Appendix D: Botanical Specialist Report

PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

# BOTANICAL ASSESSMENT

## STEYNVILLE (HOPETOWN) OUTFALL SEWER PIPELINE

**PROPOSED DEVELOPMENT OF A NEW SEWER OUTFALL PIPELINE, HOPETOWN THEMBELIHLE LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE.**


**8 October 2018**

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## SUMMARY - MAIN CONCLUSIONS

| | |
|---|---|
| **VEGETATION TYPE** | **Kimberley Thornveld**<br><br>Kimberley Thornveld is considered "Least Threatened" (GN 1002, December 2011), but only 2% is currently statutorily conserved in the Vaalbos National Park, the Sandveld Bloemhof Dam and S.A. Lombard Nature Reserves, while some 18% of this vegetation is already transformed, mostly by cultivation. The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The NCCBA maps were used to guide the identification of potential significant sites. |
| **VEGETATION ENCOUNTERED** | The proposed development footprint is located on Municipal property on disturbed to very disturbed veld (grazing together with urban influences over a long period of time has altered the vegetation composition).<br><br>The proposed development will result in a temporary disturbance along the approximately 2.2 km pipeline route within a proposed CBA area. |
| **CONSERVATION PRIORITY AREAS** | According to the Northern Cape Critical Biodiversity Areas (2016), the proposed site will impact on a CBA area, but it is also located within an area that is already significantly disturbed.<br><br>The site will not impact on any recognised centre of endemism. |
| **CONNECTIVITY** | The proposed activity will have a temporary impact along the 2.2 km pipeline route within a CBA. Connectivity is also compromised to a degree, with intensive agriculture to its north, urban development to its south and east and the WWTW to its west. |
| **LAND-USE** | The pipeline will cross municipal land that is probably used for grazing and a playground for kids. The possible impact on socio-economic activities will be localised and short term. |
| **PROTECTED PLANT SPECIES** | The following protected or endangered species was encountered:<br>• No red-listed species (Heading 4.6.1).<br>• No NEM: BA protected plant species (Heading 4.6.2).<br>• No NFA protected tree species (Heading 4.6.3)<br>• **Three NCNCA protected plant species** (Heading 4.6.4), of which two are hardy disturbance indicators. |
| **WATER COURSES AND WETLANDS** | Three seasonal water courses (small streams) were observed on site. Two of these are very disturbed as a result of alien infestation and urban influences (and also seems to be fed by sewerage overflow), while the remainder also shows signs of degradation with riparian vegetation reduced to hardy unpalatable species. |
| **MAIN CONCLUSION** | The proposed development will result in a temporary impact along the approximately 2.2 km pipeline route, most of which will be located in disturbed to very disturbed veld, but it is located within a proposed CBA area. It will also impact on three degraded seasonal streams and potentially on three NCNCA protected plant species of which two are hardy disturbance indicators (Refer to Table 3).<br><br>According to the impact assessment given in Table 6 the development could have a Low impact on the environment, but with mitigation it can be reduced insignificant. **It is thus** |

**important that responsible mitigation is implemented.**

With the correct mitigation it is unlikely that the development will contribute significantly to any of the following:

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

**WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT PROJECT BE APPROVED, WITH THE PROPOSED MITIGATION ACTIONS.**

**NO-GO OPTION**

The development may result in potential significant beneficial socio-economic gain, while the no-go option will not contribute significantly to national or provincial conservation targets.

## INDEPENDENCE & CONDITIONS

PB Consult is an independent entity with 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. 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, environmental compliance audits and environmental control work (ECO) as well as more than 70 biodiversity or botanical studies.

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.

## DECLARATION OF INDEPENDENCE

**THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS**

I Petrus, Jacobus, Johannes Botes, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014, as amended, and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 13 of GN No. R. 326.

**Note:** The terms of reference must be attached.

Signature of the specialist:

PB Consult (Sole Proprietor)

Name of company:

8 October 2018

Date:

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# 1. INTRODUCTION

Hopetown is a small town along the N12 (between Britstown and Kimberley) in the Northern Cape Province. It is located on the edge of the Great Karoo on an arid slope leading down to the Orange River. It was founded in 1850 when Sir Harry Smith extended the northern frontier of the Cape Colony to the Orange River. A handful of settlers claimed ground near a natural ford over the Orange River, and by 1854 a frontier town had developed. The town was named after William Hope, Auditor-General and Secretary of the Cape Colony Government at the time. Hopetown was a quiet farming area until several large diamonds were discovered near the town near the town between 1867 and 1869 (https://en.wikipedia.org/wiki/Hopetown). Today Hopetown is again a small quiet farming town.

BVi Engineers (Upington) was appointed by the local Municipality to design a new 3-4 km sewer connecting pipeline from the Steynville suburb in Hopetown to the existing wastewater treatment works (to the north of Hopetown). The proposed pipeline will run within the road shoulder next to the N12 for a short distance before turning west over Municipal land towards the existing treatment works. The proposed development will trigger listed activities under the National Environmental Management Act, (Act 107 of 1998) (NEMA) and the EIA regulations (as amended). EnviroAfrica was appointed to perform the NEMA EIA application and PB Consult was appointed to conduct a botanical assessment of the proposed route, since the larger footprint still supported natural vegetation. Only one vegetation type is expected, namely Kimberley Thornveld (considered "Least Threatened" in terms of the National list of ecosystems that are threatened and in need of protection).

The study area is located on Municipal land influenced by urban development and associated activities. The site showed all the signs of disturbance as a result of its proximity to urban development. To the north and west of the site, agriculture is the main land use, while it borders to the south and east on Hopetown and its suburbs. The larger site also contained remnants of old housing, a spreading informal graveyard as well as an old quarry site. A few small seasonal water courses also were also observed crossing the larger site that will be impacted by the proposed pipeline route.

## 1.1. TERMS OF REFERENCE

The terms of reference for this appointment were to:

- Evaluate the proposed site(s) in order to determine whether any significant botanical features will be impacted as a result of the proposed development.
- Determine and record the position of any plant species of special significance (e.g. protected tree species, or rare or endangered plant species) that should be avoided or that may require "search & rescue" intervention.
- Locate and record sensitive areas from a botanical perspective within the proposed development footprint that may be interpreted as obstacles to the proposed development.
- Make recommendations on impact minimization should it be required
- Consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

# 2. STUDY AREA

## 2.1. LOCATION & LAYOUT

Hopetown is located along the N12, between Britstown (130 km to the south) and Kimberley (125 km to its north), in the Thembelihle Local Municipality (Pixley ka Seme District Municipality) of the Northern Cape Province (Figure 1).

