Proposed Metals Industrial Cluster near Kuruman, Northern Cape Province

Ecological Impact Assessment Report

Prepared by
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for

Savannah Environmental (Pty) Ltd

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ABSTRACT

The proposed establishment of a Metals Industrial Cluster in Kuruman triggers a number of listed activities as included in the Environmental Impact Assessment Regulations (08 December 2014), GN R 982 – 985, in accordance with the National Environmental Management Act, No. 107 of 1998 (NEMA), as amended. The appointed Environmental Assessment Practitioner, Savannah Environmental (Pty) Ltd, commissioned EnviroNiche Consulting, to undertake an ecological impact assessment to determine the impacts which may be triggered by the proposed development. The requirements of this assessment were to undertake a specialist study to assess the biodiversity and ecology of the project site as well as determine the significance of the impacts that the proposed Metals Industrial Cluster will have on the identified project site.

The project site is located approximately 2km south-east of Kuruman. The project site and the surrounding area were assessed for any sensitive ecosystems including drainage lines and wetlands. It was found that there are no wetlands or drainage lines on the project site although a seasonal drainage line is situated just outside (100m) the site's eastern boundary. The project site is situated in the Kuruman Thornveld (SVk9) vegetation type. According to Mucina & Rutherford (2006), this vegetation type has a conservation status of "Least Threatened" and is not protected. On a plant community level there are sensitive habitats (dolomite and rocky outcrops) present within the project site.

The vegetation of the project site is natural veld but not in a pristine condition due to past grazing practices. The Camel Thorn (*Acacia erioloba*) forms dense stands in places, an indicator of overgrazing of the vegetation in the past.

In terms of the National Forest Act (Act 84 of 1998), the protected tree species present within the project site is the Camel Thorn (*Acacia erioloba*) and it is also listed as a Red Data species. The density of Camel Thorns is approximately 35 individuals per hectare. A number of protected plant species also occur on site which are listed in terms of the Northern Cape Nature Conservation Act (Act 9 of 2009).

RECOMMENDATIONS

The following is recommended:

General

- An Environmental Control Officer (ECO) must be appointed to oversee that the aspects stipulated in the Environmental Permit be carried out properly;
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to;
- The areas to be cleared as well as the construction area should be clearly demarcated;
- All construction vehicles should adhere to clearly defined and demarcated roads;
- Dust suppression and erosion management should be an integrated component of the construction approach;
- No dumping of building waste or spoil material from the development should take place on areas other than a licenced landfill site;
- All hazardous materials should be stored appropriately to prevent contamination of the project site. Any accidental chemical, fuel and oil spills that occur at the project site should be cleaned up appropriately as related to the nature of the spill;
- The project site is situated in the close proximity of a tributary of the non-perennial Kuruman River. This seasonal tributary is situated on the eastern and south-eastern sides of the project site, however the project site does not infringe on the features. Development / construction within a 500m distance from a water course requires an application for a water use license to the Department of Water Affairs;

Flora

- There should be a preconstruction walk-through of the development footprint/project site in order to locate individuals of Camel Thorn trees which would have to be removed. Plant species of conservation concern (e.g. Aloes) must also be located and relocated to a suitable and similar habitat where these plants can grow without any disturbance.
- Permits must be obtained from DAFF to remove the Camel Thorn (*Acacia erioloba*) individuals. The contractor must apply for these permits in a phased manner.
- Weed control measures must be applied to eradicate the noxious weeds (category 1a &1b species) on disturbed areas.

Fauna

- Any fauna threatened by the construction and operation activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All construction vehicles should adhere to a low speed limit (<30km/h) to avoid collisions with susceptible species such as snakes and tortoises.
- If trenches need to be dug for electrical cabling or other purposes, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are exposed should contain soil ramps allowing fauna to escape the trench.

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1. APPOINTMENT OF SPECIALIST

EnviroNiche Consulting was appointed by Savannah Environmental (Pty) Ltd to conduct an ecological impact assessment of the proposed project site as part of the EIA process to obtain environmental authorisation for the establishment of the Metals Industrial Cluster. The terms of reference were to undertake an ecological impact assessment to describe the fauna, flora, biodiversity and other ecological features of the project site as well as determine the impact of the establishment of the Metals Industrial Cluster on these features.

1.1 Details of specialist

Johann du Preez

Enviro-Niche Consulting Biodiversity and Environmental Consultants

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1.2 Summary of expertise

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science), registration number: 400271/07.
- Ecological consultant since 2000.
- Conducted, or co-conducted, over 1 500 specialist ecological surveys as an ecological consultant.
- Co-author of a book on African ecology
- Published over 30 refereed scientific reports,
- Presented 26 scientific conference presentations.

2. DECLARATION OF INDEPENDENCE

I, Pieter Johannes du Preez, ID 6008215016087, declare that I:

- am the owner of EnviroNiche Consulting
- act as an independent specialist consultant in the field of botany, ecology and vegetation science;
- am assigned as the ecology specialist consultant by **Savannah Environmental (Pty) Ltd** for this proposed project;
- I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work as stipulated in the terms of reference;
- remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and
- the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project.
- I have no and will not engage in conflicting interests in the undertaking of the activity;
- undertake to disclose to the client and the competent authority any material, information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2014;
- will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.

PJ DU PREEZ PhD PrSciNat

3. INTRODUCTION

3.1 Terms of reference

EnviroNiche Consulting has been appointed by **Savannah Environmental (Pty) Ltd** to conduct an ecological impact assessment of the project site as part of an EIA process to obtain environmental authorisation for the proposed establishment of a Metals Industrial Cluster on Portion 6253 of Erf 1 located ~2km south east of the town of Kuruman. The proposed project site falls under the jurisdiction of the Ga-Segonyana Local Municipality and within the greater John Taolo Gaetsewe District Municipality in the Northern Cape Province.

The following was to be provided / undertaken:

- A brief discussion, using available literature, on the vegetation type in which the broader study area and project site is situated in order to place the study in context.
- A broad-scale map of the vegetation and land cover of the project site using available aerial photography. A description of the dominant and characteristic species within the broad-scale plant communities comprising each of these units was to be provided. This was to cover the entire project site.
- List of all plant species recorded during the survey.
- A list of Red List plant species previously recorded within the quarter degree grids in which the study area and project site is situated, obtained from the relevant authorities.
- List of naturalised plant species recorded on the project site, indicating which are declared weeds or alien invasive species, according to the *National Environmental Management: Biodiversity Act (10/2004): Alien and Invasive Species Regulations, 2014*.
- Identification of sensitive habitats and plant communities. A map of sensitive areas within the project site was to be provided.

A detailed investigation into the status of the vegetation located within the project site was undertaken, including:

- Assessment of the natural vegetation;
- General floristic diversity;
- Habitat suitability for Red Data flora species;
- Potential presence of Red Data flora species;
- Potential presence of sensitive ecosystems

4. ASSUMPTIONS AND LIMITATIONS

4.1 Assumptions

- The biodiversity at the project site will be destroyed and considered as a total loss of 47ha (i.e. the entire project site).

4.2 Limitations

- Detailed layout of site was not available, however it is expected that the entire project site will be developed for the Metals Industrial Cluster.

5. ACTS & LEGISLATION

Acts such as those listed below (Table 1); ensure the protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment. It also ensures the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes or products or human activities.

Table 5.1: List of relevant legislation

Title of legislation, policy or guideline	Applicability to the project	Administering authority	Date
National Environmental Management Act, No. 107 of 1998 (NEMA), as amended & NEMA EIA Regulations, 2014: GN544, published in Government Gazette 33306 in 2014	A full Environmental Impact Assessment Report (EIA) is required for this project	Department of Environmental Affairs (DEA)	1998
National Environmental Management: Biodiversity Act (10/2004): Amendments, 2014	Protected species may occur on site	Department of Environment and Nature Conservation (DENC)	2014
National Water Act, No. 36 of 1998	The proposed development may trigger a section 21(C and/or i) water use.	Department of Water and Sanitation (DWS)	1998
National Heritage Resources Act (Act No 25 of 1999)	Resources could be identified during construction phase	South African Heritage Resources Agency (SAHRA)	1999

Northern Cape Nature Conservation Act (Act 9 of 2009)	Protected Camel Thorn trees and other protected species could occur on the proposed site	Department ofEnvironment and Nature Conservation (DENC)	2009
National Forests Act (Act 84 of 1998)	Protected Camel Thorn trees could occur on the proposed site	Department of Agriculture, Forestry and Fisheries (DAFF)	1998

6. DESCRIPTION OF STUDY AREA

6.1 Description of the broader study area and project site

6.1.1 Location

The project site of the proposed development is situated on the south-eastern outskirts of the town of Kuruman (Figure 6.1 and Figure 6.2) The project site falls within the quarter degree square **2723AD**.

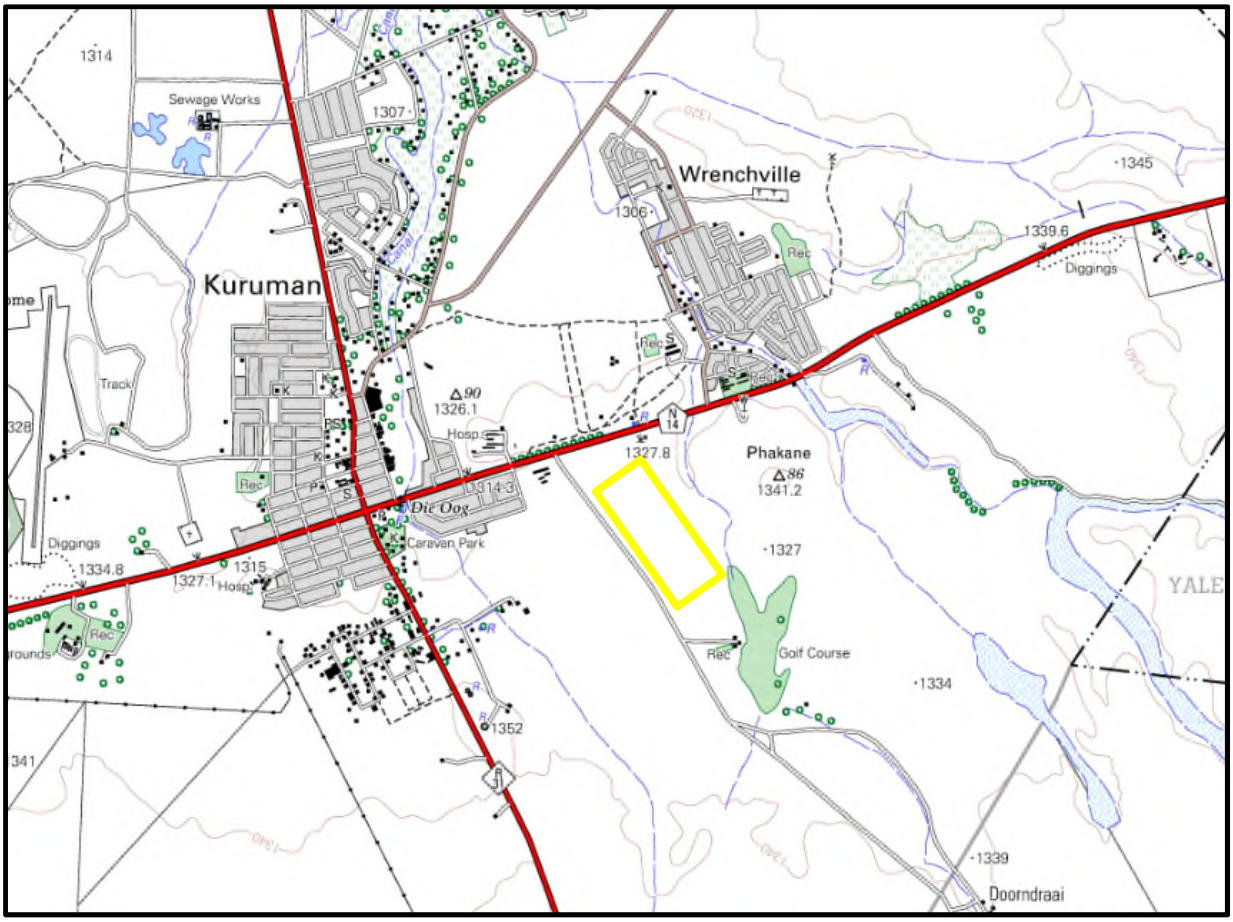

Figure 6.1: Topographic map of the broader study area and the project site. The yellow polygon indicates the location of the project site.

