantam and Karoo Hoogland Municipalities – are both under pressure from the clearing of land for agriculture and the encroachment of alien vegetation along river banks. Similarly, the high yielding water catchment areas of the high mountain areas – some of which provide a significant amount of fresh water to surrounding towns – are also demonstrating lower yields because of a lack of efficient water management strategies. In order to maintain ecosystem health and thereby ensure the sustainability of existing towns and land use practices it is critical for each municipality to safeguard these areas (NDBSP, 2008).

The proposed preferred route options will not cross any major river system on its way to Concordia or Carolusberg. However, both routes will cross over a number of small seasonal drainage lines. The Concordia line will cross these systems in the same footprint as the original pipeline, while the Carolusberg pipeline will cross them within the disturbed road reserve.

Even though these drainage lines are seasonal and slightly too moderately impacted, they are still regarded as significant environmental aspects of the proposed project and care must be taken when working in or near these streams (emphasis on minimising impact and re-instating its function).

6.6 BIOMES

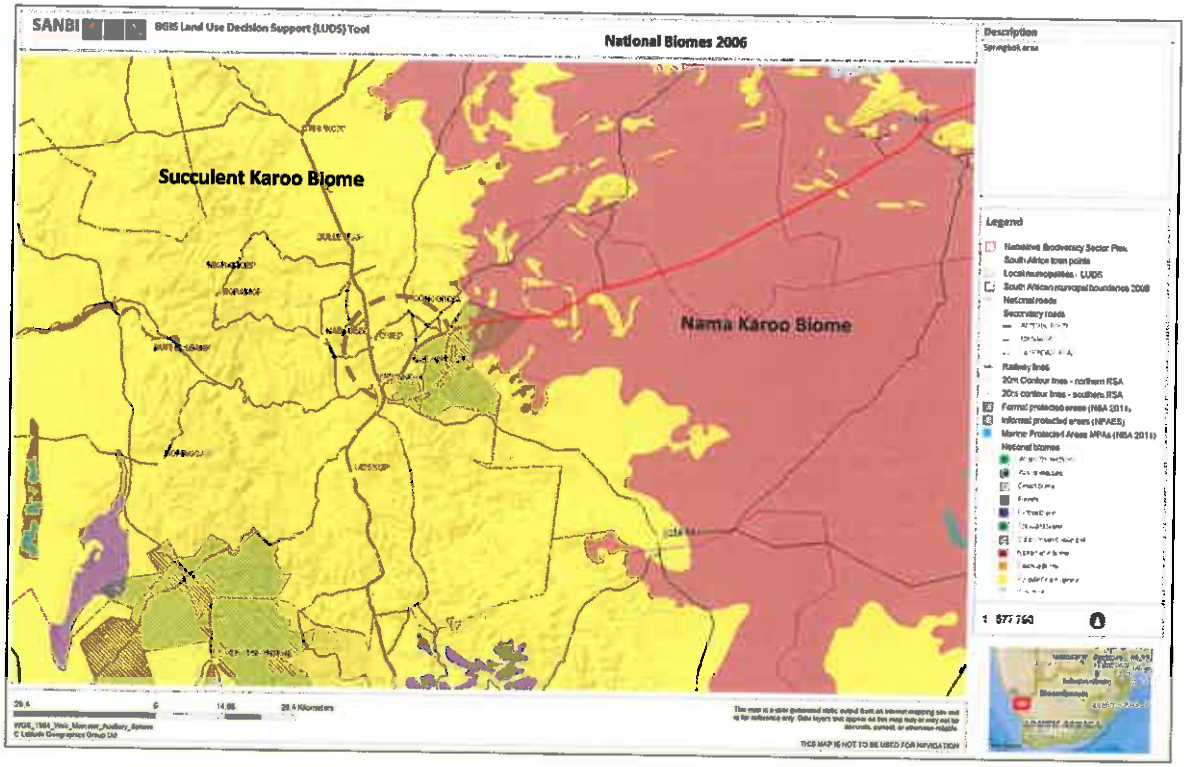
The Namaqualand is a narrow semi-desert and desert area along the west coast of South Africa. Although covering a small area of land (approximately 50 000 m^2) it is home to a unique plant composition and its biodiversity is without equal among the arid areas of the world (Manning, 2008). According to Manning (2008) it is home to more than 3 000 plant species, which is more than four times more than any other winter-rainfall desert area.

The Namaqualand falls within the Succulent Karoo Biome (Figure 14), which is the fourth largest Biome in South Africa and is unrivalled in its status as the world's only entirely arid region diversity hotspot with its high diversity of dwarf leaf-succulent shrubs (Mucina *et al*, 2006). According to the Namakwa Municipal Biodiversity Sector Plan (2008), the area surrounding Springbok contains the most endemics per quarter degree square in the Succulent Karoo (NDBSP, 2008). The Succulent Karoo is sub-divided in a number of eco-regions based on soil-, landscape-, and climatic conditions. The study area is located within the Namaqualand Hardeveld eco-region (Mucina *et al*, 2006).

6.6.1 SUCCULENT KAROO BIOME

The Succulent Karoo Biome (Figure 14) covers a flat to gently undulating plain, with some hilly and "broken" veld, mostly situated to the west and south of the escarpment, and north of the Cape Fold Belt. The altitude is mostly below 800 m, but in the east it may reach 1 500 m. A variety of geological units occur in the region. There is little difference between the soils of the Succulent Karoo and Nama Karoo Biomes - both are lime-rich, weakly developed soils on rock. The vegetation is dominated by dwarf, succulent shrubs, of which the Vygies (Mesembryanthemaceae) and Stonecrops (Crassulaceae) are particularly prominent. Mass flowering displays of annuals (mainly Daisies Asteraceae) occur in spring, often on degraded or fallow lands. Grasses are rare, except in some sandy areas, and are of the C3 type. The number of plant species (mostly succulents) is very high and unparalleled elsewhere in the world for an arid area of this size (Mucina et al, 2006).

Figure 14: National Biomes of South Africa (2006) showing the Springbok area



The Succulent Karoo has little agricultural potential due to the lack of water. The scarcity of grasses limits grazing, and the low carrying capacity requires extensive supplementary feeds. Much soil has been lost from the biome, through sheet erosion, as a consequence of nearly 200 years of grazing. Tourism is a major industry with the coastal scenery and the spring mass flower displays the main attractions. Mining is important, especially in the north (Mucina *et al*, 2006).

Less than 0.5% of the area of the Succulent Karoo Biome has been formally conserved. The biome has a high number of rare and Red Data Book plant species. The high species richness and unique global status of the biome require urgent conservation attention.

6.6.1.1 *Ecological drivers*

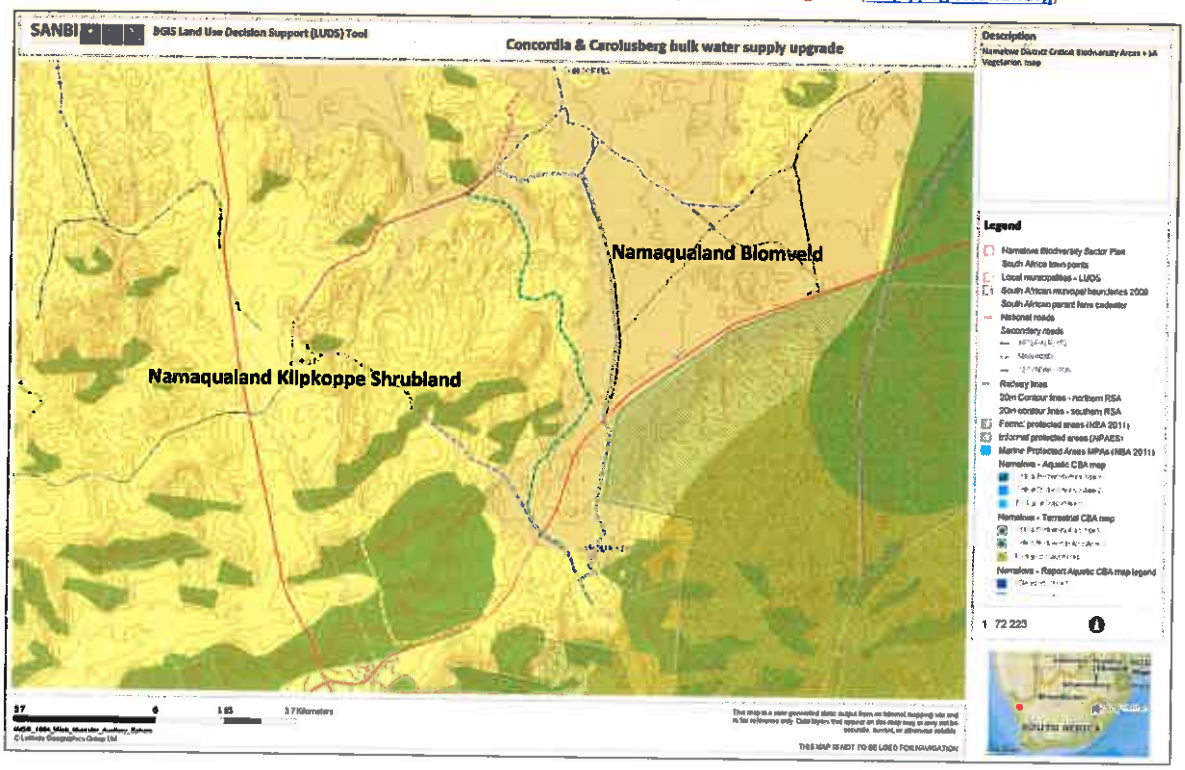
The Succulent Karoo Biome is primarily determined by the presence of low winter rainfall and extreme summer aridity. Rainfall varies between 20 and 290 mm per year. The rains are cyclonic and not in the form of thunderstorms, which means that its erosive power is far less than what is experienced in the summer rainfall biomes and the rain itself is more penetrative. During summer, temperatures in excess of 40°C are common. Fog is common nearer the coast. Frost is infrequent. Desiccating, hot, Berg Winds may occur throughout the year. However, the main feature of this climate is the predictability of its rainy season (Van Wyk & Smith, 2001 and Mucina *et al*, 2006).