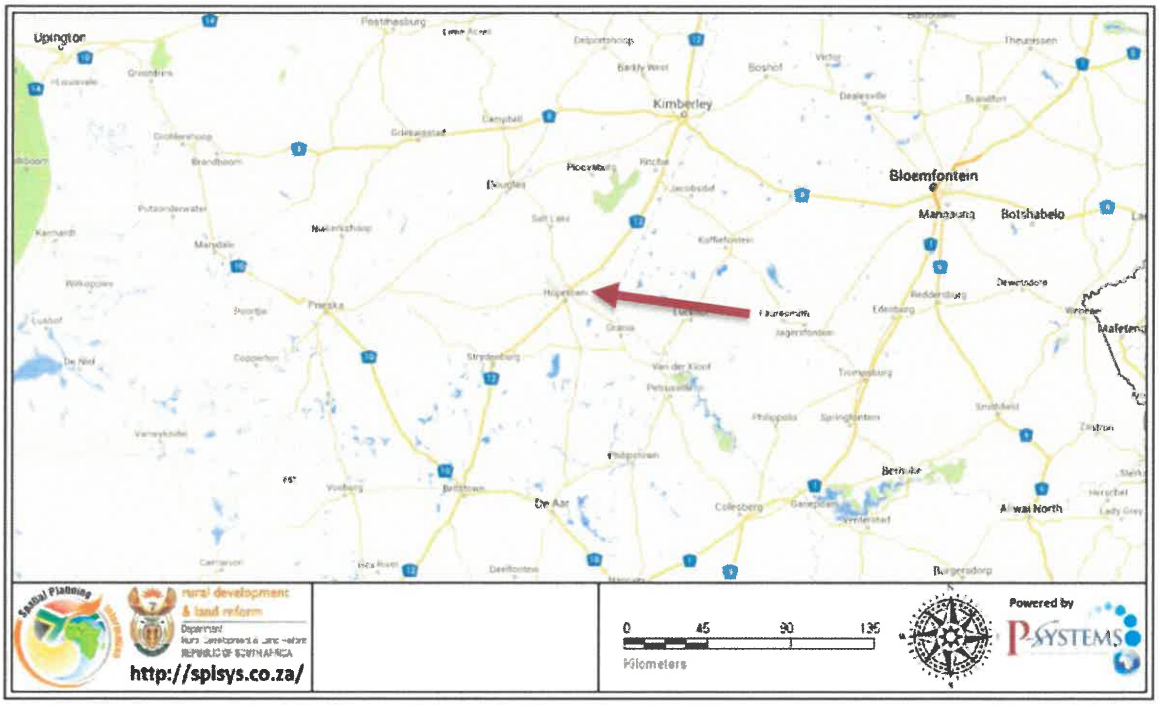



**Figure 1: Map showing the location of Hopetown in the Northern Cape Province**

The town is located just south of the Orange River, about 1.3 km away (at its nearest point). The proposed new sewer outfall pipeline will connect the Steynville suburb (to the northeast of Hopetown) with the existing Hopetown Wastewater Treatment Works (WWTW), which is located just north of the main town (Figure 2).

The proposed pipeline will be located on Municipal land, about 950 m away (south) from the Orange River.

The following approximate coordinates were given for the proposed pipeline route:

- Starting point — S29° 36' 38.2" E24° 06' 19.0"
- N12 meeting point — S29° 36' 36.2" E24° 06' 15.9"
- N12 crossing point — S29° 36' 25.7" E24° 06' 23.4"
- Halfway mark — S29° 36' 32.4" E24° 05' 48.9"
- End point (Existing WWTW) — S29° 36' 35.8" E24° 05' 24.7"

The study area for this project was the proposed pipeline route and its immediate surroundings, roughly indicated by the yellow area on Figure 2.

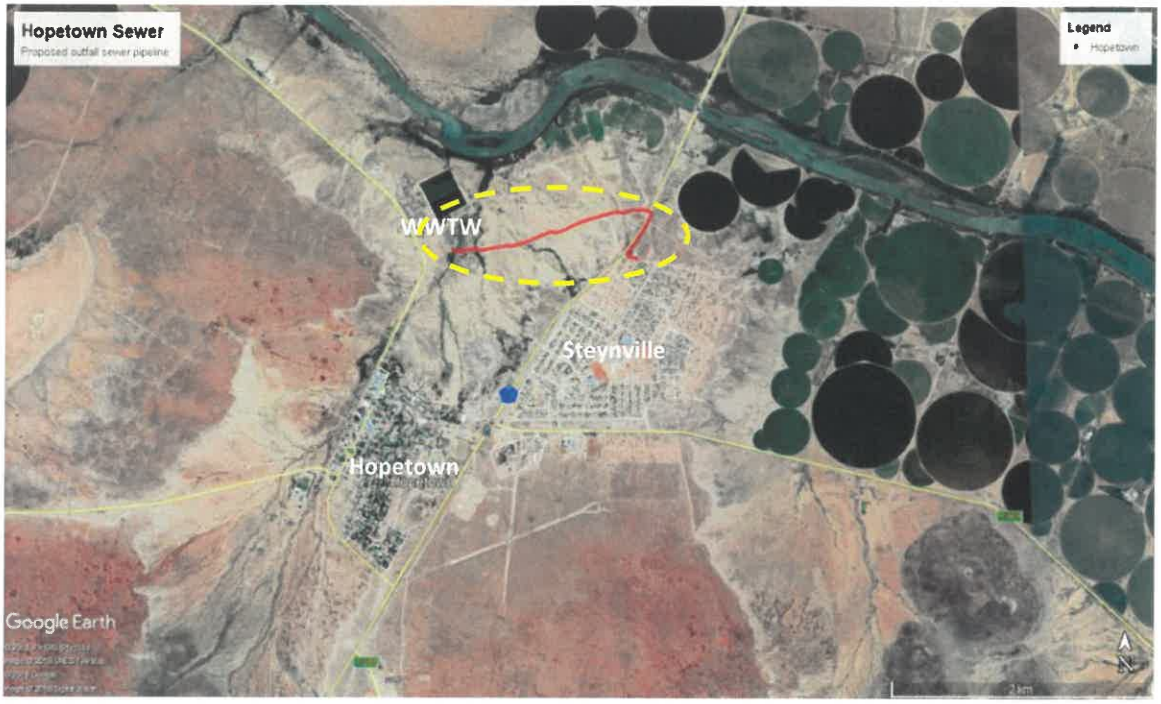
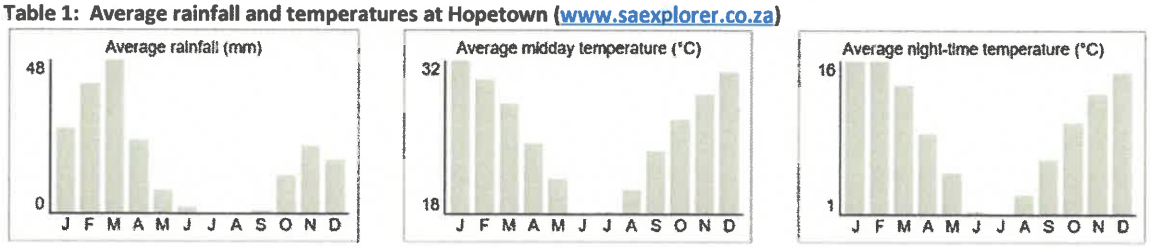