Figure 6.2: A satellite image of Kuruman and the location of the proposed project site (red polygon) (Google Earth).

6.1.2 Topography

The project site has an altitude of approximately 1 340m. The project site on portion 6253 of Erf 1 is situated on the crest of a dolomite outcrop which slopes toward the west as well as the east. A seasonal drainage line drains the project site on the eastern side. This drainage line is a seasonal tributary of the nearby non-perennial Kuruman River.

6.1.3 Geology & soils

The geology of the project site is dominated by dolomite. The area is relatively flat with a number of dolomite outcrops supporting a different plant community than the tree-dominated plant community on the deeper sandy soils.

6.1.4 Climate (Rainfall & temperatures)

The Kuruman area receives summer rainfall and is approximately 368 mm per annum. The mean annual temperature is 17,5°C (Mucina & Rutherford, 2006).

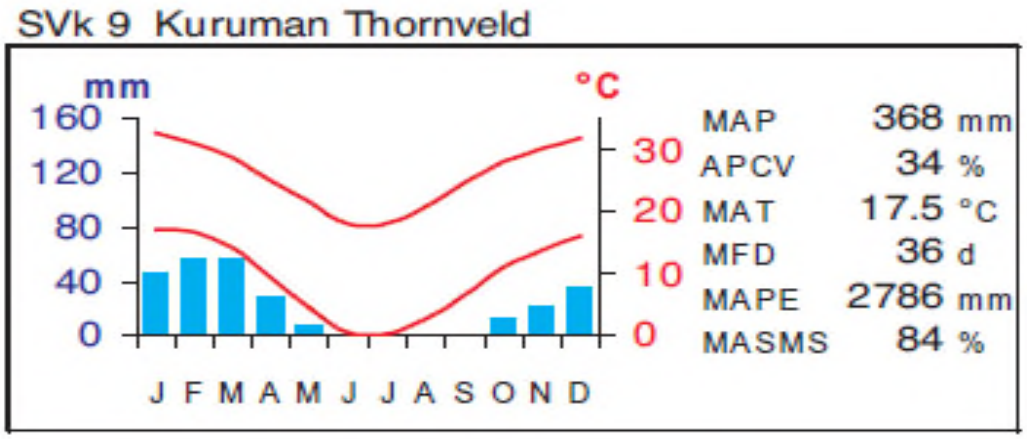

Figure 6.3: A climate-diagram of the Kuruman Thornveld (Mucina & Rutherford, 2006).

6.1.5 Land use & land cover

The project site is currently used for informal and uncontrolled grazing activities. A family is temporarily residing in a shack within the southern portion of the property, in close proximity to the western boundary. A number of footpaths occur in a criss-cross manner within the project site. These footpaths cause degradation of the natural vegetation by the trampling effect of people and animals. The nearby dirt road also cause degradation because the dust generated by cars passing by, covers the stomata of the plants. This could affect plants negatively. The dirt road furthermore cause dis-connectivity of the landscape

6.1.6 Vegetation, biogeography and conservation value

The most recent description of the broader study area's vegetation is the general description by Mucina & Rutherford (2006) relating to the vegetation which is considered to be the "Vegetation of South Africa, Lesotho and Swaziland" as well as its accompanying map of the country by (Mucina *et al.*, 2005). This memoir contains species information and a comprehensive conservation assessment of all vegetation types.

The Kuruman Thornveld (SVk9) (Fig 6.4) dominates the vegetation of the project site, as well as the areas surrounding the site. According to Mucina & Rutherford (2006), the vegetation type has a conservation status of "Least threatened". The vegetation

of the project site is dry tree-savanna with scattered individuals of trees such as Camel Thorn (*Acacia erioloba*), Common Karee (*Searsia lancea*), Buffalo Thorn (*Ziziphus mucronata*) and shrubs such as *Grewia flava, Tarchonanthus camphoratus, Acacia tortilis* and *Acacia mellifera*. Important grasses include *Aristida congesta*, *Eragrostis lehmanniana, E. trichophora, Enneapogon scoparius, Aristida adscensionis, Heteropogon contortus.* Dwarf shrubs such as *Felicia muricata, Sutera halimifolia Monechma incanum, Lycium villosum* also occur in the project site.

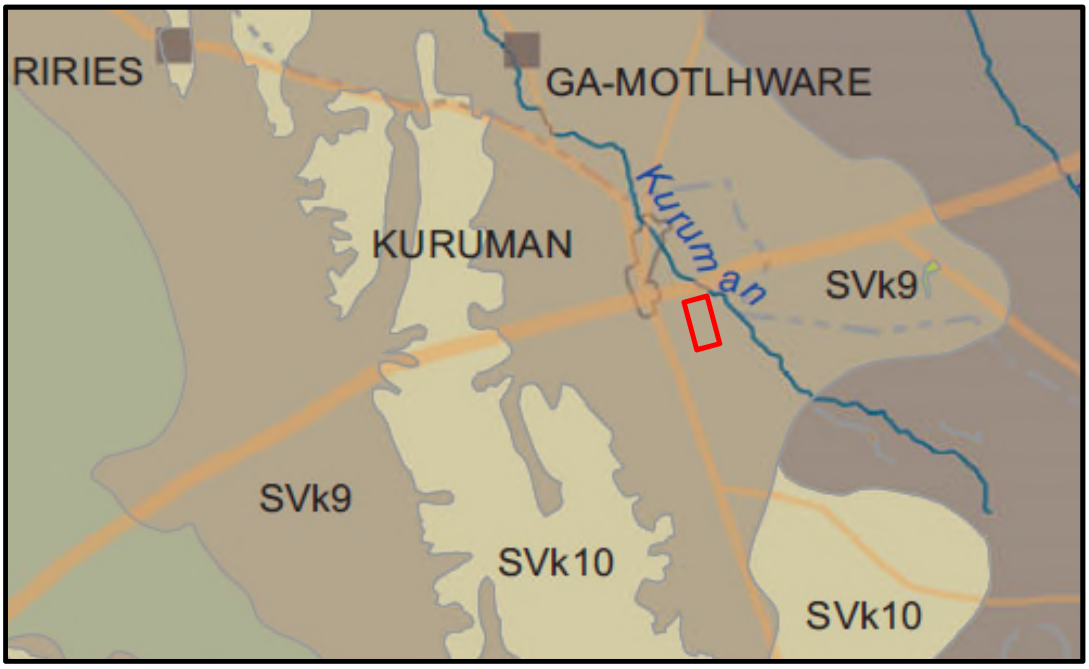

Figure 6.4: A vegetation map of the project site (red polygon) and the surrounding areas which is dominated by the Kuruman Thornveld (SVk9) (Mucina & Rutherford, 2006).

7. METHODOLOGY

7.1 Vegetation survey

Date of fieldwork: 21 April 2016.

Satellite imagery (Google Earth photos) and 1:50 000 topographic maps were used to find features within the project site.

Quantitative data was collected in each quadrat by undertaking vegetation sampling according to the Braun-Blanquet approach (Mueller-Dombois & Ellenberg 1974; Westhoff & van der Maarel 1978). In each sample site the following data was collected:

Habitat data:

- amount of bare soil;
- rock cover;
- slope;
- aspect in degrees;
- latitude and longitude position (from GPS) in decimal degrees;
- presence of biotic disturbances, e.g. grazing, animal burrows, etc.

Vegetation data

- species present;
- cover estimation of each species according to the Braun-Blanquet scale;
- vegetation height.

Data analysis

- The plant communities that were identified were described using the vegetation sample data.
- Additional checklists of plant species were compiled by traversing the project site on foot and recording species as they were encountered. Plant names follow those of POSA (2015).
- All exotic species categorised as alien invaders or weeds as listed in the *National Environmental Management: Biodiversity Act (10/2004): Alien and Invasive Species Regulations, 2014* were also recorded.

Due to the brief duration of the survey, the species list provided for the project site cannot be regarded as comprehensive, but is nevertheless likely to include the majority of the dominant and common species present.

7.1.2 Red Data plant species

A list of species collected within the quarter degree square **2723AD** are listed together with the species noted during the site visit. For all threatened plants that occur in the general geographical area of the project site, a rating of the likelihood of it occurring within the project site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match the general habitat description for species (e.g. grassland), but detailed microhabitat requirements (e.g. rocky grassland on shallow soils overlying dolomite) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. rocky grassland on shallow soils overlying granite);
- DEFINITE: species found on site.

7.2 Impact Rating Methodology

Direct, indirect and cumulative impacts of the issues identified in the EIA phase must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **consequences (magnitude)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is

very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

- The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- The **status**, which will be described as either positive, negative or neutral.
- The *degree* to which the impact can be **reversed**.
- The *degree* to which the impact may cause **irreplaceable loss of resources**.
- The *degree* to which the impact can be **mitigated**.

The significance is calculated by combining the criteria in the following formula:

S=(E+D+M)P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The significance weightings for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

7.3 Wetland Assessment and Delineation Methodology

7.3.1 Wetland delineation

Introduction

For the purposes of this investigation a wetland was defined according to the definition in the National Water Act (Act 36 of 1998) as: “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which in normal

circumstances supports or would support vegetation typically adapted to life in saturated soil."

In 2005 the DWS (the Department of Water and Sanitation, previously referred to as the Department of Water Affairs and Forestry, DWAF) published a wetland delineation procedure in a guideline document named "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*", guidelines for the undertaking of biodiversity assessments. These guidelines contain a number of stipulations relating to the protection of wetlands and the undertaking of wetland assessments. These guidelines state that a wetland delineation procedure must identify the outer edge of the temporary zone of the wetland, which marks the boundary between the wetland and adjacent terrestrial areas and it is that part of the wetland that remains flooded or saturated close to the soil surface for only a few weeks in the year, but long enough to develop anaerobic conditions and determine the nature of the plants growing in the soil.

The guidelines also state that locating the outer edge of the temporary zone must make use of four specific indicators namely:

- the terrain unit indicator;
- the soil form indicator;
- the soil wetness indicator; and
- the vegetative indicator.

In addition, the wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive in a sensitivity map. The guidelines stipulate buffers to be delineated around the boundary of a wetland; the wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive and a 30m buffer delineated around the edge of the wetland in which no development must be allowed to occur.

Desktop delineation

Use was made of 1:50 000 topographic maps, and geo-referenced Google Earth images to generate digital base maps of the project site onto which the wetland boundaries were delineated. A desktop delineation of suspected wetland areas was undertaken by identifying rivers and wetness signatures from the digital base maps. All identified areas suspected to be wetlands were then further investigated in the field.

Site assessment

The project site was traversed by foot and road to determine the presence of any wetland area/s. Notes were made of the broad ecological condition of the project site and any signs indicating the presence of a wetland. Delineation started in the lowest lying point of the project site and auger samples were taken at approximately 2m intervals. A Dutch soil auger was used to extract the cores to a depth of 50cm.

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

8. RESULTS

8.1 Vegetation overview

8.1.1 Broad vegetation types

The study area and project site is situated in the Savanna biome and Eastern Kalahari Bushveld Bioregion. The vegetation in and surrounding the study area and project site is the Kuruman Thornveld (SVk 9).

The distribution of the vegetation type is limited to the Northern Cape, from Postmasburg area to Hotazel in the north. This vegetation type has been described by Mucina and Rutherford (2006) as a flat plateau with a well-developed shrub layer with *Tarchonanthus camphoratus* and *Acacia erioloba*. The open tree layer has *Ziziphus mucronata, Acacia erioloba A. tortilis, A. hebeclada* and *A. mellifera* as dominant species.

A species list from POSA (http://posa.sanbi.org, Grid reference 2723AD) of the Kuruman area was obtained. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants published by SANBI in *Strelitzia* 25 (Raimondo et al. 2009, updated 2013). Only protected and red data species that may potentially occur in the study area and project site have been listed under results. The actual field survey confirmed which of the species, recorded

by the POSA list, (Annexure B) actually occur in the study area. In addition some species not listed by POSA are listed in Annexure A.