The unique plant species diversity is thought to be maintained and even thrive as a result of the reliable rainy season, with prolonged droughts almost non-existent. This climatic predictability is considered to be one of the main reasons for the remarkably rapid diversification of at least one of the key plant families, namely the Aizoaceae. One of the viewpoints is that succulents (with their limited water storage capacity and shallow root system) are highly successful in the Namaqualand, because of its predictable rainfall patterns and because extensive droughts periods are almost non-existent, since succulents are also highly sensitive to periodic drought (Mucina et al, 2006).

6.7 VEGETATION TYPES EXPECTED

In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) two broad vegetation types are expected in the study area (Refer to Figure 15), namely:

Figure 15: Vegetation map of SA, Lesotho and Swaziland (2006), also showing CBA areas in green (http://bgis.sanbi.org)



It is clear to see that though both these vegetation types were classified as "Least Threatened" during the National Spatial Biodiversity Assessment (NSBA), 2004, they are also considered "Poorly Protected" given the fact that very little of these two vegetation types are formally protected. Note that the status of these vegetation types remained "Least Threatened" as listed in the recently promulgated 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. Fortunately, more than 95% of most of these vegetation types are still found in a relative natural state.

Table 6: Vegetation types expected and their status (Gn. 1002, of December 2011)

VEGETATION TYPE	BIOME	STATUS	REMAINING	FORMALLY CONSERVED	CONSERVATION TARGET
Namaqualand Blomveld (Darker mustard in Figure 15)	Succulent Karoo	Least Threatened Hardly Protected	94%	1.5%	28%
Namaqualand Klipkoppe Shrubland (Lighter mustard in Figure 15)	Succulent Karoo	Least Threatened Poorly Protected	95%	5.8%	28%

6.7.1 NAMAQUALAND BLOMVELD

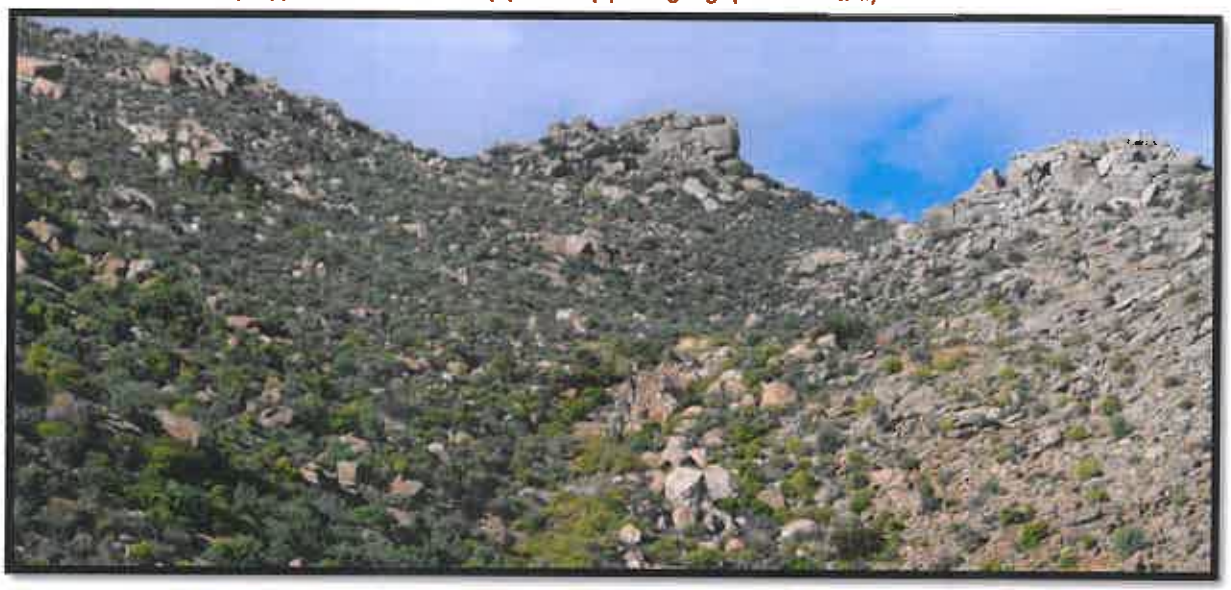
Namaqualand Blommeveld is found in valleys and flat areas between granitic rocky hills of the Namaqualand Escarpment. Usually on level to slightly undulating sedimentary surfaces between rocky granitic hills and mountains, such as wide plains and broad valleys with dry channels of intermittent water courses. Sparse dwarf shrubs with succulent or ericoid leaves dominate these shrublands. Geophytes and ephemeral herbs and in places low, spreading, leaf-succulents show spectacular flower displays in wet years (Mucina & Rutherford, 2006). Endemic taxon associated with this veld type includes (Mucina & Rutherford, 2006) – Herbs: *Lessertia capitata, Lotononis arenicola*. Succulent Herbs: *Dorotheanthus bellidiformis* subsp. *hestermalensis* and *D. rourkei*.

Photo 3: Typical Namaqualand Blomveld in between the rocky hills in the vicinity of Concordia (note *Galenia africana* dominance)

6.7.2 NAMAQUALAND KLIPKOPPE SHRUBLAND

Namaqualand Klipkoppe Shrubland is described as a dramatic landscape of huge granite and gneiss domes, smooth glacis and disintegrating boulder koppies supporting open shrubland up to 1 m tall, dominated by shrubs of dwarf to medium stature and with ericoid or succulent leaves. A few scattered Kokerboom trees (*Aloidendron dichotoma* var. *dichotoma*) are found mostly on north-facing slopes. Flat or gentle sloping rock sheets (the dominant feature of this unit) support dwarf or prostrate succulents in shallow pockets with soil or in cracks. Fringe vegetation at the bottom of steep rock sheets (collecting run-off water) could house 1-3 m tall shrubs with non-succulent leaves and canopy cover reaching 40-100% (Mucina & Rutherford, 2006).

Photo 4: Namaqualand Klipkoppe Shrubland near Okiep (note the pipeline going up the mountain)



According to Mucina & Rutherford (2006), the Namaqualand Klipkoppe Shrubland has 15 endemic plant species namely: Succulent Shrubs: *Ottosonderia montincola, Tylecodon nigricaulis*. Low Shrubs: *Lotononis benthamiana, L. longiflora, L. quinata, Wiborgia incurvata*. Herbs: *Tripteris spathulata, Zaluzianskya collina*. Geophytic Herbs: *Ornithogalum leeupoortense, O. louisae, Xysmalobium pearsonii*. Succulent Herbs: *Quagua bayeriana, Q pallens, Stapeliopsis khamiesbergensis*.

6.8 VEGETATION ENCOUNTERED

According to most definitions the Namaqualand region would be classified as a desert region, which are barren for almost three-quarters of the year (summer, autumn and winter), but which can become green and covered in carpets of beautiful flowers for two to three seasons (Le Roux, 2015). The landscape encountered can be described as dominated by the magnificent rocky hills (klipkoppe), with valleys and flat sandy areas in-between. East of Carolusberg the landscape opens up into more open flat lands. The rocky hills supports Namaqualand Klipkoppe Shrubland, while the valleys and flat areas in-between supports Namaqualand Blommeveld. Some of the valleys also show signs of agriculture (ploughed land) which co-inside with areas of especially beautiful flower displays during the spring of wet years.

6.8.1 GENTLE PLAINS

The timing of the site visit was such that geophytes were only starting to show. It was also not within the spring annual flowering season, when mass flowering displays can often be seen after good rains, especially in degraded or fallow lands. The geophytes, annual herbs and sometimes low spreading succulents can produce beautiful carpets of annual (often mono-species) flower displays.

Photo 5: Degraded vegetation, with *Galenia africana* prominent (just south of Concordia)

On the level to slightly undulating broad valleys and plains between the rocky hills a low to medium low shrubland was encountered. Large stretches of this land was found to be dominated by *Galenia africana* (probably as a result of continual grazing over a long period of time), while other areas was dominated by a succulent leaved plants. In other areas the vegetation was dominated by *Galenia africana* in combination with *Osteospermum sinuatum, Leipoldtia schultzei* and *Rushia robusta*. Grasses were always sparse or absent.

Photo 6: Open valley to the north of Carolusberg

Other species that was encountered includes: *Acanthopsis carduifolia, Atriplex lindleyi* subsp. *inflata, Aptosimum spinescens, Bulbine praemorsa, Calobota sericea, Cheiridopsis denticulata, Codon royenii, Conicosia*

elongata, Crassothonna cylindrica, Diascia namaquensis, Didelta spinosa, Drosanthemum hispidum, Eriocephalus racemosus, Eucomis regia, Euphorbia mauritanica, Euphorbia rhombifolia, Felicia dubia, Ferraria macrochlamys subsp. *macrochlamys, Gazania lichtensteinii, Grielum humifusum, Hermannia amoena, Hermannia cuneifolia, Lachenalia carnosa, Leipoldtia schultzei, Lycium bosciifolium, Lycium cinereum, Massonia depressa, Mesembryanthemum barklyi, Mesembryanthemum guerichianum, Mesembryanthemum noctiflorum, Microloma sagittatum, Montinia caryophyllacea, Ornithoglossum vulgare, Osteospermum moniliferum, Osteospermum oppositifolium, Osteospermum sinuatum, Oxalis foveolata, Prosopis glandulosa, Pteronia divaricata, Roepera foetida, Roepera morgsana, Searsia incisa, Senecio* cf. *cardaminifolius, Tetragonia fruticosa* and *Thesium lineatum.*

6.8.2 ROCKY HILLS

The rocky hills are characterised by huge boulders and domes, slowly being weathered into course sand which are deposited as a shallow sandy layer on top or between these rocks. The gentle sloping rocky sheets, was found to be dominated by a medium – low shrubland (0.3 – 0.6 m in height), again with species like Di*delta spinosa, Osteospermum sinuatum, Leipoldtia schultzei* and *Euphorbia mauritanica* prominent.