**Figure 2: The location of the proposed pipeline (in red) in relation to Hopetown**

## 2.2. CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. Hopetown normally receives about 199 mm of rain per year, largely occurring during late summer/autumn. The chart below (lower left) shows the average rainfall values for Hopetown per month. It receives the lowest rainfall (0mm) in July and the highest (48mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Hopetown range from 17.7°C in June to 32°C in January. The region is the coldest during July (1°C on average during the night). The lower right chart gives an indication of the monthly variation of average minimum daily temperatures (www.saexplorer.co.za).

**Table 1: Average rainfall and temperatures at Hopetown (www.saexplorer.co.za)**




## 2.3. TOPOGRAPHY

The proposed pipeline is located on the slightly lower erosion terrace north of the current urban edge. It will gravitate from Steynville (1 092 m above sea level) to the WWTW (1 064 m above sea level) (sloping slightly from east to west). The site also slopes slightly from south to north or towards the Orange River. Towards Hopetown the land rises onto a slightly higher plateau. Three small seasonal water courses drain the larger site towards the Orange River (which the pipeline will have to cross). In general aspect did not have any significant influence on the vegetation.

## 2.4. GEOLOGY AND SOILS

According to Mucina and Rutherford (2006), the geology is described as a highly fragmented area on Ecca and Dwyka Group sediments and Karoo dolerites as well as on Ventersdorp Supergroup lavas (Allanridge Formation). Extensive dolerite sills which form ridges, and plateaus and slopes of koppies and small escarpments mark the erosion terraces. These dolerite sills cover alternating layers of mudstone and sandstone of sedimentary origin. The Ib land type is typical of these rock- and boulder-covered slopes. Prominent soil forms are stony Mispah and gravel-rich Glenrosa forms derived from the Jurassic dolerite, while calcrete-rich soils cover the lowlands. The soils show minimal development, usually shallow on hard weathered rock with or without intermittent diverse soils, with lime generally present (Mucina & Rutherford, 2006).

# 3. EVALUATION METHOD

Desktop studies coupled with a site visit were performed. The site visit was conducted during August of 2018. The timing of the site visit was reasonable in that essentially all perennial plants were identifiable. Bulb and annual herbs were mostly absent (the possibility remains that some of these species may have been missed).


**Figure 3**: The proposed larger footprint (yellow) that was studied during the site visit

However, the author is confident that a fairly good understanding of the biodiversity status of the site was obtained. The survey was conducted by walking the site and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

# 4. THE VEGETATION

The Northern Cape contains about 3500 plant species in 135 families and 724 genera, with about 25% of this flora endemic to the region. It is also home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, it must be noted that this remarkable diversity is not distributed evenly throughout the region, but is concentrated in many local centres of endemism (NDBSP, 2008).

In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006, as updated in the 2012 beta version) only one broad vegetation type is expected in the proposed area and its immediate vicinity, namely **Kimberley Thornveld**. This vegetation type is considered "Least Threatened" (GN 1002, December 2011), but only 2% is currently statutorily conserved in the Vaalbos National Park, the Sandveld Bloemhof Dam and S.A. Lombard Nature Reserves, while some 18% of this vegetation is already transformed, mostly by cultivation. The vegetation is described as occurring on slightly irregular plains with well-developed tree layer with *Vachellia erioloba*, *V. tortilis*, *V. karroo* and *Boscia albitrunca* and well-developed shrub layer with occasional dense stands of *Tarchonanthus camphoratus* and *Senegalia mellifera*. Grass layer open with much uncovered soil.