A total of 72 species have been recorded to occur on the site while only 26 species have been recorded for the degree square around Kuruman

a) Conservation status of broad vegetation types

The vegetation types of South Africa have been classified according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are as depicted in the table below, as determined by best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Table 8.1: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

The National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environment Management: Biodiversity Act (Act No. 10 of 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The threshold for listing in this legislation is higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

Table 8.2: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	**Target (%)**	**Conserved (%)**	**Transformed (%)**	**Conservation Status**	
				Driver et al., 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEM:BA)

Kuruman Thornveld	16%	0	2%	Least Threatened	Not Listed

According to Mucina and Rutherford (2006) none of the vegetation type (i.e. Kuruman Thornveld) is protected within formal conservation areas, but only 2% of this unit has been transformed. The conservation status of this unit is classified as **Least Threatened** and is not listed under the National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environment Management: Biodiversity Act (Act No. 10 of 2004).

b) Red List and protected plant species of the study area

As previously mentioned, a species list was obtained from POSA for the relevant degree grids. The species on this list were evaluated to determine the likelihood of any of them occurring in the study area and the project site. Of the species that are considered to occur within the geographical area under consideration, there were **28** species which are regarded conservation worthy. **Three** species recorded in the degree grids are listed on the Red List plant species (Red flagged species in Annexure A). The remaining **25** species are protected within Northern Cape Nature Conservation ordinance.

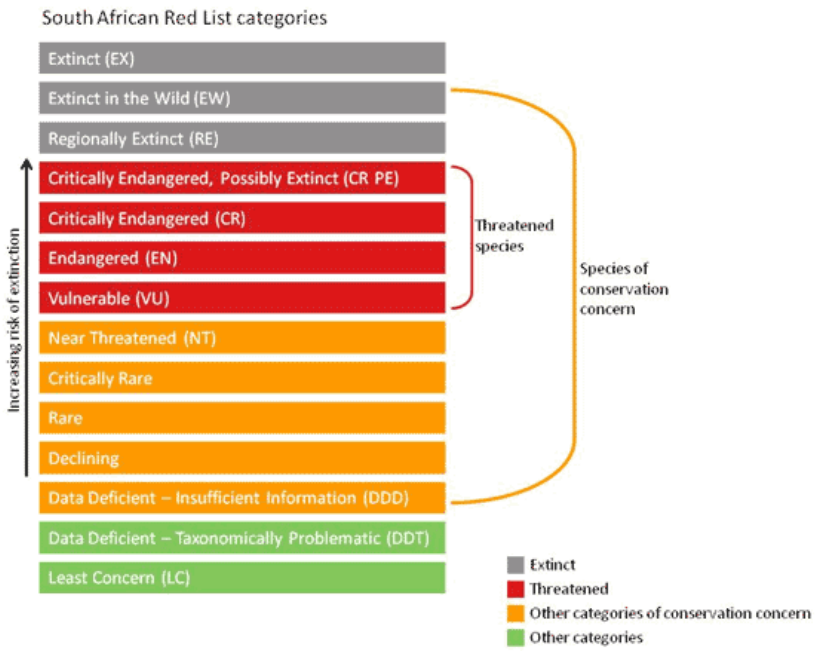

Figure 8.1: Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

Table 8.3: Species listed as conservation worthy within the South African Red List (SARL), National Forest Act (NFA), Northern Cape Nature conservation Ordination (NCNCO)

Family	Genus & species name	Status	Source
AIZOACEAE	Plinthus sericeus Pax	LC	NCNCO
AIZOACEAE	Trianthema parvifolia E.Mey. ex Sond. var. parvifolia	LC	NCNCO
AMARYLLIDACEAE	Nerine laticoma (Ker Gawl.) T.Durand & Schinz	LC	NCNCO
APIACEAE	Deverra burchellii (DC.) Eckl. & Zeyh.	LC	NCNCO
APOCYNACEAE	Brachystelma circinatum E.Mey.	LC	NCNCO
APOCYNACEAE	Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus	LC	NCNCO
APOCYNACEAE	Piaranthus decipiens (N.E.Br.) Bruyns	LC	NCNCO
APOCYNACEAE	Sarcostemma viminale (L.) R.Br. subsp. viminale	LC	NCNCO
CAPPARACEAE	Cleome conrathii Burtt Davy	NT	SARL
CARYOPHYLLACEAE	Dianthus namaensis Schinz var. dinteri (Schinz) S.S.Hooper	LC	NCNCO

CELASTRACEAE	Gymnosporia buxifolia (L.) Szyszyl.	LC	NCNCO
EUPHORBIACEAE	Euphorbia duseimata R.A.Dyer	LC	NCNCO
EUPHORBIACEAE	Euphorbia mauritanica L. var. mauritanica	LC	NCNCO
FABACEAE	Acacia erioloba E.Mey.	Declining	SARL /NFA
FABACEAE	Acacia haematoxylon Willd.	LC	NFA
GERANIACEAE	Pelargonium myrrhifolium (L.) L'Hér. var. myrrhifolium	LC	NCNCO
HYACINTHACEAE	Drimia sanguinea (Schinz) Jessop	NT	SARL
IRIDACEAE	Gladiolus permeabilis D.Delaroche	LC	NCNCO
IRIDACEAE	Lapeirousia erythrantha (Klotzsch ex Klatt) Baker		NCNCO
IRIDACEAE	Lapeirousia sandersonii Baker	LC	NCNCO
IRIDACEAE	Moraea polystachya (Thunb.) Ker Gawl.	LC	NCNCO
MESEMBRYANTHEMACEAE	Prepodesma orpenii (N.E.Br.) N.E.Br.	LC	NCNCO
OLEACEAE	Olea europaea L. subsp. africana (Mill.) P.S.Green	LC	NCNCO
OXALIDACEAE	Oxalis depressa Eckl. & Zeyh.	LC	NCNCO
PEDALIACEAE	Harpagophytum procumbens (Burch.) DC. ex Meisn.	Not Evaluated	NCNCO
SCROPHULARIACEAE	Jamesbrittenia atropurpurea (Benth.) Hilliard	LC	NCNCO
SCROPHULARIACEAE	Jamesbrittenia aurantiaca (Burch.) Hilliard	LC	NCNCO
SCROPHULARIACEAE	Jamesbrittenia integerrima (Benth.) Hilliard	LC	NCNCO

Table 8.4: Species listed as conservation worthy in terms of the South African Red List (SARL), National Forest Act (NFA), and Northern Cape Nature conservation Ordination (NCNCO) found on site during site survey.

Family	Genus & species name	Status	Source
AMARYLLIDACEAE	Nerine laticoma (Ker Gawl.) T.Durand & Schinz	LC	NCNCO
ASPHODELACEAE	Aloe heroensis	LC	NCNCO
IRIDACEAE	Lapeirousia kalahariensis Manning	LC	NCNCO
IRIDACEAE	Moraea polystachya (Thunb.) Ker Gawl.	LC	NCNCO
FABACEAE	Acacia erioloba E.Mey.	Declining	SARL/NFA
MESEMBRYANTHEMACEAE	Chasmatophyllum muscullinum	LC	NCNCO

8.1.2 Fine- scale vegetation description

It was found that the vegetation of the project site is strongly related to the Kuruman Thornveld as described by Mucina & Rutherford 2006. Small variations especially in terms of the dominant grass species and rocky outcrops species occur throughout the

site. Geology and the soil forms appear to be the driving force between the variations found between the different units.

Two different plant communities occur within the project site. The one covers the majority of the surface area and is dominated by trees and shrubs and can be described as:

a) *Acacia erioloba – Searsia lancea* tree community. This is a typical savanna community which occurs on deeper sandy soils. It consists of a grass layer which is dominated by *Schmidtia pappophoroides, Heteropogon contortus* and *Eragrostis trichophora* and scattered trees and shrubs such as *Acacia erioloba, Searsia lancea, Ziziphus mucronata, Acacia hebeclada, A. mellifera, Searsia tridactyla* and *Diospyros lycioides*. The species richness is quite high with about **70** species noted (Annexure A).

Red List and protected plant species noted during the survey in this community:

A total of two conservation worthy species were noted within the project site namely:

- *Acacia erioloba* (Declining)
- *Aloe heroensis* (NCNCO)

Ecosystem function

- Grazing and browsing;
- Trees and shrubs provide nesting areas for avifauna and occasional shelter for terrestrial fauna;
- Niche habitats for fauna – providing sheltered burrows and nesting sites, hence the high presence of fauna observed on and around these areas;
- Niche habitats for specific flora species;
- Micro-climate is created by the shrubs and trees housing species sensitive to direct sunlight or frost.

This community has a relatively high density of Camel Thorn (*Acacia erioloba*) individuals. There should be a pre-construction walk-through of the development footprint in order to locate individuals of Camel Thorn which would have to be removed. Species of conservation concern (e.g. Aloes) must be located and relocated to a suitable and similar habitat where these plants can grow without any disturbance.

b) *Oropetium capense – Aristida congesta* dolomite sheet community. This community is limited to areas where dolomite outcrops occur. The soil is very shallow and it supports a sparsely distributed plant community which consists of grasses such as Oro*petium capense, Aristida congesta, Enneapogon desvauxii, Eragrostis obtusa, Fingerhuthia africana* and forbs such *as Limeum aethipicum, Indigofera alternans, Euphorbia inaequilatera, Sesamum triphyllum,* as well as bulbous species such as *Nerine laticoma, Dipcadi ciliare, Moraea polystachya, Ornithoglossum vulgare* and the recently described *Lapeirousia kalahariensis*. The species richness is about **25** species noted (Annexure A).

Red List and protected plant species noted during the survey in this community:

A total of four conservation worthy species were noted within the project site namely:

- *Chasmatophyllum muscullinum* (Declining)
- *Lapeirousia kalahariensis* (NCNCO)
- *Moraea polystachya* (NCNCO)
- *Nerine laticoma* (NCNCO)

Ecosystem function

- Niche habitats for fauna – providing sheltered burrows and nesting sites, hence the high presence of fauna observed on and around these areas;
- Niche habitats for specific flora species.

In terms of its species composition (especially the very shallow soil on dolomite) this unit must be regarded as unique and contains rocky outcrops throughout the project site. However, these features are considered to be of a medium ecological sensitivity due to the distribution of these rocky outcrops within the broader study area. Therefore, these features can be considered as acceptable loss to the development of the Metals Industrial Cluster without detrimental environmental effects.

c) Wetland communities

The project site is sloping gently towards the east. **No seasonal drainage lines or wetlands** occur within the project site (Fig 3).

d) Alien Invasive Plants (AIPs) confirmed during the survey

The largest concentration of alien plant species is along the road reserve, located along the western boundary of the project site, where species such as **Verbesina*

encelioides *Argemone mexicana, *Datura stramonium *Tagetes minuta, *Bidens bipinnata* and **Conyza bonariensis* were noted.

9. CRITICAL BIODIVERSITY AREAS AND BROAD–SCALE ECOLOGICAL PROCESSES

9.1 Definitions and descriptions of Critical Biodiversity Areas of the Northern Cape Province

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision making tools. The use of CBAs within the North West Province follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008).

The identification and mapping of CBAs forms part of the biodiversity assessment of the Northern Cape Province which will be used to inform the development of the Provincial Biodiversity Sector plans, bioregional plans, and also be used to inform Spatial Development Frameworks (SDFs), Environmental Management Frameworks (EMFs), Strategic Environmental Assessments (SEAs) and in the Environmental Impact Assessment (EIA) process in the province.

Simply put, the purpose of the CBA is to indicate spatially the location of critical or important areas for biodiversity in the landscape. The CBA, through the underlying land management objectives that define the CBA, prescribes the desired ecological state in which the province would like to keep this biodiversity. Therefore, the desired ecological state or land management objective determines which land-use activities are compatible with each CBA category based on the perceived impact of each activity on biodiversity pattern and process.

According to the guidelines for bioregional plans, three basic CBA categories can be identified based on three high-level and management objectives (Table 9.1).

Table 9.1: Definitions and framework for linking CBAs to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives (Adapted from the guidelines for bioregional plans (Anon 2008)).

CBA category	Land Management Objective
Critical Biodiversity Areas (CBAs) Definition: CBAs 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.	
Protected Areas (PA) & CBA 1	**Natural landscapes:** Ecosystems and species are 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 landscapes that are at or past their limits of acceptable change.
CBA 2	**Near-natural landscapes:** Ecosystems and species are largely intact and undisturbed. Areas with intermediate irreplaceability or some flexibility in terms of the area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESAs) Definition: ESAs 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, food 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.	
ESA	**Functional landscapes:** Ecosystem is 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 a low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	Production landscapes: Manage land to optimisze sustainable utilisation of natural resources.