Photo 7: Rocky hills near Springbok areas, note the Kokerboom in the foreground

Other species encountered includes: *Asparagus capensis, Bulbine alooides, Berkheya fruticose, Blepharis macra, Codon royenii, Colchicum scabromarginatum, Colpias mollis* (on rock faces), *Crassothonna cylindrica, Crassula namaquensis, Diascia namaquensis, Didelta spinosa, Drosanthemum hispidum, Eriocephalus racemosus, Eriospermum paradoxum, Eucomis regia, Euphorbia decussata, Euryops* species, *Felicia dubia, Ficus cordata, Galium capense* subsp. *namaquense, Grielum humifusum, Gymnodiscus linearifolia, Heliophila laciniata, Hemimeris racemosa, Hermannia cuneifolia, Hermannia disermifolia, Hypertelis salsoloides, Jamesbrittenia pedunculosa, Lycium cinereum, Mesembryanthemum guerichianum, Microloma sagittatum,*

Moraea cf. *fenestralis, Osteospermum moniliferum, Osteospermum sinuatum, Othonna retrorsa, Oxalis inconspicua, Pelargonium crithmifolium, P. praemorsum, Pteronia divaricata, Roepera cordifolia, Roepera morgsana, Trachyandra* cf. *karrooica, Trachyandra falcate, Tetraena retrofracta, Tetragonia fruticosa* and *Tylecodon wallichii.*

Photo 8: *Searsia incisa* located along the edge of a rocky outcrop near Carolusberg

Along the foothills and within sheltered pockets on the rocky hills, larger fringe or pockets of plants were observed including: *Calobota sericea, Diospyros ramulosa, Euclea lancea, Kissenia capensis, Montinia caryophyllacea, Portulacaria* cf. *fruticulosa, Searsia burchelli* and *S. incisa*. A small number of *Aloidendron dichotoma* var. *dichotoma* (Kokerboom) was observed on the north facing slopes.

6.9 FLORA ENCOUNTERED

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, all efforts were made to do just that. Table 7 gives a list of the species encountered within the study area

Table 7: List of flora encountered on the property

No.	Species name	FAMILY	Status NFA, NCNCA	SA Red list status (V 2015/1)	Alien & invader species (AIS)
1.	*Acanthopsis carduifolia*	ACANTHACEAE		LC	
2.	*Aloidendron dichotomum (=Aloe dichotoma)*	ASPODELACEAE	Protected in terms of schedule 1 of the NCNCA	VU	
3.	*Aptosimum spinescens*	SCROPHULARIACEAE		LC	
4.	*Asparagus capensis*	ASPARAGACEAE		LC	
5.	*Atriplex lindleyi* subsp. *inflata*	AMARANTHACEAE		Naturalized exotic	CARA Cat. 3 invader NEMBA Cat. 1b AIP (in Northern Cape)
6.	*Berkheya fruticose*	ASTERACEAE		LC	
7.	*Berkheya* species (no flower)	ASTERACEAE		-	
8.	*Blepharis macra*	ACANTHACEAE		LC	
9.	*Bulbine alooides*	ASPHODELACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
10.	*Bulbine praemorsa*	ASPHODELACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
11.	*Calobota sericea*	FABACEAE		LC	
12.	*Cheiridopsis denticulata*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
13.	*Codon royenii*	BORAGINACEAE		LC	
14.	*Colchicum scabromarginatum*	COLCHICACEAE		LC	
15.	*Colpias mollis*	SCROPHULARIACEAE		LC	
16.	*Conicosia elongata*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
17.	*Crassothonna cylindrica*	ASTERACEAE		LC	
18.	*Crassula namaquensis*	CRASSULACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
19.	*Diascia namaquensis*	SCROPHULARIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
20.	*Didelta spinosa*	ASTERACEAE		LC	
21.	*Diospyros ramulosa*	EBENACEAE		LC	
22.	*Drosanthemum hispidum*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
23.	*Eriocephalus microphyllus*	ASTERACEAE		LC	
24.	*Eriocephalus racemosus*	ASTERACEAE		LC	
25.	*Eriospermum paradoxum*	RUSCACEAE		LC	
26.	*Euclea lancea*	EBEMACEAE		LC	
27.	*Eucomis regia*	HYACINTHACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
28.	*Euphorbia decussata*	EUPHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
29.	*Euphorbia mauritanica*	EUPHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
30.	*Euphorbia rhombifolia*	EUHORBIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
31.	*Euryops* species	ASTERACEAE		-	
32.	*Felicia dubia*	ASTERACEAE		LC	
33.	*Ferraria macrochlamys* subsp. *macrochlamys*	IRIDACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
34.	*Ficus cordata*	MORACEAE		LC	
35.	*Galenia africana*	AIZOACEAE	Protected in terms of	LC	

No.	Species name	FAMILY	Status NFA, NCNCA	SA Red list status (V 2015/1)	Alien & Invader species (AIS)
			schedule 2 of the NCNCA		
36.	*Galium capense* subsp. *namaquense*	RUBIACEAE		LC	
37.	*Gazania lichtensteinii*	ASTERACEAE		LC	
38.	*Grielum humifusum*	NEURADACEAE		LC	
39.	*Gymnodiscus linearifolia*	ASTERACEAE		LC	
40.	*Heliophila laciniata*	BRASSICACEAE		LC	
41.	*Hemimeris racemosa*	SCROPHULARIACEAE		LC	
42.	*Hermannia amoena*	MALVACEAE		LC	
43.	*Hermannia cuneifolia*	MALVACEAE		LC	
44.	*Hermannia disermifolia*	MALVACEAE		LC	
45.	*Hypertelis salsoloides*	MOLLUGINACEAE		LC	
46.	*Jamesbrittenia pedunculosa*	SCROPHULARIACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
47.	*Kissenia capensis*	LOASACEAE		LC	
48.	*Lachenalia carnosa*	HYACINTACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
49.	*Leipoldtia schultzei*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
50.	*Lycium bosciifolium*	SOLANACEAE		LC	
51.	*Lycium cinereum*	SOLANACEAE		LC	
52.	*Massonia depressa*	HYACINTHACEAE		LC	
53.	*Mesembryanthemum barklyi*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
54.	*Mesembryanthemum guerichianum*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
55.	*Mesembryanthemum noctiflorum*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
56.	*Microloma sagittatum*	APOCYNACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
57.	*Montinia caryophyllacea*	MONTINIACEAE		LC	
58.	*Moraea* cf. *fenestralis*	IRIDACEAE	Protected in terms of schedule 2 of the NCNCA	Rare	
59.	*Moraea ciliata*	IRIDACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
60.	*Ornithoglossum vulgare*	COLCHICACEAE		LC	
61.	*Osteospermum moniliferum*	ASTERACEAE		LC	
62.	*Osteospermum oppositifolium*	ASTERACEAE		LC	
63.	*Osteospermum sinuatum*	ASTERACEAE		LC	
64.	*Osteospermum* species	ASTERACEAE		-	
65.	*Othonna retrorsa*	ASTERACEAE		LC	
66.	*Othonna species*	ASTERACEAE		-	
67.	*Oxalis foveolata*	OXALIDACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
68.	*Oxalis inconspicua*	OXALIDACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
69.	*Pelargonium crithmifolium*	GERANIACEAE	Protected in terms of schedule 1 of the NCNCA	LC	
70.	*Pelargonium praemorsum*	GERANIACEAE	Protected in terms of schedule 1 of the NCNCA	LC	
71.	*Portulacaria* cf. *fruticulosa*	DIDIERIACEAE		LC	

No.	Species name	FAMILY	Status NFA, NCNCA	SA Red list status (V 2015/1)	Alien & invader species (AIS)
72.	*Prosopis glandulosa*	FABACEAE			CARA Cat. 2 invader NEMBA Cat. 3 AIP (in Northern Cape)
73.	*Pteronia divaricata*	ASTERACEAE		LC	
74.	*Pteronia* species	ASTERACEAE		-	
75.	*Roepera cordifolia* (=*Zygophyllum cordifolium*)	ZYGOPHYLLACEAE		LC	
76.	*Roepera foetida* (=*Zygophyllum foetidum*)	ZYGOPHYLLACEAE		LC	
77.	*Roepera morgsana* (=*Zygophyllum morgsana*)	ZYGOPHYLLACEAE		LC	
78.	*Roepera* species (=*Zygophyllum* species)	ZYGOPHYLLACEAE		-	
79.	*Ruschia robusta*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
80.	*Ruschia viridifolia*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
81.	*Searsia burchelli*	ANACARDIACEAE		LC	
82.	*Searsia incisa*	ANACARDIACEAE		LC	
83.	*Senecio cf. cardaminifolius*	ASTERACEAE		LC	
84.	*Tetraena retrofracta* (=*Zygophyllum retrofractum*)	ZYGOPHYLLACEAE		LC	
85.	*Tetragonia fruticosa*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	LC	
86.	*Thesium lineatum*	SANTALACEAE		LC	
87.	*Trachyandra cf. karrooica*	ASPODELACEAE		LC	
88.	*Trachyandra falcate*	ASPODELACEAE		LC	
89.	*Tylecodon wallichii*	CRASSULACEAE	Protected in terms of schedule 2 of the NCNCA	LC	

6.10 THREATENED AND PROTECTED PLANT SPECIES

South Africa has become the first country to fully assess the status of its entire flora. Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g. overgrazing, inappropriate fire management etc.), unsustainable harvesting, demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods). South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. As a result a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

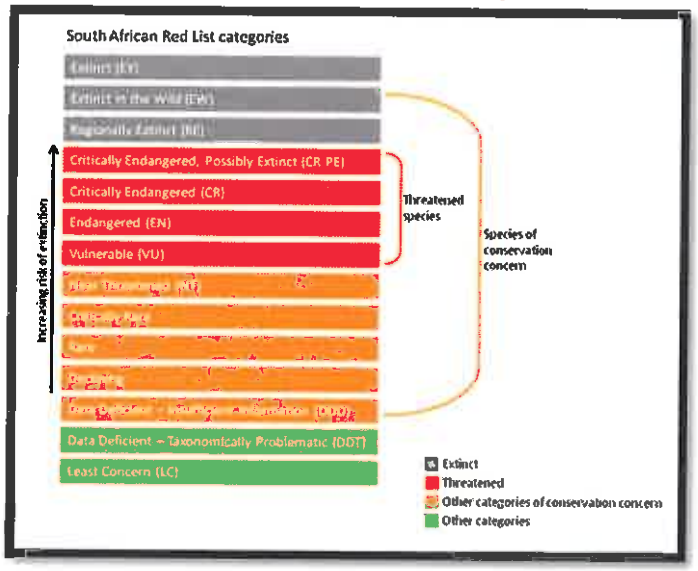
In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "*Lists of critically endangered, endangered, vulnerable and protected species*" (GN. R. 152 of 23 February 2007).
- National Forest Act, Act 84 of 1998, provides for the protection of forests as well as specific tree species through the "*List of protected tree species*" (GN 908 of 21 November 2014).
- Northern Cape Nature Conservation Act, Act of 2009, provides for the protection of "*specially protected species*" (Schedule 1), "*protected species*" (Schedule 2) and "*common indigenous species*" (Schedule 3).