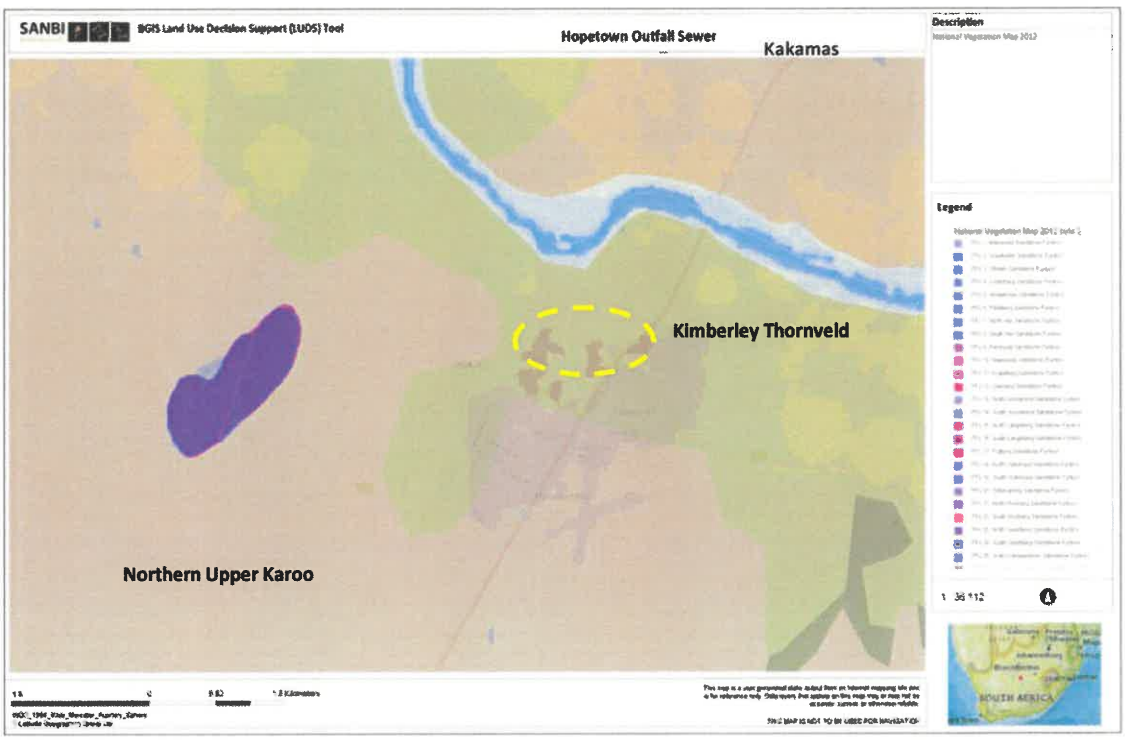



**Figure 4: Vegetation map of South Africa (2012 beta 2 version), showing the larger area and expected vegetation**

## 4.1. THE VEGETATION IN CONTEXT

Kimberley Thornveld is part of the Savanna Biome, which is the most widespread Biome in Africa and also occupies most of the far-northern part of the Northern Cape, including the Kalahari Duneveld. According to Rutherford *et. al.* (2006), the Savanna in South Africa has a low species to area ratio, and become even lower in the southern Kalahari part of the biome (with a sharply decreasing diversity of trees from east to west). On the other hand, Savanna is well known for its diversity of mammals. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulents to dominate (like in the Succulent

Karoo), while summers are too dry for dominance by perennial grasses alone, and the soils are generally too shallow and rainfall too low for trees.

Most Savanna has an herbaceous layer dominated by grass species and discontinuous to sometimes very open tree layer. In many Savanna areas in southern Africa the term bushveld is appropriate since the woody component does often not form a distinct layer but rather presents an irregular series of interlocking, often low, canopies with openings and sometimes little distinction between all shrubs and trees. The woody component is important to animals and can determine available browse, can form impenetrable barriers or determine available shade and protection against predators or scavengers. There is often excellent correlation between vegetation patterns and soil types, but rainfall gradients can result in large floristic variation even on similar substrates.

## 4.2. VEGETATION ENCOUNTERED

The proposed outfall sewer will be approximately 2.2 km in length of which the first approximately 500 m will be within the very disturbed urban edge of Steynville and the road reserve of the N12 (refer to the yellow area in Figure 5). The middle portion of the pipeline (approximately 1.5 km) follows existing twee-spoor roads for the most part, through a very disturbed form of Kimberley Thornveld (species patterns probably compromised due to heavy grazing and urban influences). The last approximately 200 m of the pipeline route (mark by the orange area in Figure 5) again traverse and area that has been significantly disturbed as a result of urban influences (old buildings / farmyards). The vegetation is discussed under these three headings.

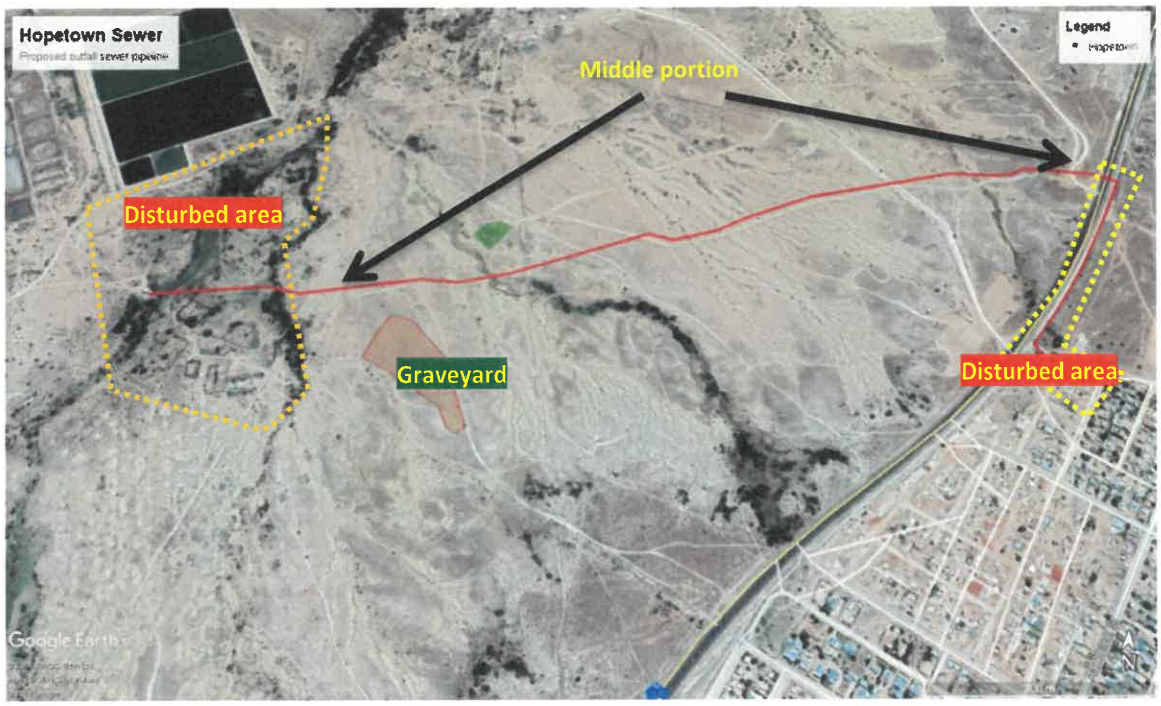



**Figure 5: Google overview of the proposed pipeline route**

### 4.2.1. Vegetation along the N12 road shoulder

The first portion of the pipeline from Steynville towards the N12, and then following the N12 northwards (refer to Disturbed area marked in yellow in Figure 5) will be located in areas that had been degraded almost to the point of transformed. The area is characterised by urban influences, trampling, dumping and footpaths. No

vegetation of any significance was observed in this section. The only species remaining were grasses and a few hardy disturbance indicator species (Refer to Photo 1 & Photo 2 underneath).