No critical biodiversity areas (CBAs) or Aquatic area are situated within the project site and is therefore not considered relevant for the project.

9.2 FAUNA SURVEY

9.2.1 Mammals

Although the potential diversity of mammals within the study area is high with as many as 55 terrestrial mammals and 9 bat species present, there are several factors which will reduce the actual number of species present within the project site. The presence of humans and roads and the hunting of animals, the grazing and browsing of plants by domestic animals, has had a major impact on the natural animal populations in the Kuruman area.

Listed mammals which may occur in the area include the White-tailed Mouse *Mystromys albicaudatus* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed Cat *Felis nigripes* (Vulnerable), Honey badger *Mellivora capensis* (IUCN LC, SA RDB EN), South African hedgehog *Atelerix frontalis* (SA RDB NT) and Ground Pangolin *Smutsia temminckii* (VU).

During the site visit the following faunal species were confirmed within the project site:

- Small colony of rodent burrows (most likely Pouched Mouse – *Saccostomus campestris* and/or Bushveld Gerbil – *Gerbilliscus leucogaster* and/or Four-striped Grass Mouse – *Rhabdomys pumilio*)
- Single rodent burrows (most likely Pygmy Hairy-footed Gerbil – *Gerbillurus paeba*)
- Common Mole-rat (*Cryptomys hottentotus*)
- Cape Porcupine (*Hystrix afrecaeaustralis*)
- Slender Mongoose (*Galerella sanguinea*)
- Yellow Mongoose (*Cynictis penicillata*)
- Relative large burrows (likely to have been made and utilized by Aardwolf – *Proteles cristatus* and/or Aardvark – *Orycteropus afer*)
- Steenbok (*Raphicerus campestris*)
- Common Duiker (*Sylvicapra grimmia*)

None of these species noted within the project site are listed and or protected species. Furthermore most of these species are highly mobile and will move away from the construction area and some may move back during the operation phase of the project.

9.2.2 Reptiles and Amphibians

Of the 27 reptilian species that have been recorded with the region none of these species are listed as Red Data species.

Fifteen amphibian species have been recorded within the region and of these 15 species eight species were recorded within close proximity of the project site. One near threatened species namely the Giant Bullfrog (*Pyxicephalus adspersus*) has been recorded for the quarter degree grid square (QDGS). Although this species was found on site (not a suitable habitat), it is still likely for this species to occur near the project site as potential suitable habitat (pans and drainage lines) is available east of the project site.

10. ECOLOGICAL SENSITIVITY ANALYSIS (Figure 10.1)

The sensitivity assessment identifies those parts of the project site that will a have a medium to high conservation value or that will be sensitive to disturbance. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have a low sensitivity. The habitat sensitivity assessment was done according to the rules provided in the "Sensitivity mapping rules for biodiversity assessments". There are features within the project site or just outside of the project site that may be considered to have a medium conservation value, as follows:

10.1 Seasonal streams

Episodic streams with a medium sensitivity occur on the eastern side of the project site but are not located within the project site itself. There will be no direct impact on these features.

- **Potential impacts:** Pollutants from the construction and operation of the Metals Industrial Cluster within the project site may contaminate the seasonal stream, and in turn downstream aquatic systems (such as the non-perennial Kuruman River).
- **Mitigation measures**: A berm can protect the seasonal stream by containing the storm water runoff of the Cluster. The stormwater from the site can be treated by allowing the water to flow through a biofilter system of reeds, bulrush, aquatic grasses and sedges.

10.2 Sensitive vegetation:

The plant community of the shallow soils on a dolomite outcrops is of medium ecological sensitivity. The species composition is unique to these outcrop areas, and a number of bulbous species occur in this community.

- **Potential impacts:** The loss of the plant community.

- **Mitigation measures**: None, as the entire project site will be developed and the features destroyed. The destruction of these features are considered to be acceptable loss due to the distribution of these features within the surrounding areas of the project site, that is, not unique to the project site alone.

10.3 Threatened and protected plant species:

There are a number of protected and Red Data species present on the project site.

- **Potential impacts:** The loss of species through the clearance of the site during the construction phase.
- **Mitigation measures**:
  Aloes can be translocated to similar suitable sites where they will not be negatively affected.
  The minimum number of Camel Thorn (*Acacia erioloba*) trees to be removed from the site (destruction permit required from DAFF). The relocation of the other species must be considered where feasible.

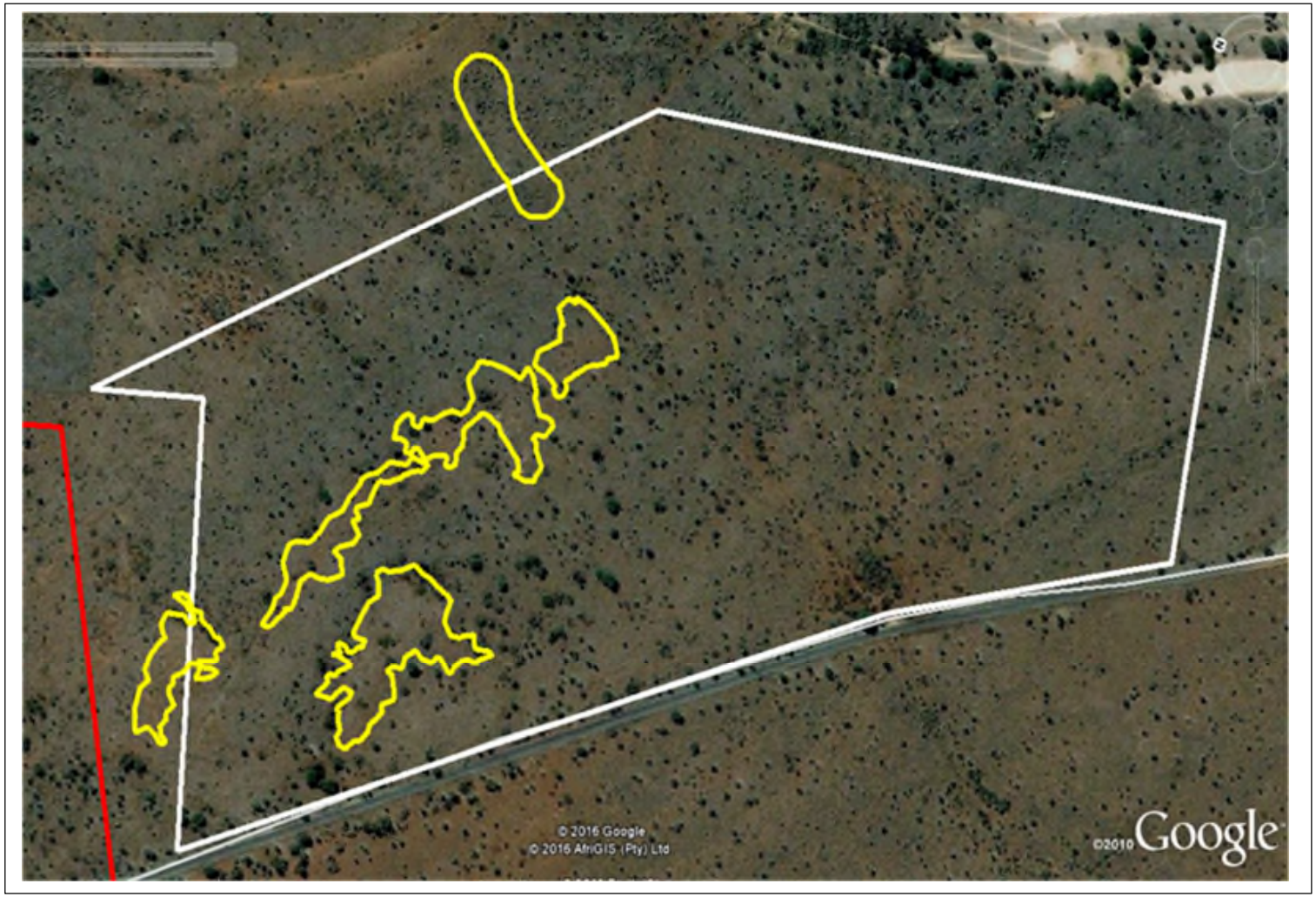

Figure 10.1: The sensitive systems present within the project site. The yellow polygons indicate the rocky outcrop communities which have a medium sensitivity and are considered to be acceptable loss to the development of the Metals Industrial Cluster. The red line indicates a nearby power line. White lines indicate project site boundary.

11. SITE IDENTIFICATION & NATURE OF IMPACTS

11.1 Overview of the most significant effects of the proposed development

a) Impacts on vegetation and protected plant species

As mentioned above, the most likely and significant impact will be on the vegetation. The proposed development will lead to a direct loss of vegetation. Consequences of the impact occurring may include:

- general loss of habitat for sensitive species;
- loss in variation within the medium sensitive habitat due to loss of portions of it;
- general reduction in biodiversity;
- increased fragmentation (depending on the location of the impact);
- disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- loss of ecosystem goods and services.

From a vegetation perspective this site's vegetation is similar to the region's vegetation and it is not situated in a critical Biodiversity Area, therefore the impact on the vegetation within the project site will not be significant.

A number of protected and red data species (28) occur (confirmed within POSA generated species list (Table 8.3) occur on the quarter degree square (2723AD) project site. Of these listed species (Table 8.4) six species were noted on the project site. Although these species are listed as protected species, the loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. On a local level the proposed project will impact on such individuals or populations. Consequences may include:

- fragmentation of populations of affected species;
- reduction in area of occupancy of affected species; and
- loss of genetic variation within affected species.

These impacts can be largely mitigated through avoidance of listed species, by allowing a minimum clearance of vegetation (restricted to the absolute necessary areas) etc. Protected plants can also be relocated to similar habitats nearby.

b) Direct faunal impacts

Faunal species will primarily be affected by the overall loss of habitat. Increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the broader area during the construction phase as a result of noise and human activity, while some slow-moving species and species confined and dependent on specified habitats would not be able to avoid the construction activities and might be killed. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phases. This impact is highly likely to occur during the construction phase and would also occur with resident fauna within the facility after construction.

Threatened species (red data species) include those listed as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possible extinction. This may arise if the proposed infrastructure is located where it will impact on such individual or populations. Consequences may include:

- fragmentation of populations of affected species;
- reduction in area of occupancy of affected species; and
- loss of genetic variation within affected species.

These may all lead to a negative change in the conservation status of the affected species, which implies a reduction in the chances of the species' overall survival.

Disturbance of faunal species can be maintained to a minimum and low significance by implementing effective mitigation measures.

c) Impacts on ephemeral tributaries and other water bodies

No ephemeral streams occur on site, however an episodic stream with a medium sensitivity is located on the eastern side of the project site about 70m from site boundary. Pollutants from the construction and operation of the Metals Industrial Cluster within the project site may potentially contaminate the seasonal streams due to un-controlled run-off. A berm can protect the seasonal stream by containing storm water runoff from the Metals Industrial Cluster. Stormwater can be treated by allowing the water to flow through a biofilter system of reeds, bulrush, aquatic grasses and sedges. Consequences to downstream systems may include:

- increased loss of soil on site and deposition of sediment in streams surrounding the project site;

- loss of sensitive wetland habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
- impairment of wetland function; and
- reduction in water quality in wetlands downstream.

By implementing mitigation measures, including the construction of a berm to prevent contaminated stormwater from entering seasonal streams, the impacts on the stream can be reduced significantly.

d) Soil erosion and associated degradation of ecosystems

Soil erosion is a risk associated with developments where vegetation clearing and disturbance is taking place. Service roads, pavements and roofs of buildings will generate an increase in runoff during intense rainfall events and may potentially exaggerate the effects of erosion. These eroded materials may enter the nearby streams and may potentially impact these systems through siltation and change in chemistry and turbidity of the water.

With effective mitigation measures in place, including regular monitoring, the occurrence, spread and potential effects of erosion may be limited to an absolute minimum.

e) Alien Plant Invasions

Major factors contributing to an invasion by alien invader plants includes habitat disturbance and associated destruction of indigenous vegetation. Consequences of this may include:

- change in vegetation structure leading to change in various habitat characteristics;
- change in plant species composition;
- change in soil chemistry properties;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

The largest concentration of alien plant species is along the road reserve, located along the western boundary of the project site, where species such as **Verbesina encelioides* **Argemone mexicana,* **Datura stramonium* **Tagetes minuta,* *Bidens *bipinnata* and **Conyza bonariensis* were noted. Consequences of this may include:

- loss and displacement of indigenous vegetation outside of the project site due to invasion by alien invasives.