6.10.1 RED LIST OF SOUTH AFRICAN SPECIES

The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2015). The South African red list categories are given in Figure 16.

Figure 16: South African red list categories (SANBI, 2015)



6.10.1.1 *Definitions of the national Red List categories*

Categories marked with ^{N} are non-IUCN, national Red List categories for species not in danger of extinction, but considered of conservation concern (Refer to Table 8). The IUCN equivalent of these categories is Least Concern (LC) (SANBI, 2015).

Table 8: Definitions of the South African national red list categories (SANBI, 2015)

Extinct (EX): A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
Extinct in the Wild (EW): A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
Regionally Extinct (RE): A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
Critically Endangered, Possibly Extinct (CR PE): Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
Critically Endangered (CR): A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
Endangered (EN): A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.

Vulnerable (VU): A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
Near Threatened (NT): A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
"Critically" Rare A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
"Rare: A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows: ➢ Restricted range: Extent of Occurrence (EOO) <500 km2, OR ➢ Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km2, OR ➢ Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR ➢ Small global population: Less than 10 000 mature individuals.
"Declining: A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
Least Concern: A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
Data Deficient - Insufficient Information (DDD): A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Data Deficient - Taxonomically Problematic (DDT): A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
Not Evaluated (NE): A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

6.10.1.2 ***Red listed plant species encountered***

Two species listed in the red list of South African Plants (version 2015.1. Downloaded from Redlist.sanbi.org on 2016/06/01) were encountered (Refer to Table 9).

Table 9: Red data plant species encountered

NO.	SPECIES NAME	REASON FOR LISTING	RECOMENDATIONS
1.	***Aloidendron dichotomum*** (Kokerboom) **Vulnerable**	Climate change models project a 36% decline in range in 100 years, assuming dispersal into newly suitable areas. Patterns of modelled declines have been supported by field and repeat photo studies. However no colonization of newly suitable areas has yet happened. Without dispersal, the models predict a 73% decline in 100 years, qualifying the species as EN.	Avoid and minimise impact on all individuals. Search & rescue if no other option available. Transplant in immediate vicinity.
2.	***Crassula namaquensis***	Please note that one of the subspecies of *Crassula namaquensis*, namely *C. namaquensis* subspecies *comptonii* is classified as rare (restricted distribution). However, that particular subspecies is limited to the Bokkeveld escarpment. It is thus highly unlikely that the plant encountered will be *C. namaquensis* subspecies *comptonii*. Other subspecies are not threatened. The plant encountered is thus not considered threatened.	N/a
3.	***Moraea cf. fenestralis*** **Rare**	A wide-ranging but sparsely distributed species restricted to a specialized micro-habitat where it can be rare or locally common. Population size is difficult to estimate as not all mature individuals flower every year (populations are thought to be stable).	Difficult to identify and thus to protect individually. Protection through topsoil protection.

6.10.2 NEM: BA PROTECTED SPECIES

The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).

- No species protected in terms of NEM: BA was encountered.

6.10.3 NFA PROTECTED SPECIES

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (GN 908 of 21 November 2014).

- No species protected in terms of the NFA was observed within the proposed footprint.

6.10.4 NCNCA PROTECTED SPECIES

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and 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. NB. Please note that all indigenous plant species are protected in terms of Schedule 3 of this act (e.g. any work within a road reserve).

The following species (Refer to Table 10) protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 10: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Aloidendron dichotomum (=Aloe dichotoma)* **Schedule 1 protected**	Very few individuals observed and none within the proposed preferred footprint. Unlikely to be impacted.	Avoid and minimise impact on all individuals. Search & rescue if no other option available. Transplant in immediate vicinity.
2.	*Bulbine alooides* **Schedule 2 protected.**	All species in the family Aspodelaceae protected by default. Single observations.	Search & rescue and further protection through topsoil conservation.
3.	*Bulbine praemorsa* **Schedule 2 protected**	All species in the family Aspodelaceae protected by default. Single observations.	Search & rescue and further protection through topsoil conservation.
4.	*Cheiridopsis denticulata* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally very common.	Species protection through topsoil conservation.
5.	*Conicosia elongata* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally very common.	Species protection through topsoil conservation.
6.	*Crassula namaquensis* **Schedule 2 protected**	All species in the family Crassulaceae protected by default. Plant not common.	Search & rescue and further protection through topsoil conservation.
7.	*Diascia namaquensis* **Schedule 2 protected**	All species in the genus *Diascia* protected by default. Only observed in shady areas within rocky outcrops.	Species protection through topsoil conservation.
8.	*Drosanthemum hispidum* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally very common.	Species protection through topsoil conservation.
9.	*Eucomis regia* **Schedule 2 protected**	All species in the genus *Eucomis* protected by default. Only observed in shady areas within klipkoppe.	Species protection through topsoil conservation.
10.	*Euphorbia decussata* **Schedule 2 protected**	All species in the genus *Euphorbia* protected by default. Relatively common.	Most of larger *Euphorbia* transplant poorly. Species protection through topsoil

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
			conservation.
11.	*Euphorbia mauritanica* **Schedule 2 protected**	All species in the genus *Euphorbia* protected by default. Plant locally very common.	Most of larger Euphorbia transplant poorly. Species protection through topsoil conservation.
12.	*Euphorbia rhombifolia* **Schedule 2 protected**	All species in the genus *Euphorbia* protected by default. Only observed occasionally.	Most of larger Euphorbia transplant poorly. Species protection through topsoil conservation.
13.	*Ferraria macrochlamys subsp. macrochlamys* **Schedule 2 protected**	All species in the family Iridaceae protected by default. Only single observations.	Species protection through topsoil conservation.
14.	*Galenia africana* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally very common.	This is a pioneer species, common in the Namaqualand. Protection through topsoil conservation.
15.	*Jamesbrittenia pedunculosa* **Schedule 2 protected**	All species in the genus *Jamesbrittenia* protected by default. Only observed in shady areas within klipkoppe.	Species protection through topsoil conservation.
16.	*Lachenalia carnosa* **Schedule 2 protected**	All species in the genus *Lachenalia* protected by default. Occasional observations in klipkoppe	Search & rescue when observed. Species protection through topsoil conservation.
17.	*Leipoldtia schultzei* **Schedule 2 protected**	All species in the family *Aizoaceae* protected by default. Locally very common.	Species protection through topsoil conservation.
18.	*Mesembryanthemum barklyi* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Common pioneer species.	Species protection through topsoil conservation.
19.	*Mesembryanthemum guerichianum* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally very common.	Species protection through topsoil conservation.
20.	*Microloma sagittatum* **Schedule 2 protected**	All species in the family Apocynaceae protected by default. Plant locally common.	Species protection through topsoil conservation.
21.	*Moraea* cf. *fenestralis* **Schedule 2 protected**	All species in the family Iridaceae protected by default + Red data species. Only a single observation.	Species protection through topsoil conservation.
22.	*Moraea ciliata* **Schedule 2 protected**	All species in the family Iridaceae protected by default. Only single observations.	Species protection through topsoil conservation.
23.	*Oxalis foveolata* **Schedule 2 protected**	All species in the genus *Oxalis* protected by default. Only single observations.	Species protection through topsoil conservation.
24.	*Oxalis inconspicua* **Schedule 2 protected**	All species in the genus *Oxalis* protected by default. Only single observations.	Species protection through topsoil conservation.
25.	*Pelargonium crithmifolium* **Schedule 1 protected**	All species in the genus *Pelargonium* protected by default. Occasionally observations.	Species protection through topsoil conservation.
26.	*Pelargonium praemorsum* **Schedule 1 protected**	All species in the genus *Pelargonium* protected by default. Occasionally observations.	Species protection through topsoil conservation.
27.	*Ruschia robusta* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally very common.	Species protection through topsoil conservation.
28.	*Ruschia viridifolia* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Occasionally observed	Species protection through topsoil conservation.
29.	*Tetragonia fruticosa* **Schedule 2 protected**	All species in the family Aizoacea protected by default. Plant locally common.	Species protection through topsoil conservation.
30.	*Tylecodon wallichii* **Schedule 2 protected**	All species in the family Crassulaceae protected by default. Occasional.	Search & rescue and further protection through topsoil conservation.

6.11 CRITICAL BIODIVERSITY AREAS

The Namakwa District Biodiversity Sector Plan (NDBSP) with its associated Terrestrial Critical Biodiversity Areas (CBA's) maps was created with three main land-use planning and decision-making avenues in mind:

1) Reactive decision-making, such as environmental impact assessment (EIA) agricultural land-use decisions, water-use licensing and other development control decisions through the Land Use Planning Ordinance (LUPO) or other land-use legislation,
2) Proactive forward planning, such as Integrated Development Plans (IDP's), Spatial Development Frameworks (SDF's) & Zoning Schemes, and
3) Proactive conservation, such as stewardship, land acquisition & easements.

The importance of these functions is described within the NDBSP (2008) Sector plan as follows:

Terrestrial (or land) ecosystems provide valuable ecosystem services that contribute to human well-being. For example they can provide:

- buffers against natural hazards such as fire and floods
- carbon sequestration (storage), important for reducing the impacts of climate change
- regulation of water supply grazing for wild animals and livestock
- natural spaces for recreation &tourism
- the air we breathe
- spiritual, ritual and ceremonies
- horticultural & wild flower industries
- natural heritage
- food, fibre and medicinal plants

Rivers are central to human welfare and economic development. They provide:

- water for agricultural, industrial and domestic uses
- flood attenuation and regulation
- food and medicinal plants
- transport and/or purification of biodegradable wastes
- tourism, recreational and cultural use
- enhanced property values

Ecological corridors provide valuable ecosystem services that are often impossible or very costly to replicate or offset. For example they:

- Support the migration (movement) and long-term survival of plant and animal species and their ecological processes (e.g. fire, pollination, seed dispersal), in response to global climate change.
- Are important areas for storing carbon to reduce the impacts of global climate change.
- are important areas for regulating water supply (e.g. filtering and storing drinking water, keeping excess nutrients out of wetlands and rivers, ensuring a high water yield from mountain catchments).
- Supply good quality water from mountain catchment areas, both surface and groundwater.
- The supply of water quality and quantity is not only for human consumption but for ensuring the survival of downstream estuaries, wetlands (vleis) and streams (which in turn provide us with other ecosystem services).
- Are of important scenic value, contributing to tourism and the 'sense of place'.