**Photo 1:** The road next to which the pipeline will be placed in the Steynville area (looking from the N12 east onto Steynville). Note the degraded status of the vegetation and the general poor condition of the veld.

**Photo 2:** The road reserve next to the N12 in which the proposed pipeline will be placed (looking from north to south – towards Steynville on the left).

### 4.2.2. The middle portion of the pipeline

The pipeline will then cross underneath the N12 and will follow existing twee-spoor tracks from the N12 over Municipal land towards the existing wastewater treatment works (located to the north west of Hopetown). Even though this area is probably the best preserved remaining natural veld along the pipeline route, it can only be described as a very disturbed form of Kimberley Thornveld (Refer to Photo 3 to Photo 7). In fact the structural formation of the remaining vegetation does not correlate with Kimberley Thornveld. The expected tree-layer (which is mostly well developed in Kimberley Thornveld) is basically absent and the only area where small indigenous trees are still encountered was along the few seasonal streams, and even here the indigenous plant species are almost replaced by the alien invasive *Prosopis* tree. The veld seems to have been subject to overgrazing (and most of the remaining species are relatively unpalatable plants) and has been subject to urban impacts over a long time. Footpaths and tracks criss-cross the site. An informal graveyard was observed to on the site as well as an old quarry site (Photo 7). Three seasonal water courses cross the proposed pipeline footprint, but even these water courses have been degraded with only the occasional small tree or larger shrub still remaining (Photo 6). Apart from the obvious degradation of the veld alien invasive species like *Atriplex lindleyi*, the cactus *Harrisia martinii, Prosopis* species (next to water courses), *Opuntia ficus-indica,* planted Privet trees (*Ligustrum* species) and the "garingboom" *Agave americana* were also occasionally observed (the last two in association with old built sites).

The remaining natural veld can be described as dominated by a grassy layer with sparse small shrubs scattered in between. The site was very dry, which made identification of some of the plants difficult (not being in flower or in very poor condition). Plant species observed includes the following: *Aptosimum spinescens* (occasionally), *Asparagus* cf. *aethiopicus*, *Calicorema capitata* (occasional), one of the *Cotula* species, *Eriocephalus* species (commonly found), the succulent *Euphorbia bergii*, (a few individuals to the south of the pipeline route, near the grave site), *Galenia africana*, *Gnidia polycephala* (occasionally), *Lycium hirsutum* (near water courses), *Lycium cinereum* (occasionally), the herb *Oedera* cf. *genistifolia*, *Psilocaulon* species, *Pteronia* cf. *paniculata*, *Rhigozum trichotomum*, *Roepera spinosa* (occasionally), *Salsola aphylla*, *Senegalia mellifera* and *Tetreana decumbens*.

**Photo 3:** Typical vegetation encountered along the proposed pipeline route (looking from south to north adjacent to the N12. Note the grassy layer and the absence of the Tree-layer. The orange arrow indicating the approximate location of the pipeline.

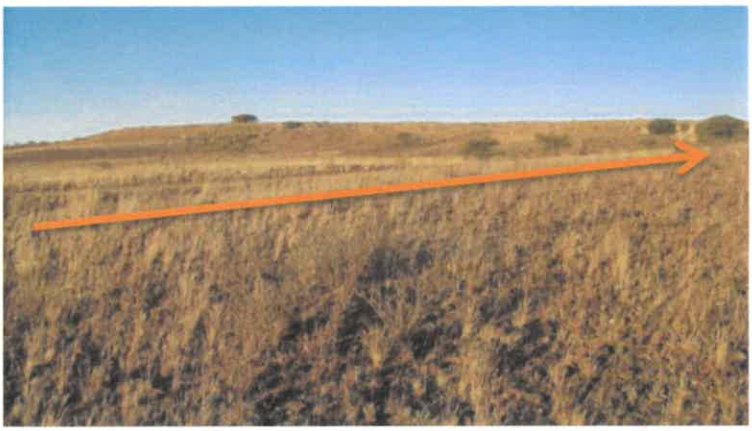


**Photo 4:** Typical vegetation encountered towards the middle of the site (looking from north to south – back towards Hopetown). The orange arrow indicating the approximate location of the pipeline next to an existing road.

**Photo 5:** Typical vegetation towards the western part of the site, with the arrow indicating the approximate location of the proposed pipeline.

Almost the entire remaining shrub layer consists out of hardy unpalatable shrubs of which many are disturbance indicators.

Most of the small streams were either invaded by Prosopis trees (where water regularly flows – like the overflow from the sewerage works running down the stream next to the WWTW), or very disturbed, with only the occasional indigenous small trees like *Parkinsonia africana*, *Vachellia karroo* and *Ziziphus mucronata* in association with *Lycium*, *Atriplex* and *Prosopis* species observed. Photo 6 shows the most pristine of the three water courses. Both of the other two water courses, the one towards the middle of the site and the one next to the WWTW, seem to receive periodic (or constant) overflow sewerage sustaining these streams.

**Photo 6:** The seasonal water course to the east of the site (probably in the best condition of the three streams observed). The other two streams (middle and west part of the site) seem to receive periodic inflows or overflows of sewerage (that may or may not be treated).

**Photo 7:** The informal graveyard that was observed to the south of the proposed pipeline (Refer to Figure 5, above for its location).

### 4.2.3. The degraded western portion (near the WWTW)

The last section of the pipeline (marked in orange in Figure 5) again passes over a much degraded piece of land that seems to have been small holdings in the past (Photo 9). Building rubble and garden associated plants dominate together with thick stands of *Prosopis*.

**Photo 8:** The degraded western portion of the pipeline route showing the small stream (next to the WWTW pump station) looking from west to east. Note the *Vachellia* and *Prosopis* next to the small stream. The arrow indicating the proposed pipeline route.

Only hardy small trees like *Parkinsonia africana* and *Vachellia karroo* remains in association with *Asparagus aethiopicum*, *Lycium hirsutum* and *Psilocaulon* species remains together with a number of other alien plant

species mentioned above (Photo 8). The most significant feature in this area is the small seasonal stream, which at present seems to flow continuously as a result of overflow sewerage water (which might be treated or partially treated).