Although the potential severity of this impact may be high, it can be easily mitigated through regular alien control.

f) Impacts on Critical Biodiversity Areas and Broad-Scale Ecological Processes

No impacts are applicable as no Critical Biodiversity Areas occur on the project site or in the surrounding areas.

11.2 Potential cumulative impacts due to nearby developments

As the development is proposed to be located within the urban edge of the project site it can be expected that more development will be taking place within close proximity of the project site. Future developments will also require the removal of vegetation which will have an impact. However, the impact will be low due to the conservation status of the vegetation which is classified as Least Threatened.

11.3 Conclusion on cumulative impacts due to surrounding developments:

It is highly unlikely that a cumulative effect could arise from the development of the Metals Industrial Cluster, if future and current development implement mitigation measures proposed for each individual project. It is unlikely that development will result in the reduced ability of the vegetation unit to meet its conservation targets as the conservation status of the vegetation is classified as a Least Threatened ecosystem.

Due to the semi-natural environment, already transformed due to some degradation, bush encroachment and the highly fractured nature that characterize this area, the earmarked area contribute little towards the functionality of the plant communities and the ecology.

It is recommended that efforts on invasive species management, erosion control and rehabilitation is coordinated to avoid negative effects of one development on the environmental state on and around the other.

11.4 Impact risk factors for different phases of the project

Potential ecological impacts resulting from the development would stem from a variety of different activities and risk factors associated with the construction and operation phases of the project including the following:

a) Construction Phase

Vegetation clearing for roads, buildings, storage areas, etc. could impact listed plant species as well as high biodiversity plant communities. Vegetation clearing will also lead to habitat loss for fauna and potentially the loss of sensitive faunal species, habitats and ecosystems.

Erosion risk may result due to the loss of plant cover and soil disturbance created during the construction phase. This may impact the nearby seasonal streams and the larger downstream seasonal streams if large amounts of sediment enters the drainage systems (although unlikely to be at this extent). Although the effects would probably only become apparent during the operation phase, the impact stems from the construction phase and suitable mitigation measures will also need to be applied at this stage.

Presence and operation of construction machinery on site. This will create a physical impact as well as generate dust and noise pollution and other forms of disturbance on site.
Increased human presence can lead to poaching, wood harvesting, illegal medicinal plant harvesting and other forms of disturbance such as veld fires.

Loss of connectivity and habitat fragmentation may result due to the presence of the roads, site fencing and other support infrastructure of the development.

b) Operation Phase

The daily maintenance and operation activities of the facilities would generate some noise and disturbance which may deter some fauna from the area. Loss and displacement of indigenous vegetation outside of the project site due to invasion by alien species.

12. ASSESSMENT OF IMPACTS

12.1 Impacts of the proposed Metals Industrial Cluster, access roads and associated infrastructure

The project site is very homogenous in terms of the vegetation type (i.e. Kuruman Thornveld) and the rocky outcrop areas are widespread, and not confined to the project site.

Table 12.1: List of impacts

1. Activity: Upgrading and/or creation of site access road and internal roads.		
Environmental Aspect: Removal of vegetation, compaction and disturbance of soils, creation of runoff zone, destruction of animal burrows, impact on protected species, alteration of soil surface properties		
Environmental impact: Loss of vegetation, increase in runoff and erosion, possible distribution of alien invasive species, possible disturbance and reduction of habitat or injury to burrowing vertebrates, possible change of natural runoff and drainage patterns, possible loss of protected species, possible permanent loss of revegetation potential of soil surface. Note: relatively large access roads already exist to provide access to the site boundary.		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (4)	Minor (2)
Probability (P)	Highly Probable (4)	Highly Probable (4)
Significance **(S = E+D+M)*P**	**Medium (40)**	**Low (28)**
Status (positive, neutral or negative)	Negative	• Neutral where situated on transformed areas or on existing access roads. • Negative on undisturbed areas. • Minimal new negative impacts expected.
Reversibility	Not reversible	Relatively reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	
Mitigation: • After the final layout has been approved, conduct a thorough footprint investigation (walk-through) to detect and map (by GPS) all protected plant species, especially Camel Thorn Tree individuals which will have to be removed, and where applicable a permit would be required, and animal burrows present within the project site. • Protected plant species must be relocated if possible. • Animal burrows must be monitored by the ECO prior to construction for activity/presence of animal species. If detected, such animals must be removed and relocated by a qualified professionals/contractor.		

- During construction create designated turning areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas.
- Keep the clearing of natural and semi-natural grasslands to a minimum.
- If fil material is to be used, this should be sourced from areas free of invasive species.
- Topsoil (the upper 25 cm of soil) is an important natural resource with a seedbank; where it has to be stripped, never mix it with subsoil or any other material. Store and protect it separately until it can be re-used, and minimise the handling of the topsoil.
- Reinforce portions of existing access routes that are prone to erosion, create structures or low berms to drain the access roads rapidly during rainfall events, yet preventing erosion of the track and surrounding areas.
- Ensure that runoff from compacted or sealed surfaces is slowed down and dispersed sufficiently to prevent accelerated erosion from being initiated (stormwater and erosion management plan required).
- Monitor the establishment of (alien) invasive species and remove as soon as detected, before regenerative material can be formed.
- After decommissioning, if access roads or portions thereof will not be of further use to the landowner, remove all foreign material and rip area to facilitate the establishment of vegetation, followed by a suitable revegetation program.

Cumulative impacts:

- Possible erosion of areas lower than the access roads,
- Possible spread and establishment of alien invasive species.

Residual impacts:

- Altered vegetation composition and structure.
- Altered topsoil conditions.
- Potential barren areas.
- Potential for erosion and invasion by weed or alien species.

2. Activity: Installation of fencing around the project area– may also serve as maintenance track and as fire-break.

Environmental Aspect: (Note: Fencing already exists around the entire site, but will most likely be upgraded and reinforced). Removal of vegetation, compaction of soils, creation of runoff zone, impact on protected species, impact on movement of terrestrial vertebrates.

Environmental impact: Loss of vegetation and specifically protected or red data species, window of opportunity for the establishment of alien invasive species, altered topsoil characteristics prone to compaction, increased runoff and erosion, temporary disturbance of burrowing animals, possible reduction of habitat and forage availability to terrestrial vertebrates.

	Without mitigation	**With mitigation**
Extent (E)	Local (1)	Local (1)
Duration (D)	Long-term (4)	Long term (4)
Magnitude (M)	Low (4)	Small (0)
Probability (P)	Highly Probable (4)	Probable (3)

Significance (S = E+D+M)*P	**Medium (36)**	**Low (15)**
Status (positive, neutral or negative)	Negative	• Neutral where present on transformed areas. • Slightly Negative on natural areas. • Minimal new negative impacts expected.
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	

Mitigation:

- After the final layout has been approved, conduct a thorough footprint investigation to detect and map (by GPS) any protected plant species and animal burrows.
- Protected plant species must be relocated if possible.
- Animal burrows must be monitored by the ECO prior to construction for activity/presence of animal species. If detected, such animals must be removed and relocated by a qualified professional/contractor.
- During the design phase, the possible impact of burrowing vertebrates and rodents on the development must be determined, and fencing must be designed to either exclude these animal species if it will be detrimental or enable occasional migration of smaller vertebrates onto and across the site (which could be beneficial to small vertebrate populations).
- Minimise the area affected, especially during construction.
- During construction strictly prohibit any off-road driving or parking of vehicles and machinery outside the footprint areas.
- Strictly prohibit littering of any kind.
- Monitor the establishment of alien and indigenous invasive species and remove as soon as detected, whenever possible before regenerative material can be formed.
- If the area will be used as a fire-break, maintain a suitably low grass layer by regular mowing or appropriate species selection, but do not leave soil bare. Alternatively, ensure that the soil is covered to prevent erosion.

Cumulative impacts:

- Possible erosion of cleared areas and associated accelerated erosion from surrounding areas.
- Possible loss of ecosystem functioning due to an increase in invasive species.

Residual impacts:

- Altered vegetation composition.
- Compacted topsoil.
- Possibility for erosion and invasion by alien invasive species.

3. Activity: Construction and operation of buildings and loading zones on semi-natural vegetation and disturbed areas

Environmental Aspect: Removal of or excessive damage to vegetation, compaction of topsoil, creation of runoff zone, redistribution and concentration of runoff from surfaces, displacement of terrestrial vertebrates, reduced buffering capacities of the landscapes during extreme weather events.

Environmental impact: Loss of vegetation and/or species of conservation concern, loss of and alteration of microhabitats, altered vegetation cover, site-specific altered distribution of rainfall and resultant runoff patterns, general increase in runoff from hard surfaces and/or bare areas and associated accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible increase of detrimental effects during periods of extreme weather events, e.g. increased flooding, severe erosion or dust due to lower buffering capacity of sparser vegetation

	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Moderate (6)	Low (4)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**High (60)**	**Medium (45)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Highly Probable	Slight Probability
Can impacts be mitigated?	Reasonably	

Mitigation:

- After the final layout has been approved, conduct a thorough footprint investigation to detect and map (by GPS) any protected plant species and active animal burrows.
- Protected plant species must be relocated if possible.
- Animal burrows must be monitored by the ECO prior to construction for activity/presence of animal species. If detected, such animals must be removed and relocated by a qualified professional/contractor.
- Keep areas affected to a minimum, strictly prohibit any disturbance outside the demarcated footprint area.
- Clear as little indigenous vegetation as possible, aim to maintain vegetation where it will not interfere with the construction or operation of the development, rehabilitate an acceptable vegetation layer according to rehabilitation recommendations of the relevant EMPr, if possible.
- Use only species that were part of the original indigenous species composition as listed in the specialist report.
- Remove all invasive vegetation before and after construction and continuously up to decommissioning.
- If fill material is to be used, this should be sourced from areas free of invasive species.
- Topsoil (the upper 25 cm of soil) is an important natural resource; where it must be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise the handling of topsoil.

- Temporarily stored topsoil must be re-applied within 6 months, topsoil stored for longer need to be managed according to a detailed topsoil management plan.
- Monitor the area regularly after larger rainfall events to determine where erosion may be initiated and then mitigate by modifying the soil micro-topography and revegetation or soil erosion control efforts accordingly.
- Prevent leakage of oil or other chemicals, and strictly prohibit littering of any kind.
- Monitor the establishment of all invasive species and remove as soon as detected, whenever possible before regenerative material can be formed

Cumulative impacts:

If mitigation measures are not strictly followed the following could occur:

- contamination of drainage lines, lower-lying rivers or wetlands located outside of the project site.
- alteration of occupancy by terrestrial fauna beyond the project site, possible reduction of available habitat and food availability to terrestrial fauna.
- spread and establishment of invasive species.

Residual impacts:

- Altered topsoil characteristics.
- Altered vegetation composition.

4. Activity: Temporary construction camps and sites where machinery is kept during construction.

Environmental Aspect: Removal of vegetation, compaction of soils, creation of runoff zone, displacement of terrestrial vertebrates, possible contamination of topsoil and groundwater by hydrocarbons.

Environmental impact: Loss of vegetation and/or species of conservation concern, loss of microhabitats, altered vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in concentrated runoff from sealed or compacted surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible contaminated topsoil, possible contaminated ground water or wetlands located outside of the project site.

	Without mitigation	**With mitigation**
Extent (E)	Regional (4)	Local (1)
Duration (D)	Medium-term (3)	Short-term (2)
Magnitude (M)	Moderate (6)	Minor (2)
Probability (P)	Definite (5)	Probable (3)
Significance (S = E+D+M)*P	**High (65)**	**Low (15)**
Status (positive, neutral or negative)	Negative	Slightly Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely

Can impacts be mitigated?	Reasonably	
Mitigation: • After the final layout has been approved, conduct a thorough footprint investigation to detect and map (by GPS) any protected plant species and animal burrows. • Protected plant species must be relocated where deemed necessary. • Animal burrows must be monitored by the ECO prior to construction for activity/presence of animal species. If detected, such animals must be removed and relocated by a qualified professional/contractor. • Place infrastructure as far as possible on sites that have been transformed already. • Stay within demarcated temporary construction areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas. • Prevent spillage of construction material and other pollutants, contain and treat any spillages immediately, strictly prohibit any pollution/littering according to the relevant EMPr. • No fires may be lit for cooking or any other purposes. • Facilities may not be used as staff accommodation. • Topsoil (the upper 25 cm of soil) is an important natural resource; where it must be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil. • Temporarily stored topsoil must be re-applied within 6 months, topsoil stored for longer need to be managed according to a detailed topsoil management plan. • After construction remove all foreign material prior to starting the rehabilitation. • Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed.		
Cumulative impacts: If mitigation measures are not strictly followed the following could occur: • contamination of drainage lines, lower-lying ephemeral streams and wetlands located outside of the project site. • contamination of groundwater which is an extremely important source of water supply for the region. • spread and establishment of invasive species.		
Residual impacts: • Altered topsoil characteristics. • Altered vegetation composition.		