6.11.1 BIODIVERSITY CATEGORIES FOR LAND-USE PLANNING

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans. The use of CBA's in the NDM follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008):

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.
- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

From a land-use planning perspective it is useful to think of the difference between CBA's and ESA's in terms of where in the landscape the biodiversity impact of any land-use activity action is most significant:

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).
- For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

The table underneath gives the framework for linking spatial planning categories (CBA's) to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives (as used within the NDM, 2008).

Table 11: Linking CBA categories to land management objectives within the Namaqualand District Municipality

CBA CATEGORY	LAND MANAGEMENT OBJECTIVE
PA & CBA 1	*Natural landscapes*: • Ecosystems and species fully intact and undisturbed • These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. • These are landscape that are at or past their limits of acceptable change

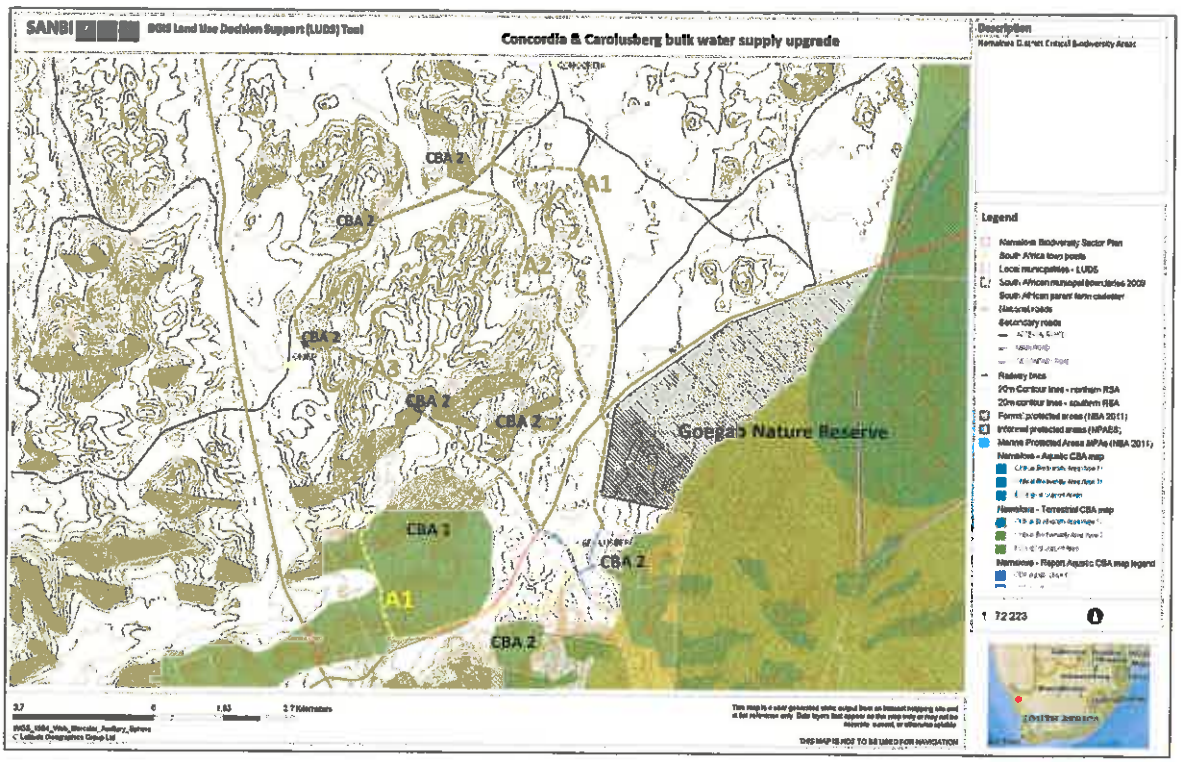
CBA CATEGORY	LAND MANAGEMENT OBJECTIVE
CBA 2	*Near-natural landscapes*: • Ecosystems and species largely intact and undisturbed. • Areas with intermediate irreplaceability or some flexibility in terms of area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising our ability to achieve targets. • These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESA)	*Functional landscapes*: • Ecosystems moderately to significantly disturb but still able to maintain basic functionality. • Individual species or other biodiversity indicators may be severely disturbed or reduced. • These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA and Transformed	*Production landscapes*: • Manage land to optimize sustainable utilization of natural.

* **PA** = Protected Areas, **ESA** = Ecological Support Area, **ONA** = Other Natural Areas

6.11.2 CRITICAL BIODIVERSITY AREAS ENCOUNTERED

Figure 17 shows the various route options for both the Concordia refurbishment (red dotted line) and 4 possible alternative route options for the Carolusberg pipeline, overlaid onto the terrestrial Critical Biodiversity Areas (CBA) map for the Namaqualand District Municipality.

Figure 17: SANBI BGIS. NDM critical biodiversity areas map showing the CBA's for the area impacted by the proposed project



According to Figure 17 the proposed project (and alternatives) may impact on the following critical biodiversity areas (CBA's):

- The Concordia pipeline (the red dotted line) replacement, will pass near three (3) terrestrial CBA 2 areas, but will not impact on them directly. Near Okiep it appears as if the pipeline starts within the CBA, but this is not the case (urban area). The new pipeline will be located south of the existing pipeline, and will thus be further away from the CBA's than the existing pipeline.

- The Carolusberg preferred option (blue dotted line in Figure 17) will not impact on any terrestrial or aquatic CBA and will follow an existing road reserve for most of its way.
- The Carolusberg alternative A2 (green dotted line in Figure 17) will not cross any CBA, but will be located within natural vegetation for almost its entire length.
- The Carolusberg alternative A3 (purple dotted line in Figure 17), which is also the existing line, impacts on at least one terrestrial CBA 2.
- The Carolusberg alternative A4 (yellow dotted line in Figure 17) will cross right through the centre of a CBA 1 area (classified as an expert critical terrestrial area).

Purely in terms of impact on CBA areas and remaining natural vegetation:

- The proposed Concordia option will have no additional impact (staying within the existing footprint and not impacting directly onto any CBA site).
- The Carolusberg A4 option will be the least desirable (biggest impact on CBA areas) option.
- The Carolusberg A3 (existing pipeline route) will be the second least desirable option.
- Both the Carolusberg A1 & A2 options should be viable, but A2 will have a much larger impact on remaining natural veld.

6.12 INVASIVE ALIEN PLANTS

Alien and invasive plant (AIP) species were introduced into South Africa more than 1 000 years ago *via* trading routes from other countries in southern Africa (Alberts & Moolman, 2013). Since the arrival of settlers from Europe these numbers have increased dramatically. At present, AIPs are encountered on large portions of land in South Africa (10 million hectares) and it is reportedly consuming nearly 330 million cubic meters of water annually, or 7% of the annual run-off. But what is really scary is that this water consumption levels are increasing rapidly and could reach 50% of the mean annual run-off in the not too distant future (Alberts & Moolman, 2013). The aggressive behaviour of the AIPs in their unnatural habitat is a direct threat to the vast wealth of biodiversity in South Africa. South Africa is a relatively small country that comprises only 2% of the total surface of the Earth, but it contains 10% of the plant species, 7% of the vertebrates, and is home to three biodiversity hotspots.

In South Africa, there are currently three pieces of national legislation that relate to the control of Alien and Invasive Species (AIS) namely:

- Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), administered by the Department of Agriculture, forestry and Fisheries.
- List of weeds and invader plants declared in terms of Regulations 15 and 16 (as Amended, March 2001) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) administered by the Department of Agriculture, Forestry and Fisheries (DAFF);

- Alien and invasive species list 2016 (GN R. 864 of 29 July 2016) promulgated in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management, Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), administered by the Department of Environmental Affairs (DEA).

6.12.1 FERTILIZER, FARM FEEDS, AGRICULTURAL REMEDIES AND STOCK REMEDIES ACT

According to Government Notice No. 13424 dated 26 July 1992, it is an offence to "acquire, dispose, sell or use an agricultural or stock remedy for a purpose or in a manner other than that specified on the label on a container thereof or on such a container".

Contractors using herbicides need to have a valid Pest Control Operators License (limited weeds controller) according to the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947).

6.12.2 CONSERVATION OF AGRICULTURAL RESOURCES ACT

The **CARA** sets out the regulations (amended March 2001) regarding the control of weeds and invasive plants and provides a list of declared plants. The amended regulations make provision for four groups of invader plants. The first three groups consist of undesirable alien plants and are covered by Regulation 15, namely:

- **Category 1** declared weeds (Section 15A of the amended act) are prohibited plants that will no longer be tolerated on land or on water surfaces, neither in rural or urban areas. These plants may no longer be planted or propagated, and all trade in their seeds, cuttings or other propagative material is prohibited. Plants included in this category because their harmfulness outweighs any useful properties or purpose they may have.
- **Category 2** declared plant invaders (Section 15B of the amended act) are plants with a proven potential of becoming invasive, but which nevertheless have certain beneficial properties that warrant their continued presence in certain circumstances. May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- **Category 3** declared plant invaders (Section 15C of the amended act) are undesirable because they have the proven potential of becoming invasive, but most of them are nevertheless popular ornamentals or shade trees that will take a long time to replace. May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, provided they are not within 30 metres of the 1:50 year flood line of a river, stream, lake or other type of inland water body. The "executive officer" can impose further conditions on Category 3 plants already in existence, which might include removing them if the situation demands it.
- **Bush encroachers**, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

Refer to Table 7 for listed weeds and invader species encountered in terms of CARA.

6.12.3 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT

NEMBA aims to provide the framework, norms, and standards for the conservation, sustainable use, and equitable benefit-sharing of South Africa's biological resources. The purpose of NEMBA as it relates to Alien and Invasive Species (AIS) is to prevent the unauthorised introduction and spread of such species to ecosystems and habitats where they do not naturally occur; manage and control such species to prevent or minimise harm to the environment and to biodiversity in particular; and to eradicate alien invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. The Regulations on Alien and Invasive Species, referred to as the **"AIS Regulations"** combine invasive species already listed in the CARA, with two new lists relating to invasive species and prohibited species.