**Photo 9:** Building rubble remaining at one of the old farm buildings within this section of the proposed pipeline route.

**Photo 10:** Old farm yard associated with the old house depicted in Photo 9. Note the dominance by the alien *Prosopis* trees.

## 4.3. CRITICAL BIODIVERSITY AREAS MAPS

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

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.

- **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.

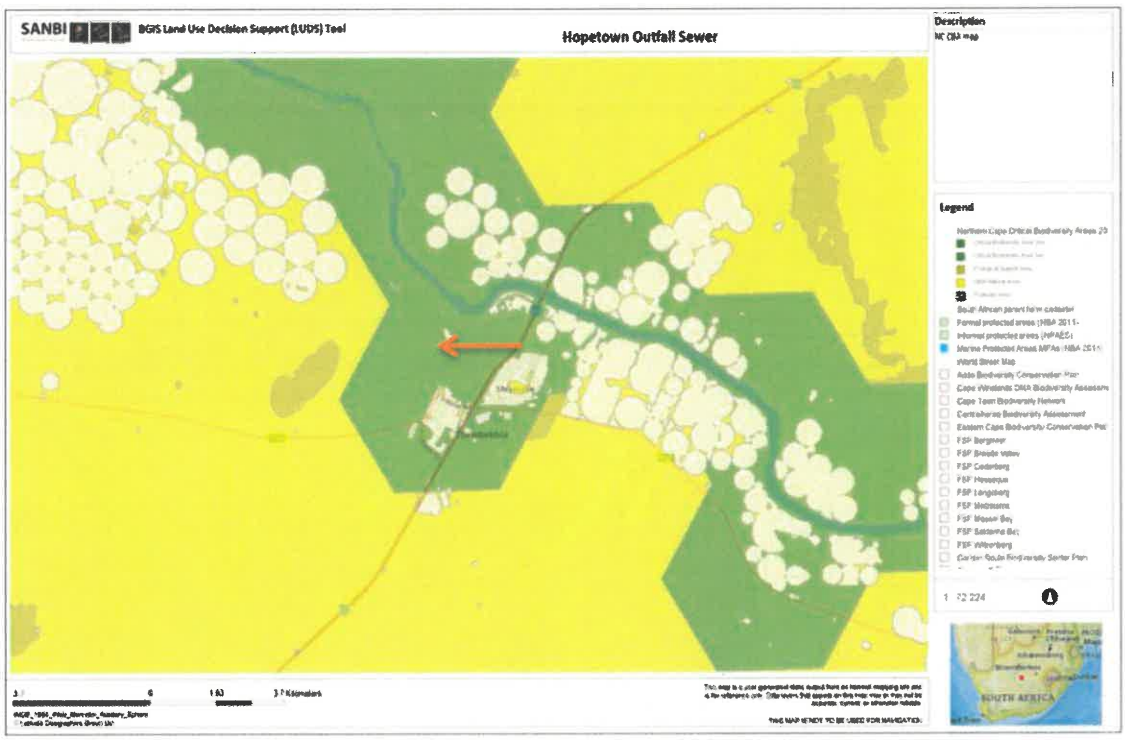



**Figure 6:** The Northern Cape Critical Biodiversity Areas (2016) showing the location of the proposed development

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).

According to the NCCBA (Refer to Figure 6), the proposed development will be located within a CBA. However, for the purposes of the impact assessment it was taken into account that the pipeline will be located in areas

already very much disturbed and activity itself will be temporary since the pipeline will be below ground. With mitigation and rehabilitation the impact associated with the construction of the pipeline can be much reduced.

## 4.4. POTENTIAL IMPACT ON CENTRES OF ENDEMISM

The proposed development does not impact on any recognised centre of endemism. The Griqualand West Centre of Endemism starts some distance away to the west of Hopetown (Van Wyk & Smith, 2001).

**The proposed site does not fall within any recognised centre of endemism.**

## 4.5. FLORA ENCOUNTERED

Table 2 gives a list of the plant species encountered during this study. Because of the limitations (timing and a single site visit as well as the drought currently experienced at the site) it is likely that a number of annuals might have been missed.

**Table 2: List of indigenous species encountered within or near the proposed footprint**

| No. | Species name | FAMILY | Status | Alien & Invader species (AIS) |
|---|---|---|---|---|
| 1. | *Aptosimum spinescens* | SCROPHULARIACEAE | LC | |
| 2. | *Asparagus* cf. *aethiopicus* (no flowers) | ASPARAGACEAE | LC | |
| 3. | *Calicorema capitata* | AMARANTHACEAE | LC | |
| 4. | *Cotula* species | ASTERACEAE | | |
| 5. | *Eriocephalus* species | ASTERACEAE | | |
| 6. | *Euphorbia bergii* | EUPHORBIACEAE | NCNCA, Schedule 2 Protected (all species in this Genus) | Apply for a NCNCA Flora permit (DENC) |
| 7. | *Galenia africana* | AIZOACEAE | NCNCA, Schedule 2 Protected (all species in this Family) | Apply for a NCNCA Flora permit (DENC) |
| 8. | *Gnidia polycephala* | THYMELAEACEAE | LC | |
| 9. | *Lycium cinereum* | SOLANACEAE | LC | |
| 10. | *Lycium hirsutum* | SOLANACEAE | LC | |
| 11. | *Mesembryanthemum species (=Psilocaulon species)* | AIZOACEAE | LC Protected in terms of schedule 2 of the NCNCA | Apply for a NCNCA Flora permit (DENC) |
| 12. | *Oedera* cf. *genistifolia* | ASTERACEAE | LC | |
| 13. | *Parkinsonia africana* | FABACEAE | LC | |
| 14. | *Pteronia* cf. *paniculata* | ASTERACEAE | LC | |
| 15. | *Rhigozum trichotomum* | BIGONACEAE | LC | |
| 16. | *Roepera spinosa (=Zygophyllum spinosa)* | ZYGOPHYLLACEAE | LC | |
| 17. | *Salsola aphylla* | AMARANTHACEAE | LC | |
| 18. | *Senegalia mellifera (=Acacia mellifera)* | FABACEAE | LC | |
| 19. | *Tetraena decumbens (=Zygophyllum decumbens)* | ZYGOPHYLLACEAE | LC | |
| 20. | *Vachellia karroo* | FABACEAE | LC | |
| 21. | *Ziziphus mucronata* | RHAMNACEAE | LC | |

## 4.6. 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).

### 4.6.1. Red list of South African plant 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).

- **No red-listed species** was observed.