5. Activity: Transport of materials to site, movement of vehicles on site during construction and operation.
Environmental Aspect: Compaction of soils, possible contamination by hydrocarbons, possible introduction and spread of weeds and alien invasive species, temporary disturbance of terrestrial fauna.
Environmental impact: Loss of vegetation, increase in runoff and erosion, disturbance or possible mortality incidents of terrestrial fauna, possible contamination of soil and groundwater by oil- or fuel spillages, possible establishment and spread of undesirable weeds and alien invasive species that could further damage ecosystem functionality.

	Without mitigation	With mitigation
Extent (E)	Regional (4)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (4)	Small (0)
Probability (P)	Definite (5)	Highly Probable (4)
Significance (S = E+D+M)*P	**Medium (60)**	**Low (20)**
Status (positive, neutral or negative)	Negative	Neutral
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- Restrict all movement of vehicles and heavy machinery to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas may be allowed.
- Parking areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary stormwater control) if oil and fuel spillages are highly likely to occur.
- Strict speed limits must be set and adhered to.
- Driving between dusk and dawn should be permissible to emergency situations only.
- Prevent spillage of any, oils or other chemicals, strictly prohibit other pollution.
- Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed, destroy all material to prevent re-establishment.

Cumulative impacts:

- Possible pollution of surrounding areas if no mitigation is implemented.
- Contamination of groundwater which is an extremely important source of water supply for the region.
- Possible spread of alien invasive species beyond the site if no mitigation is implemented.

Residual impacts:

- Related to access roads and internal maintenance tracks only.

Assessment of Cumulative Impacts

1. Nature: Reduced ability to meet conservation targets
Environmental Aspect: Reduced ability to meet conservation targets of the Northern Cape Province.
Environmental impact: The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets. The area is not included within a National Protected Areas Expansion Strategy focus area, and falls outside any threatened and or endangered ecosystem type / vegetation type. Although the vegetation type in the study area are

classified as Least Threatened, it is poorly protected and certain habitats or communities may be subsequently affected.		
	Overall impact of the proposed project considered in isolation	**Cumulative Impact of the project and other projects in the area**
Extent (E)	Local (1)	Local (3)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Small (0)	Low (4)
Probability (P)	Very Improbable (1)	Probable (3)
Significance (S = E+D+M)*P	**Low (5)**	**Low (33)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Low reversibility
Irreplaceable loss of resources?	Not Likely	Probable
Confidence in finding	High	
Mitigation: • Implementation of the required mitigation measures for all developments within the area. • Preconstruction walk-through to ensure that sensitive habitats are avoided. • Minimise the development footprint as far as possible.		

12.2 Implications of the anticipated impacts for Site

The proposed development will have a significant impact on the above-ground ecology of the site. It will however be reduced with the implementation of mitigation measures. The project site has a low ecological sensitivity because of the vegetation type (i.e. Kuruman Thornveld) which is widespread and classified as a least threatened ecosystem. The site is also semi-degraded due to past agricultural activities (over grazing). There are rocky outcrops located within the project site, which are considered to be of a medium ecological sensitivity due to the distribution of these features throughout the area and is considered to be acceptable in terms of loss of the features to the development.

Potentially significant negative impacts on the ecological environment could be soil degradation issues because of construction activity; possible introduction of alien invasive plants, a long-term (more than 8 months) low or absent vegetation cover after construction and impacts on protected plant species.

With the diligent implementation of mitigating measures by the developer, contractors, and operational staff, the severity of these impacts can be minimised and reduced to acceptable levels. The impact on fauna is expected to be small to negligent. Presence of indigenous terrestrial vertebrates within the study area is relatively low. Animals that may be permanently present can be relocated or will move away during construction, and may resettle after construction, depending on safety specifications necessitated by the development. No restricted or specific habitat of vertebrates exist on the project site that will be affected by the proposed development.

13 DISCUSSION AND CONCLUSION

The proposed establishment of a Metals Industrial Cluster in Kuruman triggers a number of listed activities as included in the Environmental Impact Assessment Regulations (08 December 2014), GN R 982 – 985, in accordance with the National Environmental Management Act, No. 107 of 1998 (NEMA), as amended. The appointed Environmental Assessment Practitioner, Savannah Environmental (Pty) Ltd, commissioned EnviroNiche Consulting, to undertake an ecological impact assessment to determine the impacts which may occur due to the development of the Metals Industrial Cluster. The requirements of this assessment were to undertake a specialist study to assess the biodiversity and ecology of the project site as well as determine the significance of the impacts that the proposed Metals Industrial Cluster will have within the identified project site and on the ecological features and functioning present.

The project site is situated south-east of Kuruman. The project site and surrounding area were assessed for any sensitive ecosystems including drainage lines and wetlands. It was found that

there are no wetland or drainage lines on the project site although a seasonal drainage line is situated just outside the site's eastern boundary. The site is situated in the Kuruman Thornveld (SVk9) vegetation type. According to Mucina & Rutherford (2006), this vegetation type has a conservation status of "Least Threatened". On plant community level, there are also some sensitive habitats (dolomite and rocky outcrops) present on the project site. However, these are only considered to be of a medium ecological sensitivity and are considered acceptable in terms of loss.

In terms of the National Forest Act (Act 84of 1998), the protected species present on the project site is the Camel Thorn (*Acacia erioloba*) which is also listed as a Red Data species. The density of Camel Thorns is about 35 individuals per hectare. A number of protected plant species also occur on the project site. They are listed in terms of the Northern Cape Nature Conservation Act (Act 9 of 2009).

From an ecological perspective the project site is suitable for a development of this nature if the recommended mitigation measures are adhered to and implemented.

13.1 No-go Option

The No-Go Option means that the status quo in terms of ecosystem functioning and the existence of protected species remains on the project site as the proposed Metals Industrial Cluster will not be constructed.

However, if the no-go option is applied then the economic benefits and potential growth of the greater Kuruman area will not be released and it will be considered as a lost opportunity for progress in the area.

Therefore, due to the acceptability of the project site for the development and the overall sensitivity of the project site the no-go option is not considered as being feasible and will therefore not be implemented.

13.2 The most significant potential impacts expected are:

The following impacts are considered to be the most significant regarding the development of the Metals Industrial Cluster:

- Reduction of a stable vegetation cover and associated below-ground biomass that currently increases soil surface porosity, water infiltration rates and thus improves the soil moisture availability. Without this vegetation, the soil will be prone to extensive surface capping,

leading to accelerated erosion and further loss of organic material and soil seed reserves from the local environment.

- A loss of portions of potential sensitive habitats. .
- Disturbed vegetation in the project site carries a high risk of invasion by alien invasive plants, which may or may not be present in the project site or in close proximity to the project site. The control and continuous monitoring and eradication of alien invasive plants will form and integral part of the environmental management of the facility from construction to decommissioning.
- Possible impacts on the nearby drainage lines that may be present outside of the project site, as well as larger drainage lines and the non-perennial Kuruman River downstream from the project site due to altered surface. This may influence species depending on these parts of the ecosystem, as well as downstream wetland ecosystems.
- Aquifers play an important role as a water resource throughout the region. The project site falls within an area with a high amount of groundwater resources. Due to the high infiltration rates of the soils, chemicals and other pollutants pose a threat to these resources if not mitigated effectively. Furthermore, an increase in infiltration may potentially lead to dissolution of carbonate rocks in these areas, by water that percolates through pre-existing fractures leading to enlarged fracture apertures which may consequently result in the development of large cavities and sinkholes.

14. RECOMMENDATIONS

The following is recommended:

<u>General</u>

- An Environmental Control Officer (ECO) must be appointed to oversee that the aspects stipulated in the Environmental Permit be carried out properly;
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to;
- The areas to be cleared as well as the construction area should be clearly demarcated;
- All construction vehicles should adhere to clearly defined and demarcated roads;
- Dust suppression and erosion management should be an integrated component of the construction approach;
- No dumping of building waste or spoil material from the development should take place on areas other than a licenced landfill site;
- All hazardous materials should be stored appropriately to prevent contamination of the project site. Any accidental chemical, fuel and oil spills that occur at the project site should be cleaned up appropriately as related to the nature of the spill;

- The project site is situated in the close proximity of a tributary of the non-perennial Kuruman River. This seasonal tributary is situated on the eastern and south-eastern sides of the project site, however the project site does not infringe on the features. Development / construction within a 500m distance from a water course requires an application for a water use license to the Department of Water Affairs;

Flora

- There should be a preconstruction walk-through of the development footprint/project site in order to locate individuals of Camel Thorn trees which would have to be removed. Plant species of conservation concern (e.g. Aloes) must also be located and relocated to a suitable and similar habitat where these plants can grow without any disturbance.
- Permits must be obtained from DAFF to remove the Camel Thorn (*Acacia erioloba*) individuals. The contractor must apply for these permits in a phased manner.
- Weed control measures must be applied to eradicate the noxious weeds (category 1a &1b species) on disturbed areas.

Fauna

- Any fauna threatened by the construction and operation activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All construction vehicles should adhere to a low speed limit (<30km/h) to avoid collisions with susceptible species such as snakes and tortoises.
- If trenches need to be dug for electrical cabling or other purposes, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are exposed should contain soil ramps allowing fauna to escape the trench.

15. REFERENCES

APPS, P. (ed.). 2012. Smither's Mammals of Southern Africa. A field guide. Random House Struik, Cape Town, RSA

ALEXANDER, G. & MARAIS, J. 2007. A Guide to the Reptiles of Southern Africa. Struik Nature, Cape Town.

ANHAEUSSER, C.R., JOHNSON, M.R., THOMAS, R.J. (2008). The Geology of South Africa. Council for Geosciences.

BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J. & DE VILLIERS, M. S. 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Strelitzia 32. SANBI, Pretoria.

BRANCH W.R. 1998. Field guide to snakes and other reptiles of southern Africa. Struik, Cape Town.

CRITICAL BIODIVERSITY AREAS MAPS (PER MUNICIPALITY) AND GIS DATA AVAILABLE FROM: Biodiversity GIS (BGIS), South African National Biodiversity Institute, Tel. +27 21 799 8739 or CapeNature, Tel. +27 21 866 8000. Or on the web at: http://bgis.sanbi.org/fsp/project.asp

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM, 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Gazette, Republic of South Africa

DU PREEZ, L. & CARRUTHERS, V. 2009. A Complete Guide to the Frogs of Southern Africa. Struik Nature., Cape Town.

FRIEDMANN, Y. & DALY, B. 2004. Red data book of the mammals of South Africa, a conservation assessment. Johannesburg, Endangered Wildlife Trust.

HOARE, D. 2012. DAVID HOARE CONSULTING CC (2012). Impact Assessment Report: Specialist ecological study on the potential impacts of the proposed Hidden Valley Wind Energy Facility Project near Matjiesfontein, Northern Cape.

MARAIS, J. 2004. Complete Guide to the Snakes of Southern Africa. Struik Nature, Cape Town.

MACVICAR, C. N., SCOTNEY, D. M. SKINNER, T. E. NIEHAUS, H. S. & LOUBSER, J. H., 1974. A classification of land (climate, terrain form, soil) primarily for rainfed agriculture. S. Afr. J. Agric.

Extension, 3(3): 1-4.MCDONALD, D.J. 1997. VEGMAP: a collaborative project for a new vegetation map of southern Africa. *South African Journal of Science* 93: 424–426.

MINTER LR, BURGER M, HARRISON JA, BRAACK HH, BISHOP PJ & KLOEPFER D (eds). 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.

MUCINA, L, BREDENKAMP, G.J., HOARE, D.B & MCDONALD, D.J. 2000. A National Vegetation Database for South Africa *South African Journal of Science* 96: 1–2.
MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.