The AIS Regulations list 4 different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa, namely:

- **Category 1a:** invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. These species need to be controlled on your property, and officials from the Department of Environmental Affairs must be allowed access to monitor or assist with control.
- **Category 1b**: invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management programme.
- **Category 2**: These are invasive species that can remain in your garden, but only with a permit, which is granted under very few circumstances.
- **Category 3:** These are invasive species that can remain in your garden. However, you cannot propagate or sell these species and must control them in your garden. In riparian zones or wetlands all Category 3 plants become Category 1b plants.

Refer to Table 7 for listed alien and invasive species encountered in terms of NEM: BA.

6.12.4 NORTHERN CAPE NATURE CONSERVATION ACT

Although provinces have a mandate to implement and enforce national legislation (such as CARA or NEM:BA), provincial authorities can also add further to legislation in the form of provincial ordinances, whereby each province can further prohibit certain species should the authorities feel that a species poses a potential risk or threat to the province's ecosystems or biodiversity.

In the Northern Cape Schedule 6 of the Northern Cape Nature Conservation Act, Act 9 of 2009 list additional invasive species that must be controlled. Schedule 6 list includes all species listed as weeds in CARA as well as an additional 36 species (none of which has been observed during this study).

Refer to Table 7 for listed invasive species encountered in terms of NCNCA. *Please note that all species categorized as Category 1 plants in terms of CARA are automatically listed in terms of the NCNCA (Refer to Table 7).*

6.12.5 ALIEN AND INVASIVE PLANTS ENCOUNTERED

Only two alien plant species was observed within the proposed footprint area (Refer to Table 12). What is especially noteworthy is the fact that they were very low in numbers (especially since this area is and has been grazed by goats over a long period of time). Of these the most concerning is the presence of the *Prosopis* tree, especially if found near to any water course (or resource).

Table 12: List of alien and invasive species encountered within the larger footprint

SPECIES	CARA	NEM: BA	NCNCA	MANAGEMENT RECOMMENDATIONS
Atriplex lindleyi subsp. *inflata*	Cat.3	Cat 1b:	All species listed in terms of CARA	Remove all individuals encountered within construction footprint.
Prosopis glandulosa	Cat. 2	Cat 3 (NC), becomes 1b in riparian zones	All species listed in terms of CARA	Remove all individuals encountered within construction footprint.

There are various means of managing alien and invasive plant species, which can include mechanical-, chemical- and biological control methods or a combination of these. The control methods given below are based on the guideline used by the Working for Water Programme (Bold, 2007) and or the CapeNature alien control guideline (Martens *et. al.*, 2003).

6.12.5.1 *Prosopis grandulosa control methods*

Large trees: Control of larger trees can be done by two methods:

- **Mechanical removal**: Control is difficult because plants damaged by inadequate removal, will re-sprout from dormant buds just below ground level, resulting in dense stands of multi-stemmed shrub, which may become even more difficult to remove. Mechanical removal must be accompanied by root-removal/rip (taking the roots out with the plant). Follow-up work is likely to be required.
- **Cut stump**: Large trees can be cut just above ground level, but this must be accompanied by the application of a suitable herbicide immediately after the cut was made in order for the herbicide to be effective. Herbicides recommended include: Confront 360 SL (40 ml / litre water + wetter + dye) or Garlon 480 EC (40 ml / litre of water + wetter + dye).


Photo 9: Atriplex lindleyi

Re-sprout can be controlled by foliar spray, using (Confront 360 SL: 15 ml / litre of water + wetter + dye).

Saplings can be controlled by hand-pull, making sure the roots are also removed.

6.12.5.2 ***Atriplex control methods***

Mechanical removal or hand-pull of the whole plant.

6.13 FAUNA

The winter rains in Namaqualand once attracted vast annual migration herds of grazers and browsers from the interior of the country, but these free-roaming herds of springbok, hartebeest, wildebeest, eland, and zebra are now restricted to the more sparsely populated parts of Botswana, game farms and reserves. The Namaqualand resident mammal fauna comprises mostly smaller species, including a dozen species of rats, mice, gerbils and other rodents (Manning, 2008). Endemism rates for invertebrates are high, and many unique and remarkable adaptive insects can be found in this region, including the scorpion, of which 22 are already known to be endemic to the Namakwa District Municipality (NDBSP, 2008). Of importance in some areas of the Namaqualand are the "heuweltjies", raised mounds of calcium-rich soil, thought to have been created by termites, often supporting distinctive plant communities. (www.plantzafrica.com). As with insects, there is an abundance of reptiles and snakes in the region, many of which are near endemic (including the Namaqua dwarf adder, which is the smallest of Africa's adders, measuring between 20-25 cm), as well as a few unique frogs such as the endemic rain frog, the marbled rubber frog and the paradise toad (NDBSP, 2008).

According to the Namakwa District Biodiversity Sector Plan (2008) the nearby Goegap Nature Reserve, is home to 45 mammals, 25 reptiles, 3 amphibians as well as an interesting array of plant life. Mammal species include gemsbok, springbok, Hartman's zebra, bat eared foxes and aardwolf. The larger footprint for the proposed pipeline is very likely to include a number of smaller mammal species, like hare, rats, mice and gerbils and possibly klipspringer, steenbok, fox, porcupine, caracal and rock dassie. There is also expected to be an abundance of reptiles and snakes, especially in the rocky parts of the area (lots of hiding places).

However, the nature of the proposed development is not expected to pose any significant threat to any of these fauna species, especially since the pipeline will be placed above ground in the rocky sections (the rocky sections expecting to house the majority of resident fauna). The construction period will also be short term and it is expected that most resident mammal and reptile species will just avoid the construction area, during the construction period.

6.14 AVIFAUNA

In common with other desert areas, the avifauna (birdlife) of Namaqualand is dominated by ground-living species like larks, chats, sandgrouse, korhaans and bustards. Although naturally sparse, many of these birds are very interesting in particular in their adaption to the extreme ecological conditions associated with the Succulent Karoo (Manning, 2008). According to the Namaqualand District Biodiversity Sector Plan (2008), the nearby Goegap Reserve host up to 94 bird species. Typical species that can be expected in the Namaqualand includes the common Ostrich, White Pelican, Greater Flamingo, Blackheaded Heron, Southern Black Korhaan, Cape Spurfowl, African Sacred Ibis, South African Shelduck, Pied Crow, Blacksmith Lapwing, Namaqua Sandgrouse, Jackal Buzzard, Southern Pal Chanting Goshawk, Rock Kestrel, Bokmakierie, Pale-winged Starling, White-backed Mousebird, Namaqua Dove, Ant –eating Chat, Cape Weaver, Cape Sparrow, Yellow Canary, Malachite Sunbird and the Southern Double-collared Sunbird.

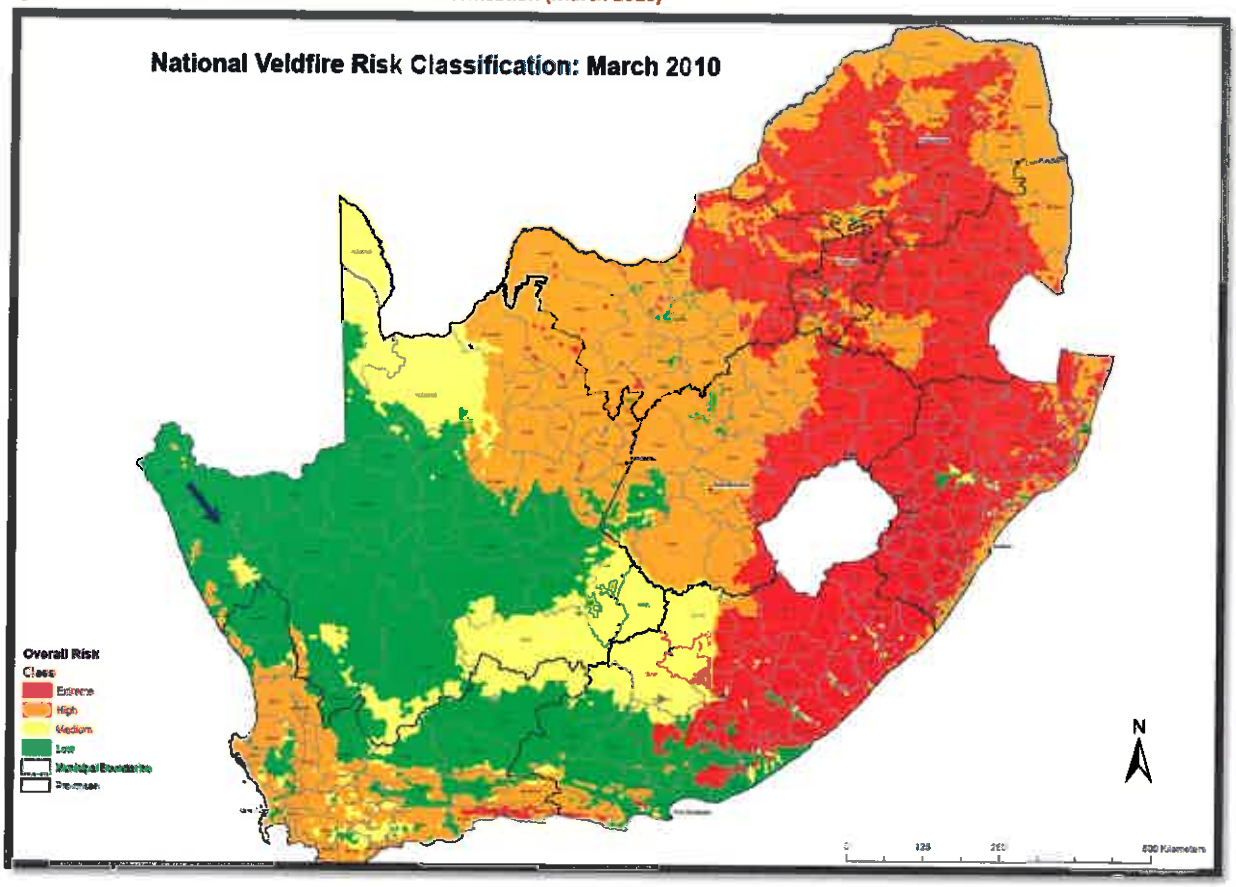
The nature of the proposed construction is such that it might disturb a small number of resident ground living species, but it should not pose any significant impact on any species. Any disturbance will be short term (months) and it is expected that bird species, like small mammals, will just avoid the construction area during the construction period.