### 4.6.2. NEM: BA protected plant 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 NEM: BA protected species was observed.**

### 4.6.3. NFA Protected plant species

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (as updated).

- **No species protected in terms of the NFA** was observed.

### 4.6.4. NCNCA protected plant 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 are protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

**Table 3: Plant species protected in terms of the NCNCA encountered within the study area**

| NO. | SPECIES NAME | COMMENTS | RECOMMENDATIONS |
|---|---|---|---|
| 1. | *Euphorbia bergii*<br>**Schedule 2 protected** | All species in the genus *Euphorbia* protected by default. Locally common. | **Search & rescue:**<br>Individuals within footprint to be transplanted to surrounding area. |
| 2. | *Galenia africana*<br>**Schedule 2 protected** | This plant is weedy a disturbance indicator and commonly found in Erf 1654. | No special measures needed, this is a weedy pioneer species. |
| 3. | *Mesembryanthemum species*<br>**Schedule 2 protected** | This plant is a weedy disturbance indicator and commonly found throughout. | No special measures needed, this is a weedy pioneer species. |

# 5. IMPACT ASSESSMENT METHOD

The objective of this study was to evaluate the botanical diversity of the property area in order to identify significant environmental features which might have been impacted as a result of the development. The Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al.*, 2005), were used to evaluate the botanical significance of the property 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. 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 (Refer to **Error! Reference source not found.**).

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

**Table 4: Categories and criteria used for the evaluation of the significance of a potential impact**

| ASPECT / CRITERIA | LOW (1) | MEDIUM/LOW (2) | MEDIUM (3) | MEDIUM/HIGH (4) | HIGH (5) |
|---|---|---|---|---|---|
| **CONSERVATION VALUE**<br>Refers to the intrinsic value of an attribute 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 | The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss. | The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss. | 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. | 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. | The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area. |
| **LIKELIHOOD**<br>Refers to the probability of the specific impact occurring as a result of the proposed activity | Under normal circumstances it is almost certain that the impact will not occur. | The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances. | The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur. | It is very likely that the impact will occur under normal circumstances. | The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances. |
| **DURATION**<br>Refers to the length in time during which the activity is expected to impact on the environment. | Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years). | Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years). | Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require on-going mitigation. Rehabilitation time is expected to be longer (5-15 years). | 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 on-going mitigation. Rehabilitation time is expected to be longer (15-50 years). | The impact is expected to be permanent. |
| **EXTENT**<br>Refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur. | Under normal circumstances the impact will be contained within the construction footprint. | 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. | 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). | 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. | Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius). |
| **SEVERITY**<br>Refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur. | 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. | 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. | It is expected that the 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. | 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. | 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. |

## 5.2. 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 7.

**Table 5: 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 cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international. |

# 6. DISCUSSING BOTANICAL SENSITIVITY

The aim of impact assessment is to determine the vulnerability of a habitat to a specific impact. In order to do so, the sensitivity of the habitat should be determined by identifying and assessing the most significant environmental aspects of the site against the potential impact(s). For this development the following biodiversity aspects was considered:

- **Location**: The proposed development footprint is located on Municipal property on disturbed to very disturbed veld (grazing together with urban influences over a long period of time has altered the vegetation composition). Three degraded seasonal water courses cross the path of the proposed pipeline.
- **Activity**: The proposed activity is expected to result in a temporal disturbance along approximately 2.2 km of the pipeline route.
- **Geology & Soils**: No special features such as true quarts patches or heuweltjies were observed in or near to the larger footprint area that may result in specialised plant habitat.
- **Land use and cover**: The pipeline will cross municipal land that is probably used for grazing and a playground for kids. The possible impact on socio-economic activities will be localised and short term.
- **Vegetation status:** Kimberley Thornveld is not considered a threatened vegetation type. However only 2% is formally conserved. The vegetation on site conforms to a much disturbed version of this vegetation type.
- **Conservation priority areas:** According to the NCCBA the proposed site will impact on a CBA area, but the site is already much degraded as a result of urban influences. The site will not impact on any recognised centre of endemism.
- **Connectivity**: The proposed activity will have a temporary impact along the 2.2 km pipeline route within a CBA. Connectivity is also compromised to a degree, with intensive agriculture to its north, urban development to its south and east and the WWTW to its west.
- **Watercourses and wetlands**: Three seasonal water courses (small streams) were observed on site. Two of these are very disturbed as a result of alien infestation and urban influences (and also seems to be fed by sewerage overflow), while the remainder also shows signs of degradation with riparian vegetation reduced to hardy unpalatable species.
- **Protected or endangered plant species**: The only protected species encountered were three NCNCA protected species, of which two are hardy disturbance indicators. Only the Euphorbia bergii is worth protection and was only observed to the south of the site, but it is possible individuals might be encountered in the final footprint. Impact minimisation recommendations are given in Table 3.
- **Invasive alien species**: A number of alien and invasive species were observed of which the Prosopis tree was the most significant. The remainder were mostly associated with old building sites.
- **Veld fires**: According to the National Veldfire risk classification (March 2010), Kimberley Thornveld falls within an area with a Low fire risk classification. However, veld fire risk must be considered during construction.