MUCINA, L., HOARE, D.B., LÖTTER, M.C., DU PREEZ, P.J., RUTHERFORD, M.C., SCOTT-SHAW, C.R., BREDENKAMP, G.J., POWRIE, L.W., SCOTT, L., CAMP, K.G.T., CILLIERS, S.S., BEZUIDENHOUT, H., MOSTERT, T.H., SIEBERT, S.J., WINTER, P.J.D., BURROWS, J.E., DOBSON, L., WARD, R.A., STALMANS, M., OLIVER, E.G.H., SIEBERT, F., SCHMIDT, E., KOBISI, K., KOSE, L. 2006. *Grassland Biome.* In: Mucina, L. & Rutherford, M.C. (eds.) Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

MUCINA, L., RUTHERFORD, M.C. & POWRIE, L.W. (editors) 2005. Vegetation map of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria. ISBN 1-919976-22-1
MUELLER-DOMBOIS, D. AND ELLENBERG, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

RAIMONDO, D., VON STADEN, L., FODEN, W., VICTOR, J.E., HELME, N.A., TURNER, R.C. KAMUNDI, D.A. & MANYAMA, P.A. (Eds.). 2009. Red list of South African plants 2009. Strelitzia 25:1-668

SKINNER, J.D. & CHIMIMBA, C.T. 2005. The mammals of the Southern African Subregion. Cambridge University Press, Cambridge.

TESSEMA, A & NZOTTA, U. 2014. Multi-Data Integration Approach in Groundwater Resource Potential Mapping: A Case Study from the North West Province, South Africa. WRC Report No. 2055/1/13. Water Research Commision.

WESTHOFF, V. AND VAN DER MAAREL, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.

Websites:

AGIS, 2007. Agricultural Geo-Referenced Information System, accessed from www.agis.agric.za

ADU, 2012. Animal Demography Unit, Department of Zoology, University of Cape Town. http://www.adu.org.za

BGIS: http://bgis.sanbi.org/website.asp

SANBI databases:

http://posa.sanbi.org/searchspp.php

http://SIBIS.sanbi.org

Climate:

http://en.climate-data.org/location/10658/

ANNEXURE A:
Preliminary checklist of plant species recorded on site.

Table A1: Species noted in the *Acacia erioloba – Searsia lancea* community
Yellow-marked species are protected species. (* indicates exotics)

No	Scientific name	Growth form
1	*Acacia erioloba*	Tree
2	*Acacia hebeclada*	Shrub
2	*Acacia mellifera*	Shrub
4	*Acacia tortilis*	Tree
5	*Albuca setosa*	Bulbous plant
6	*Aloe heroensis*	Succulent
7	*Aristida congesta*	Grass
8	*Aristida stipitata*	Grass
9	*Asparagus suaveolens*	Dwarf shrub
10	*Cassia italica*	Forb
11	*Celtis africana*	Tree
12	*Chasmatophyllum musculinum*	Succulent
13	*Chloris virgata*	Grass
14	*Chrysocoma cilata*	Karroid shrub
15	*Commelina africana*	Forb
16	*Commelina benghalensis*	Forb
17	*Cucumis sessilifolia*	Climber
18	*Cynodon dactylon*	Grass
19	*Dicoma schinzii*	Forb
20	*Diospyros austro-africana*	Shrub
21	*Diospyros lycioides*	Shrub
22	*Dipcadi ciliare*	Geophyte
23	*Ehretia alba*	Shrub
24	*Elephantorrhiza elepantina*	Geophyte
25	*Enneapogon desvauxii*	Grass
26	*Enneapogon scaber*	Grass
27	*Eragrostis biflora*	Grass
28	Eragrostis echinochloidea	Grass
29	*Eragrostis lehmanniana*	Grass
30	*Eragrostis obtusa*	Grass
31	*Eragrostis pallens*	Grass
32	*Felicia muricata*	Karroid shrub
33	*Geigeria ornativa*	Forb
34	*Gnidia polycephala*	Karroid shrub
35	*Grewia flava*	Shrub

36	*Helichrysum luciloides*	Karroid shrub
37	*Helichrysum zeyheri*	Karroid shrub
38	*Hermannia comosa*	Karroid shrub
39	*Hermannia tomentosa*	Prostrate forb
40	*Heteropogon contortus*	Grass
41	*Kyphocarpha angustifolia*	Forb
42	*Lapeirousia kalahariensis*	Bulbous plant
43	*Lebeckia spinescens*	Shrub
44	*Ledebouria sp.*	Bulb
45	*Lycium cinerium*	Shrub
46	*Melinis repens*	Grass
47	*Moraea polystachya*	Bulbous plant
48	*Ophioglossum polyphyllum*	Fern
49	*Oropetium capense*	Grass
50	*Pavonia burchellii*	Forb
51	*Phyllanthus parvulus*	Forb
52	*Pollichia campestris*	Forb
53	*Rhynchosia nervosa*	Prostrate forb
54	*Schmidtia pappophoroides*	Grass
55	*Searsia lancea*	Tree
56	*Searsia tridactyla*	Shrub
57	*Sesamum triphyllum*	Forb
58	*Stipagrostis zeyheri*	Grass
59	*Talinum caffrum*	Geophytic forb
60	*Tarchonanthus camphoratus*	Shrub
61	*Themeda triandra*	Grass
62	*Tragus berteronianus*	Grass
63	*Tragus koeleroides*	Grass
64	*Viscum rotundifolium*	Parasite
65	*Ziziphus mucronata*	Tree
66	**Argemone mexicana,*	Weed
67	**Bidens bipinnata*	Weed
68	**Conyza bonariensis*	Weed
69	**Datura stramonium*	Weed
70	**Tagetes minuta*	Weed
71	**Verbesina encelioides*	Weed

Table A2: Species noted in the *Oropetium capense – Aristida congesta* dolomite sheet community (yellow-marked species are protected species).

No	Scientific name	Growth form
1	*Aloe hereroensis*	Succulent
2	*Aristida congesta*	Grass
3	*Bulbostylis burchellii*	Sedge
4	*Chasmatophyllum musculimum*	Succulent
5	*Cleome gynandra*	Forb
6	*Commelina africana*	Forb
7	*Dipcadi ciliare*	Bulb
8	*Enneapogon desvauxii*	Grass
9	*Eragrostis bicolor*	Grass
10	*Eragrostis obtusa*	Grass
11	*Euphorbia inaequilatera*	Forb
12	*Fingerhuthia africana*	Grass
13	*Indigofera alternans*	Forb
14	*Lapeirousia kalahariensis*	Bulb
15	*Ledebouria luteola*	Bulb
16	*Limeum aethopicum*	Forb
17	*Limeum fenestratum*	Forb
18	*Microchloa caffra*	Grass
19	*Moraea polystachya*	Bulb
20	*Nerine laticoma*	Bulb
21	*Ophioglossum polyphyllum*	Fern
22	*Ornithoglossum vulgare*	Bulb
23	*Oropetium capense*	Grass
24	*Phyllanthus sp.*	Forb
25	*Sesamum triphyllum*	Forb
26	*Tephrosia lupinifolia*	Forb

ANNEXURE B

List of plant species of conservation concern which are known to occur in the vicinity of study area (2723 Half Degree Grid). The list is derived from the POSA website (*NE – Note Evaluated). Species recorded within the 2723AD Quarter Degree Grid are illustrated in bold.

Colours Relate as follow:

Threatened Status: Critically (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient (DDD), NE (NE)

- Protected according to National Forest Act 1998 / NFA (No 84 of 1998).
- Protected according to Northern Cape Nature Conservation Act, Act 9 of 2009 (Schedule 1: Specially Protected Species), and
- Protected according to the Northern Cape Nature Conservation Act, Act 9 of 2009 (Schedule 2: Specially Protected Species).
- * Invasive Alien Plant

Family	Species	Threat status
ACANTHACEAE	Barleria bechuanensis C.B.Clarke	LC
ACANTHACEAE	Barleria lichtensteiniana Nees	LC
ACANTHACEAE	Barleria macrostegia Nees	LC
ACANTHACEAE	Barleria media C.B.Clarke	LC
ACANTHACEAE	Hypoestes forskaolii (Vahl) R.Br.	LC
ACANTHACEAE	Monechma divaricatum (Nees) C.B.Clarke	LC
ACANTHACEAE	Monechma genistifolium (Engl.) C.B.Clarke	LC
ACANTHACEAE	Monechma incanum (Nees) C.B.Clarke	LC
AIZOACEAE	Plinthus sericeus Pax	LC
AIZOACEAE	Trianthema parvifolia E.Mey. ex Sond. var. parvifolia	LC
AMARANTHACEAE	*Achyranthes aspera L. var. aspera	Not Evaluated
AMARANTHACEAE	Aerva leucura Moq.	LC
AMARANTHACEAE	*Amaranthus hybridus L. subsp. hybridus var. hybridus	Not Evaluated
AMARANTHACEAE	Hermbstaedtia fleckii (Schinz) Baker & C.B.Clarke	LC
AMARANTHACEAE	Hermbstaedtia odorata (Burch.) T.Cooke var. albi-rosea Suess.	LC
AMARANTHACEAE	Pupalia lappacea (L.) A.Juss. var. lappacea	LC
AMARANTHACEAE	Sericorema remotiflora (Hook.f.) Lopr.	LC
AMARYLLIDACEAE	Nerine laticoma (Ker Gawl.) T.Durand & Schinz	LC
ANACARDIACEAE	Searsia lancea (L.f.) F.A.Barkley	LC
ANACARDIACEAE	Searsia tridactyla (Burch.) Moffett	LC
APIACEAE	Deverra burchellii (DC.) Eckl. & Zeyh.	LC
APOCYNACEAE	Brachystelma circinatum E.Mey.	LC
APOCYNACEAE	Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus	LC

APOCYNACEAE	Piaranthus decipiens (N.E.Br.) Bruyns	LC
APOCYNACEAE	Sarcostemma viminale (L.) R.Br. subsp. viminale	LC
ASPARAGACEAE	Asparagus laricinus Burch.	LC
ASPARAGACEAE	Asparagus suaveolens Burch.	LC
ASPHODELACEAE	Aloe claviflora Burch.	LC
ASPHODELACEAE	Aloe grandidentata Salm-Dyck	LC
ASPHODELACEAE	Bulbine abyssinica A.Rich.	LC
ASPHODELACEAE	Bulbine frutescens (L.) Willd.	LC
ASPHODELACEAE	Trachyandra laxa (N.E.Br.) Oberm. var. laxa	LC
ASPLENIACEAE	Asplenium adiantum-nigrum L. var. adiantum-nigrum	LC
ASPLENIACEAE	Asplenium cordatum (Thunb.) Sw.	LC
ASTERACEAE	*Bidens pilosa L.	Not Evaluated
ASTERACEAE	Chrysocoma ciliata L.	LC
ASTERACEAE	Cineraria vallis-pacis Dinter ex Merxm.	LC
ASTERACEAE	Dicoma kurumanii S.Ortiz & Netnou	LC
ASTERACEAE	Dimorphotheca cuneata (Thunb.) Less.	LC
ASTERACEAE	Eriocephalus glandulosus M.A.N.Müll.	LC
ASTERACEAE	Erlangea misera (Oliv. & Hiern) S.Moore	LC
ASTERACEAE	Felicia clavipilosa Grau subsp. clavipilosa	LC
ASTERACEAE	Felicia filifolia (Vent.) Burtt Davy subsp. filifolia	LC
ASTERACEAE	Felicia muricata (Thunb.) Nees subsp. cinerascens Grau	LC
ASTERACEAE	Felicia muricata (Thunb.) Nees subsp. muricata	LC
ASTERACEAE	Foveolina dichotoma (DC.) Källersjö	LC
ASTERACEAE	Gazania krebsiana Less. subsp. arctotoides (Less.) Roessler	LC
ASTERACEAE	Gazania krebsiana Less. subsp. serrulata (DC.) Roessler	LC
ASTERACEAE	Geigeria brevifolia (DC.) Harv.	LC
ASTERACEAE	Geigeria filifolia Mattf.	LC
ASTERACEAE	Geigeria ornativa O.Hoffm. subsp. ornativa	LC
ASTERACEAE	Gnaphalium englerianum (O.Hoffm.) Hilliard & B.L.Burtt	LC
ASTERACEAE	Helichrysum argyrosphaerum DC.	LC
ASTERACEAE	Helichrysum caespititium (DC.) Harv.	LC
ASTERACEAE	Helichrysum cerastioides DC. var. cerastioides	LC
ASTERACEAE	Helichrysum lineare DC.	LC
ASTERACEAE	Helichrysum nudifolium (L.) Less. var. nudifolium	LC
ASTERACEAE	Helichrysum spiciforme DC.	LC
ASTERACEAE	Helichrysum zeyheri Less.	LC
ASTERACEAE	Hirpicium echinus Less.	LC
ASTERACEAE	Kleinia longiflora DC.	LC
ASTERACEAE	Leysera tenella DC.	LC
ASTERACEAE	Nolletia ciliaris (DC.) Steetz	LC
ASTERACEAE	Osteospermum leptolobum (Harv.) Norl.	LC
ASTERACEAE	Osteospermum microphyllum DC.	LC
ASTERACEAE	Osteospermum muricatum E.Mey. ex DC. subsp. muricatum	LC
ASTERACEAE	Pegolettia retrofracta (Thunb.) Kies	LC
ASTERACEAE	Pentzia argentea Hutch.	LC