6.15 VELD FIRE RISK

The revised veldfire risk classification (Forsyth, 2010) in terms of the National Veld and Forest Fire Act 101 of 1998 was promulgated in 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.

The proposed pipeline upgrade is located in an area supporting low shrubland for the majority of the route which has been classified with a **low fire risk classification** (Refer to Figure 18). It is thus 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.

Figure 18: South African National Veldfire Risk Classification (March 2010)



7. IMPACT ASSESSMENT METHOD

The concept of environmental impact assessment in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA) and the Environmental Impact Assessment (EIA) was developed to identify and evaluate the nature of potential impact in order to determine whether an activity is likely to cause significant environmental impact on the environment. The concept of significance is at the core of impact identification, evaluation and decision making, but despite this the concept of significance and the method used for determining significance remains largely undefined and open to interpretation (DEAT, 2002).

7.1 DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria.

Significance = Conservation Value x (Likelihood + Duration + Extent + Severity) (Edwards 2011)

7.1.1 CRITERIA USED

Conservation value: Conservation value refers to the intrinsic value of an attribute (e.g. an ecosystem, a vegetation type, a natural feature or a species) or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species (Refer to Table 13 for categories used).

Table 13: Categories used for evaluating conservation status

CONSERVATION VALUE	
Low (1)	The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
Medium/low (2)	The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
Medium (3)	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
Medium/High (4)	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
High (5)	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.

Likelihood refers to the probability of the specific impact occurring as a result of the proposed activity (Refer to Table 14, for categories used).

Table 14: Categories used for evaluating likelihood

LIKELIHOOD	
Highly Unlikely (1)	Under normal circumstances it is almost certain that the impact will not occur.
Unlikely (2)	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.
Possible (3)	The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur.
Probable (4)	It is very likely that the impact will occur under normal circumstances.
Certain (5)	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.

Duration refers to the length in time during which the activity is expected to impact on the environment (Refer to Table 15).

Table 15: Categories used for evaluating duration

DURATION	
Short (1)	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).
Medium/short (2)	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).
Medium (3)	Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require ongoing mitigation. Rehabilitation time is expected to be longer (5-15 years).
Long (4)	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require ongoing mitigation. Rehabilitation time is expected to be longer (15-50 years).
Permanent (5)	The impact is expected to be permanent.

Extent refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur (Refer to Table 16).

Table 16: Categories used for evaluating extent

EXTENT	
Site (1)	Under normal circumstances the impact will be contained within the construction footprint.
Property (2)	Under normal circumstances the impact might extent outside of the construction site (e.g. within a 2 km radius), but will not affect surrounding properties.
Surrounding properties (3)	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).
Regional (4)	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.
Provincial (5)	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).

Severity refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur (Refer to Table 17).

Table 17: Categories used for evaluating severity

SEVERITY	
Low (1)	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.
Medium/low (2)	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium (3)	It is expected that he impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium/high (4)	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.
High (5)	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

7.2 SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal in order to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. In order to do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact and evaluate the significance of that impact should it occur.

Potential significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 18. Mitigation options are evaluated and comparison is then made (using the same method) of potential significance before mitigation and potential significance after mitigation (to advise the EAP).

Table 18: Categories used to describe significance rating (adjusted from DEAT, 2002)

SIGNIFICANCE	DESCRIPTION
Insignificant or Positive (4-22)	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or the impact may be positive.
Low (23-36)	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium Low (37-45)	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Social, cultural and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. Social, cultural and economic activities of communities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long term effect on the social and/or natural environment, within site boundary.
Medium high (56-63)	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. Social, cultural and economic activities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long-term effect on the social and/or natural environment, beyond site boundary within local area.
High (64-79)	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. Social, cultural and economic activities of communities are disrupted and may come to a halt. These impacts will usually result in long-term change to the social and/or natural environment, beyond site boundaries, regional or widespread.
Unacceptable (80-100)	An impact of the highest order possible. There is no possible mitigation that could offset the impact. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. The impact will result in permanent change. Very often these impacts are un-mitigatable and usually result in very severe effects, beyond site boundaries, national or international.

8. BIODIVERSITY ASSESSMENT

The towns of Concordia and Carolusberg are supplied with freshwater from the Namaqualand Regional Water Supply Scheme (NRWSS), managed by Sedibeng Water. The pipelines supplying these towns have been in use well over its design period (subject to continual failings) and needs to be replaced as a matter of urgency. They also do not have the long term capacity to service these towns. Sedibeng Water Board considers the upgrade of the Concordia and Carolusberg bulk water supply lines as their next highest priority infrastructure upgrade (after replacement of the main line from Henkries to Okiep).

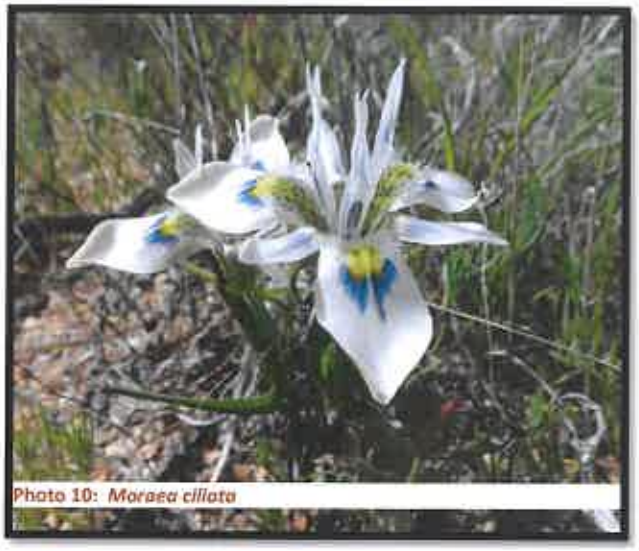


Photo 10: *Moraea ciliata*

Photo 11: *Lachenalia carnosa*

It is thus very important to note that the "No-Go Alternative" will not result in a *status quo* or no impact. It will only mean that the capacity of the two pipelines cannot be expanded. It is very likely that both these pipelines will have to be replaced in any case, as part of maintenance as a result of the many failures. This will mean that the pipeline will be replaced as emergency repairs or in sections over a period time, without any environmental control, which might result in a much higher overall environmental impact over which there will be very little control.

Photo 12: *Ornithoglossum vulgare*

8.1 CONCORDIA PIPELINE: IMPACT EVALUATION

Table 19 rates the significance of environmental impacts associated with the preferred Concordia pipeline (replacement of original within the original footprint). It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

Table 19: Significant rating of impacts associated with the Concordia Pipeline (including the No-Go option)

ASPECT	POSSIBLE IMPACT	Without mitigation						With mitigation					SHORT DISCUSSION
		CV	Lik.	Dur.	Ext.	Sev.		CV	Lik.	Dur.	Ext.	Sev.	
Potential Impact on the Biophysical Environment													
Geology & soils	Degradation of special habitats.	2	2	1	1	1	10	2	1	1	1	1	8	No special features encountered (e.g. true quartz patches). The impact on geology and soils is expected to be very low.
Landuse and cover.	Disruption of social, cultural or economic activities of the land user.	2	2	1	1	2	12	2	1	1	1	1	8	The proposed activity will cross historical agricultural land, but the impact is expected to be temporary and very low.
Potential impact on threatened and/or protected ecosystems													
Vegetation type	Loss of Vegetation and associated habitat.	2	2	2	1	2	14	2	3	1	1	1	12	Aboveground placement in rocky hills will minimise disturbance, while footprint in sandy sections mostly within already disturbed areas (original construction footprint).
Connectivity	Loss of migration options (e.g. seed & pollinators) as a result of habitat fragmentation.	2	2	2	1	1	12	2	2	1	1	1	10	Short term temporary impact.
Conservation priority areas	Loss of conservation priority areas impacting on local or national conservation targets.	2	1	1	1	1	8	2	1	1	1	1	8	Concordia route does not impact on and CBA or ESA.
Watercourse and wetlands	Loss of ecosystem function.	2	3	2	1	2	16	2	1	2	1	1	10	Temporary impact on small ephemeral drainage lines.

ASPECT	POSSIBLE IMPACT	Without mitigation					With mitigation					SHORT DISCUSSION
		CV	Lik.	Dur.	Ext.	Sev.	CV	Lik.	Dur.	Ext.	Sev.	
Flora	Loss of threatened or protected species.	3	4	2	1	2	3	1	2	1	1	Red listed species not encountered along this route, but a number of NCNCA protected species will be impacted.
		27					15					
Fauna	Disturbance to species or loss of threatened or protected species.	1	2	2	1	1	1	1	2	1	1	Highly unlikely that any significant permanent impact will result on any single species.
		6					5					
Avi-fauna	Disturbance to species or loss of threatened or protected species.	1	2	2	1	1	1	1	2	1	1	Highly unlikely that any significant permanent impact will result on any single species.
		6					5					
Invasive alien species	Aggravation of infestation as a result of poor management practices.	1	2	2	1	2	1	1	2	1	1	Very low infestation rates observed. Correct removal will result in positive impact.
		7					5					
Veld fire	Loss of fauna & flora as a result of poor fire cycle management.	2	3	3	3	2	2	1	2	1	1	Veld fire risk is considered low, but EMP must control construction activities.
		22					10					
Potential accumulated impact												
Concordia pipeline	Total predicted impact as a result of the proposed activity.	3	4	3	3	2	3	3	2	1	2	Construction within the same footprint, mostly disturbed veld and aboveground placement. Single ephemeral drainage lines will be impacted.
		36					24					
Impacts associated with the "NO-GO" option												
No-Go alternative	Continual maintenance and repair without Environmental control.	2	4	2	1	3	2	4	1	1	1	Continual maintenance and repair without Environmental control.
		20					14					

From the above it is clear that even without mitigation the proposed Concordia replacement pipeline is not considered to pose any significant threat on local or national conservation targets. It is likely to have some impact on protected species, but with mitigation this can be much reduced. This is based mainly on the facts that the pipeline will be placed mainly within its original footprint and above ground in the more sensitive rocky hills areas (lessening the footprint and construction impact significantly).

8.2 CAROLUSBERG PIPELINE: IMPACT EVALUATION

Table 20 rates the significance of environmental impacts associated with the preferred Carolusberg pipeline. It also evaluates the expected accumulative effect of the proposed development on the various alternatives as well as the No-Go option.