## 6.1. IMPACT ASSESSMENT

The following table rates the significance of environmental impacts associated with the proposed development. It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

**Table 6: Impact assessment associated with the proposed development**

| Impact assessment Pipeline route | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Aspect** | **Mitigation** | **CV** | **Lik** | **Dur** | **Ext** | **Sev** | **Significance** | Short discussion |
| **Geology & soils:** Potential impact on special habitats (e.g. true quartz or "heuweltjies") | Without mitigation | 1 | 1 | 2 | 1 | 2 | 6 | No special habitats observed, apart from a few rocky outcrops, but no special botanical significance associated with these outcrops. |
| | With mitigation | 1 | 1 | 2 | 1 | 1 | 5 | Minimise footprint |
| | | | | | | | | |
| **Landuse and cover:** Potential impact on socio-economic activities. | Without mitigation | 1 | 2 | 2 | 1 | 2 | 7 | Temporary disturbance within Municipal land, used by local inhabitants. |
| | With mitigation | 1 | 1 | 2 | 1 | 1 | 5 | Minimise footprint and disturbance period. |
| | | | | | | 1 | | |
| **Vegetation status:** Loss of vulnerable or endangered vegetation and associated habitat. | Without mitigation | 1 | 2 | 2 | 1 | 2 | 7 | Temporary impact on disturbed Kimberley Thornveld (Least Threatened), but it overlaps a CBA (future protection area). |
| | With mitigation | 1 | 1 | 2 | 1 | 1 | 5 | Minimise footprint. |
| | | | | | | | | |
| **Conservation priority:** Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism. | Without mitigation | 2 | 2 | 2 | 1 | 2 | 14 | Site overlaps into a CBA (proposed future protection support area) but is already very disturbed. |
| | With mitigation | 2 | 1 | 2 | 1 | 1 | 10 | Minimise the footprint (the whole of Erf 1654 falls within the ESA). |
| | | | | | | | | |
| **Connectivity:** Potential loss of ecological migration corridors. | Without mitigation | 1 | 2 | 2 | 1 | 2 | 7 | Connectivity is already somewhat compromised, the veld in poor condition, but the site falls within a CBA. |
| | With mitigation | 1 | 1 | 2 | 1 | 1 | 5 | Minimise the disturbance footprint. |
| | | | | | | | | |
| **Watercourses and wetlands:** Potential impact on natural water courses and its ecological support areas. | Without mitigation | 3 | 2 | 2 | 1 | 2 | 21 | The pipeline route will cross three degraded seasonal streams. |
| | With mitigation | 2 | 1 | 2 | 1 | 1 | 10 | Minimise the footprint at these features, implement erosion prevention measures and good alien control methods. |
| | | | | | | | | |
| **Protected & endangered plant species:** Potential impact on threatened or protected plant species. | Without mitigation | 3 | 2 | 2 | 1 | 2 | 21 | Protected plants and even endangered plants have been observed in the potential pipeline footprint. |
| | With mitigation | 2 | 1 | 2 | 1 | 1 | 10 | Adjust the pipeline route to avoid larger protected trees and minimise the footprint. |
| | | | | | | | | |
| **Invasive alien plant species:** Potential invasive | Without mitigation | 3 | 4 | 3 | 2 | 2 | 33 | Dense stands of Prosopis towards the lower portion of Erf 1654. |

| Impact assessment Pipeline route | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Aspect** | **Mitigation** | **CV** | **Lik** | **Dur** | **Ext** | **Sev** | **Significance** | Short discussion |
| plant infestation as a result of the activities. | With mitigation | 3 | 2 | 2 | 1 | 1 | 18 | Special care must be taken during their removal (in order to avoid re-sprouting). |
| | | | | | | | | |
| **Veld fire risk:** Potential risk of veld fires as a result of the activities. | Without mitigation | 1 | 1 | 2 | 1 | 2 | 6 | Veld fire risk very low |
| | With mitigation | 1 | 1 | 1 | 1 | 1 | 4 | Address fire danger throughout construction. |
| | | | | | | | | |
| **Cumulative impacts:** Cumulative impact associated with proposed activity. | Without mitigation | 3 | 4 | 3 | 2 | 2 | 33 | Mostly associated with the fact that the site overlaps a CBA, will cross degraded water courses and the potential impact on protected plant species. |
| | With mitigation | 3 | 2 | 2 | 1 | 1 | 18 | Minimise the impact on protected plant species and minimise the disturbance footprint. |
| | | | | | | | | |
| **The "No-Go" option:** Potential impact associated with the No-Go alternative. | Without mitigation | 3 | 1 | 1 | 1 | 1 | 12 | No temporary impact on natural veld or protected or endangered plant species, but also no social gain. |
| | With mitigation | 2 | 1 | 1 | 1 | 1 | 8 | Social gain from re-using the treated wastewater, and most importantly ensuring save disposal of treated effluent (the current WWTW is a health risk). |

According Table 6, the main impacts associated with the proposed development will be on:

- A very disturbed conservation priority area (CBA);
- Three disturbed water courses (and the associated alien infestation);
- Protected plant species (mainly *Euphorbia bergii*).
- Construction might stimulate further invasion by invasive alien plant species.

Because of the degraded status of the site and the temporary nature of the proposed impact, the cumulative impact (even without mitigation) is expected to be relatively Low. However, this can be reduced to almost insignificant through the implementation of mitigation measures (as explained under recommendations).

# 7. IMPACT MINIMISATION RECOMMENDATIONS

The proposed development will result in a temporary impact along the approximately 2.2 km pipeline route, most of which will be located in disturbed to very disturbed veld, but it is located within a proposed CBA area. It will also impact on three degraded seasonal streams and potentially on three NCNCA protected plant species of which two are hardy disturbance indicators (Refer to Table 3).

According to the impact assessment given in Table 6 the development could have a Low impact on the environment, but with mitigation it can **be reduced** insignificant. **It is thus important that responsible mitigation is implemented.**

With the correct mitigation it is unlikely that the development will contribute significantly to any of the following:

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

## 7.1. MITIGATION ACTIONS

The following mitigation actions should be implemented to ensure that the proposed development does not pose a significant threat to the environment:

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must include the recommendations made in this report.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and any other conditions pertaining to specialist studies.
- Water course should be crossed in such a manner as to minimise the disturbance footprint and potential erosion as a result of construction
- The **Search & Rescue recommendations given in** Table 3 must be implemented with regards to protected species encountered and a DENC flora permit must be obtained in terms of the NCNCA.
- **Before any work is done** the development footprint and access routes must be clearly demarcated (to ensure the above mitigation measures are correctly interpreted) and approved by the ECO. The demarcation must include the total footprint necessary to execute the work, but must aim at minimum disturbance.
- 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 any area outside of the construction footprint must be avoided.
- All areas impacted as a result of construction must be 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.
- 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.
    - All rubble and rubbish should be collected and removed from the site to a suitable registered waste disposal site.

- The pipeline route must be adjusted to minimise the impact on any large indigenous tree that might be encountered along its route and the construction footprint must be minimised as much as possible.
- Responsible alien removal program overseen by the ECO must be implemented especially with the removal of Prosopis trees near water courses. All alien invasive species within the footprint and at least 5 m to the side of the footprint must be removed.

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