Table 20: Significant rating of impacts associated with the Carolusberg Pipeline (Including alternatives and the No-Go option)

ASPECT	POSSIBLE IMPACT	Without mitigation						With mitigation					SHORT DISCUSSION
		CV	Lik.	Dur.	Ext.	Sev.		CV	Lik.	Dur.	Ext.	Sev.	
Potential Impact on the Biophysical Environment													
Geology & soils	Degradation of special habitats.	2	2	2	1	1	12	2	1	2	1	1	10	No special features encountered (e.g. true quartz patches). The impact on geology and soils is expected to be very low.
Landuse and cover.	Disruption of social, cultural or economic activities of the land user.	2	2	2	1	1	12	2	1	2	1	1	10	The pipeline will cross near to existing mining activities and natural veld, but should have little (if any) impact on its normal functioning.
Potential impact on threatened and/or protected ecosystems													
Vegetation type	Loss of Vegetation and associated habitat.	2	2	2	1	2	14	2	1	2	1	1	10	Aboveground placement in rocky hills will minimise disturbance, while footprint in sandy sections mostly within already disturbed areas (original construction footprint).
Connectivity	Loss of migration options (e.g. seed & pollinators) as a result of habitat fragmentation.	2	2	2	1	1	12	2	1	2	1	1	10	Short term temporary impact.
Conservation priority areas	Loss of conservation priority areas impacting on local or national conservation targets.	2	1	2	1	1	10	2	1	2	1	1	10	Concordia route does not impact on and CBA or ESA.
Watercourse and wetlands	Loss of ecosystem function.	4	4	2	1	2	36	4	2	2	1	2	28	Temporary impact on small ephemeral drainage lines and streams.

ASPECT	POSSIBLE IMPACT	Without mitigation					With mitigation					SHORT DISCUSSION
		CV	Lik.	Dur.	Ext.	Sev.	CV	Lik.	Dur.	Ext.	Sev.	
Flora	Loss of threatened or protected species.	4	4	2	1	3	4	3	2	1	2	Red listed species not encountered along this route, but a number of NCNCA protected species will be impacted.
		40					32					
Fauna	Disturbance to species or loss of threatened or protected species.	1	2	2	1	1	1	1	2	1	1	Highly unlikely that any significant permanent impact will result on any single species.
		6					5					
Avi-fauna	Disturbance to species or loss of threatened or protected species.	2	2	2	1	1	1	1	2	1	1	Highly unlikely that any significant permanent impact will result on any single species.
		12					5					
Invasive alien species	Aggravation of infestation as a result of poor management practices.	1	2	2	1	2	1	1	2	1	1	Very low infestation rates observed. Correct removal will result in positive impact.
		7					5					
Veld fire	Loss of fauna & flora as a result of poor fire cycle management.	2	3	3	3	2	2	1	2	1	2	Veld fire risk is considered low, but EMP must control construction activities.
		22					12					
Potential accumulated impact												
Carolusberg A1 (Preferred Option)	Total predicted impact as a result of the proposed activity.	3	4	2	2	3	3	2	2	1	2	Construction mostly within road reserve and aboveground placement in klipkoppe. A number of small seasonal streams will be impacted.
		33					21					
Carolusberg A2	Total predicted impact as a result of the proposed activity.	3	4	2	2	4	3	2	2	2	2	Construction mostly within road reserve and aboveground placement in klipkoppe. A number of small seasonal streams will be impacted.
		36					24					
Carolusberg A3	Total predicted impact as a result of the proposed activity.	4	4	3	2	4	4	3	2	2	3	Pipeline will be subject to constant maintenance and is located in a relative sensitive area, mainly within in the Klipkoppe vegetation of good condition.
		52					40					
Carolusberg A4	Total predicted impact as a result of the proposed activity.	5	4	3	2	4	5	3	2	2	3	Placed almost totally within a CBA area, in veld which is mostly still in relatively good condition.
		65					50					

ASPECT	POSSIBLE IMPACT	Without mitigation					With mitigation					SHORT DISCUSSION
		CV	Lik.	Dur.	Ext.	Sev.	CV	Lik.	Dur.	Ext.	Sev.	
Impacts associated with the "NO-GO" option												
No-Go alternative	Continual maintenance and repair without Environmental control.	4	4	2	3	4	4	3	2	2	2	Pipeline will be subject to constant maintenance and is located in a relative sensitive area, mainly within in the Klipkoppe vegetation of good condition.
		52					36					

From the above it is clear that the preferred route option is regarded as the option with the least environmental impact because of the following:

- It will be located mostly within a road reserve (although the road reserve in this case still supports indigenous vegetation in good condition);
- The route only crosses a short section of natural veld outside of the road reserve and in this section the pipeline will be placed above ground for the most part (minimising construction footprint and physical disturbance).

Alternative A2 is the option with the second least expected environmental impact, but will cross large sections of klipkoppe veld in excellent condition.

Alternative A3 (Existing route) is the option with the second largest expected environmental impact, because it crosses mostly klipkoppe veld in good condition, but difficult to access and it also cross a critical biodiversity area.

Alternative A4 will be located mostly within a CBA area and is therefore regarded as the least desirable option.

The NO-GO option is also not expected to result in quite significant environmental impact, because it is located in remaining natural veld in good condition, it cross a CBA and because maintenance will be done without environmental oversight, which might result in an even higher cumulative impact over time.

9. RECOMMENDATIONS

Having evaluated and discussed the various biodiversity aspects associated with the project it is clear that the most significant impacts are expected to be associated with the impacts (even temporary) on:

- ecological sensitive areas (e.g. river system & CBA's) and;
- protected plant species.

However, the preferred options for both Concordia (within the same footprint) and Carolusberg (Alternative A1) are likely to result in the least environmental impact. The fact that the pipeline will be placed above ground in the rocky sections will reduce the impact on vegetation and indigenous species significantly as a result of the much reduced construction footprint and the fact that very little of the area will be physically impacted. Rehabilitation of all aboveground features of the outdated pipeline infrastructure should, however, be non-negotiable.

However, with appropriate mitigation it is considered highly unlikely that the proposed project will contribute significantly to any of the following:

- Significant loss of vegetation and associated habitat in terms of local or national conservation targets;
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to development and operational activities;
- Loss of local biodiversity and threatened plant species;
- Loss of ecosystem connectivity (e.g. corridor function).

Lastly it is felt that good environmental planning and control during construction, the appointment of a suitably qualified ECO and the implementation of an approved EMP, could significantly reduce environmental impact.

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.

10. IMPACT MINIMIZATION

There are numerous possibilities for mitigation measures to lessen the direct impact of the pipeline construction along both routes. The construction areas should be clearly demarcated and should aim for the absolute minimum disturbance footprint. Only existing access routes should be used where-ever possible.

10.1 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 pertaining to other specialist studies and requirements of the DENC or DAFF.
- All access to the klipkoppe areas must be approved by the ECO during construction, aiming at minimum disturbance.
- Access should be limited to existing routes and any additional temporary access routes must be approved by the ECO and rehabilitated on completion.

10.2 LEGISLATION

- An application must be made to DENC for a flora permit in terms of the NCNCA with regards to search and rescue and other impacts on species protected in terms of Schedule 1 and 2 of the act.
- An application for a Department of Water Affairs authorization might be applicable with regards to the location of the new Carolusberg pipeline route.

10.3 SITE SPECIFIC MITIGATION

- Before any work is done the route must be clearly demarcated (with the aim at minimal width/smallest footprint). The demarcation must include the total footprint necessary to execute the work, but must aim at minimum disturbance.
- All significant biodiversity features must be identified and mapped on the site plans. This includes all areas falling within Ecological support areas, Critical Biodiversity Areas (CBA1 & CBA2) as well as any river crossing. Special care must be taken when working in any of these areas, which include that a suitably experienced ECO or Botanist must first walk the route in these areas to establish whether any significant features will be irreversibly impacted by the proposed activity.

- Before construction the footprint must be scanned by a botanist or suitably qualified ECO in order to identify plants of significance. The Botanist must advise on the best way to minimise the impact (e.g. through Search & Rescue) on such plants taking the following into account:
    - All *Aloe* (Alwyn), *Aloidendron dichotomum* (Kokerboom), *Bulbine*, *Crassula* and *Cotyledon* species encountered must be transplanted directly off the construction footprint wherever encountered.
    - A watering program must be implemented for transplanted plants.
    - All efforts must be made to protect all mature indigenous trees that might be encountered.

- In areas where the pipeline will be placed underground topsoil (the tope 15 – 20 cm of soil) must be removed and protected to be re-used during the rehabilitation after construction (the purpose being to re-use as much of the seed and bulb stock within the topsoil layer for re-establishing these species in the disturbed areas).
- All watercourses and stream must be classified as significant environmental features. When working within or near any watercourse:
    - The impact on the riparian corridor must be minimised through footprint minimisation.
    - River or stream function must be restored as part of rehabilitation.
    - River crossing should be done during low flow (dry season) wherever possible.
    - River crossings should be diagonally to the river banks (the shortest route possible).
    - Adequate measures must be implemented to ensure against erosion.

- Lay-down areas or construction sites must be located within already disturbed areas or areas of low ecological value and must be pre-approved by the ECO.
- Indiscriminate clearing of areas must be avoided.
- All alien vegetation must be removed from within the construction footprint (the road reserve) and immediate surroundings (especially river corridors).
    - It is imperative that the correct alien eradication methods are employed (especially with regards to *Prosopis* control) as incorrect methods **WILL** aggravate the infestation (Please refer to Paragraph 6.12.5).
    - Follow up work must be carried out after rehabilitation to ensure that no invasive alien plant re-establishes itself.

- All construction areas must be suitably rehabilitated on completion of the project.
    - This includes the removal of all excavated material, spoil and rocks, all construction related material and all waste material.
    - It also included replacing the topsoil back on top of the excavation as well as shaping the area to represent the original shape of the environment.

- All absolute aboveground infrastructure associated with the original pipeline must be removed.
- Not removing the old underground pipeline (especially within the rocky sections) should reduce the direct impact and footprint significantly, but any aboveground remains from the original pipeline should be removed.

- An integrated waste management approach must be implemented during construction.
  - Construction related general and hazardous waste may only be disposed of at Municipal approved waste disposal sites.
  - Clean spoil from excavation work should be used as fill where possible.
  - All rubble and rubbish should be collected and removed from the site to a suitable registered waste disposal site.

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