ASTERACEAE	Pteronia glauca Thunb.	LC
ASTERACEAE	Pteronia mucronata DC.	LC
ASTERACEAE	Pulicaria scabra (Thunb.) Druce	LC
ASTERACEAE	Senecio consanguineus DC.	LC
ASTERACEAE	*Sonchus oleraceus L.	Not Evaluated
ASTERACEAE	Tarchonanthus camphoratus L.	LC
ASTERACEAE	Tarchonanthus obovatus DC.	LC
ASTERACEAE	Tolpis capensis (L.) Sch.Bip.	LC
ASTERACEAE	Ursinia nana DC. subsp. nana	LC
ASTERACEAE	*Verbesina encelioides (Cav.) Benth. & Hook. var. encelioides	Not Evaluated
AYTONIACEAE	Plagiochasma rupestre (J.R.& G.Forst.) Steph. var. rupestre	
BIGNONIACEAE	Rhigozum trichotomum Burch.	LC
BORAGINACEAE	Anchusa riparia A.DC.	LC
BORAGINACEAE	Heliotropium ovalifolium Forssk.	LC
BORAGINACEAE	Heliotropium strigosum Willd.	LC
BRASSICACEAE	*Brassica tournefortii Gouan	Not Evaluated
BRASSICACEAE	Erucastrum strigosum (Thunb.) O.E.Schulz	LC
BRYACEAE	Bryum apiculatum Schwägr.	
BRYACEAE	Bryum capillare Hedw.	
BUDDLEJACEAE	Buddleja saligna Willd.	LC
CAMPANULACEAE	Wahlenbergia androsacea A.DC.	LC
CAPPARACEAE	Cleome conrathii Burtt Davy	NT
CAPPARACEAE	Cleome kalachariensis (Schinz) Gilg & Gilg-Ben.	LC
CAPPARACEAE	Cleome oxyphylla Burch. var. oxyphylla	LC
CARYOPHYLLACEAE	Dianthus namaensis Schinz var. dinteri (Schinz) S.S.Hooper	LC
CARYOPHYLLACEAE	Pollichia campestris Aiton	LC
CELASTRACEAE	Gymnosporia buxifolia (L.) Szyszyl.	LC
CHENOPODIACEAE	Atriplex semibaccata R.Br. var. appendiculata Aellen	LC
CHENOPODIACEAE	Chenopodium hederiforme (Murr) Aellen	LC
CHENOPODIACEAE	Salsola rabieana I.Verd.	LC
CHENOPODIACEAE	Salsola tuberculata (Moq.) Fenzl	LC
COMMELINACEAE	Commelina africana L. var. barberae (C.B.Clarke) C.B.Clarke	LC
COMMELINACEAE	Commelina africana L. var. lancispatha C.B.Clarke	LC
COMMELINACEAE	Commelina livingstonii C.B.Clarke	LC
CONVOLVULACEAE	Evolvulus alsinoides (L.) L.	LC
CONVOLVULACEAE	Ipomoea suffruticosa Burch.	LC
CONVOLVULACEAE	Seddera suffruticosa (Schinz) Hallier f.	LC
CONVOLVULACEAE	Xenostegia tridentata (L.) D.F.Austin & Staples	LC
CRASSULACEAE	Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp.	LC
CRASSULACEAE	Kalanchoe lanceolata (Forssk.) Pers.	LC
CUCURBITACEAE	Acanthosicyos naudinianus (Sond.) C.Jeffrey	LC
CUCURBITACEAE	Citrullus lanatus (Thunb.) Matsum. & Nakai	LC
CUCURBITACEAE	Coccinia sessilifolia (Sond.) Cogn.	LC
CUCURBITACEAE	Cucumis africanus L.f.	LC

CUCURBITACEAE	Cucumis heptadactylus Naudin	LC
CUCURBITACEAE	Kedrostis africana (L.) Cogn.	LC
CYPERACEAE	Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke	LC
CYPERACEAE	Cyperus bellus Kunth	LC
CYPERACEAE	Cyperus longus L. var. tenuiflorus (Rottb.) Boeck.	LC
CYPERACEAE	Cyperus margaritaceus Vahl var. margaritaceus	LC
CYPERACEAE	Cyperus marginatus Thunb.	LC
CYPERACEAE	Cyperus marlothii Boeckeler	LC
CYPERACEAE	Kyllinga alba Nees	LC
CYPERACEAE	Scirpoides dioeca (Kunth) Browning	LC
DIPSACACEAE	Scabiosa columbaria L.	LC
EBENACEAE	Diospyros austro-africana De Winter	LC
EBENACEAE	Diospyros lycioides Desf. subsp. lycioides	LC
EBENACEAE	Euclea crispa (Thunb.) Gürke subsp. ovata (Burch.) F.White	LC
EBENACEAE	Euclea undulata Thunb.	LC
ELATINACEAE	Bergia pentheriana Keissl.	LC
EQUISETACEAE	Equisetum ramosissimum Desf. subsp. ramosissimum	LC
ERIOSPERMACEAE	Eriospermum corymbosum Baker	LC
EUPHORBIACEAE	Croton gratissimus Burch. var. gratissimus	LC
EUPHORBIACEAE	Euphorbia duseimata R.A.Dyer	LC
EUPHORBIACEAE	Euphorbia mauritanica L. var. mauritanica	LC
EUPHORBIACEAE	*Euphorbia peplus L.	Not Evaluated
FABACEAE	Acacia erioloba E.Mey.	Declining
FABACEAE	Acacia haematoxylon Willd.	LC
FABACEAE	Acacia hebeclada DC. subsp. hebeclada	LC
FABACEAE	Acacia hereroensis Engl.	LC
FABACEAE	Acacia karroo Hayne	LC
FABACEAE	Acacia mellifera (Vahl) Benth.	LC
FABACEAE	Bolusia acuminata (DC.) Polhill	LC
FABACEAE	Calobota cuspidosa (Burch.) Boatwr. & B.-E.van Wyk	LC
FABACEAE	Chamaecrista biensis (Steyaert) Lock	LC
FABACEAE	Chamaecrista mimosoides (L.) Greene	LC
FABACEAE	Crotalaria leubnitziana Schinz	LC
FABACEAE	Crotalaria spartioides DC.	LC
FABACEAE	Crotalaria sphaerocarpa Perr. ex DC. subsp. sphaerocarpa	LC
FABACEAE	Crotalaria virgultalis Burch. ex DC.	LC
FABACEAE	Elephantorrhiza elephantina (Burch.) Skeels	LC
FABACEAE	Indigofera alternans DC. var. alternans	LC
FABACEAE	Indigofera comosa N.E.Br.	LC
FABACEAE	Indigofera daleoides Benth. ex Harv. var. daleoides	LC
FABACEAE	Indigofera flavicans Baker	LC
FABACEAE	Indigofera hololeuca Benth. ex Harv.	LC
FABACEAE	Indigofera sessilifolia DC.	LC
FABACEAE	Indigofera vicioides Jaub. & Spach var. vicioides	LC
FABACEAE	Lotononis crumanina Burch. ex Benth.	LC

FABACEAE	*Medicago laciniata (L.) Mill. var. laciniata	Not Evaluated
FABACEAE	*Melilotus albus Medik.	Not Evaluated
FABACEAE	Otoptera burchellii DC.	LC
FABACEAE	Ptycholobium biflorum (E.Mey.) Brummitt	
FABACEAE	Ptycholobium biflorum (E.Mey.) Brummitt subsp. biflorum	LC
FABACEAE	Requienia sphaerosperma DC.	LC
FABACEAE	Rhynchosia confusa Burtt Davy	Not Evaluated
FABACEAE	Rhynchosia holosericea Schinz	LC
FABACEAE	Rhynchosia totta (Thunb.) DC. var. totta	LC
FABACEAE	Rhynchosia venulosa (Hiern) K.Schum.	Not Evaluated
FABACEAE	Senna italica Mill. subsp. arachoides (Burch.) Lock	LC
FABACEAE	Sutherlandia frutescens (L.) R.Br.	LC
FABACEAE	Tephrosia burchellii Burtt Davy	LC
FABACEAE	Tephrosia longipes Meisn. subsp. longipes var. longipes	LC
FABACEAE	Tephrosia lupinifolia DC.	LC
FABACEAE	Vigna unguiculata (L.) Walp. subsp. unguiculata	LC
FISSIDENTACEAE	Fissidens erosulus (Müll.Hal.) Paris	
GENTIANACEAE	Chironia palustris Burch. subsp. palustris	LC
GERANIACEAE	Pelargonium myrrhifolium (L.) L'Hér. var. myrrhifolium	LC
GISEKIACEAE	Gisekia africana (Lour.) Kuntze var. africana	LC
HYACINTHACEAE	Dipcadi marlothii Engl.	LC
HYACINTHACEAE	Drimia sanguinea (Schinz) Jessop	NT
IRIDACEAE	Gladiolus permeabilis D.Delaroche	LC
IRIDACEAE	Lapeirousia erythrantha (Klotzsch ex Klatt) Baker	
IRIDACEAE	Lapeirousia sandersonii Baker	LC
IRIDACEAE	Moraea polystachya (Thunb.) Ker Gawl.	LC
JUNCACEAE	Juncus exsertus Buchenau	LC
JUNCACEAE	Juncus rigidus Desf.	LC
LAMIACEAE	Leucas capensis (Benth.) Engl.	LC
LAMIACEAE	*Salvia stenophylla Burch. ex Benth.	
LAMIACEAE	Stachys burchelliana Launert	LC
LENTIBULARIACEAE	Utricularia gibba L.	LC
LOBELIACEAE	Lobelia erinus L.	LC
LOBELIACEAE	Lobelia thermalis Thunb.	LC
LOPHIOCARPACEAE	Lophiocarpus polystachyus Turcz.	LC
LORANTHACEAE	Tapinanthus oleifolius (J.C.Wendl.) Danser	LC
MALPIGHIACEAE	Sphedamnocarpus pruriens (A.Juss.) Szyszyl.	LC
MALPIGHIACEAE	Triaspis hypericoides (DC.) Burch. subsp. hypericoides	LC
MALVACEAE	Abutilon betschuanicum Ulbr.	
MALVACEAE	Abutilon dinteri Ulbr.	LC
MALVACEAE	Abutilon rehmannii Baker f.	LC
MALVACEAE	Corchorus asplenifolius Burch.	LC
MALVACEAE	Grewia flava DC.	LC

MALVACEAE	Hermannia bicolor Engl. & Dinter	LC
MALVACEAE	Hermannia comosa Burch. ex DC.	LC
MALVACEAE	Hermannia linearifolia Harv.	LC
MALVACEAE	Hermannia linnaeoides (Burch.) K.Schum.	LC
MALVACEAE	Hermannia stellulata (Harv.) K.Schum.	LC
MALVACEAE	Hermannia tomentosa (Turcz.) Schinz ex Engl.	LC
MALVACEAE	Hibiscus marlothianus K.Schum.	LC
MALVACEAE	Melhania burchellii DC.	LC
MALVACEAE	Melhania prostrata DC.	LC
MALVACEAE	Melhania virescens (K.Schum.) K.Schum.	LC
MALVACEAE	Pavonia burchellii (DC.) R.A.Dyer	LC
MALVACEAE	Sida chrysantha Ulbr.	LC
MALVACEAE	Sida cordifolia L. subsp. cordifolia	LC
MALVACEAE	Waltheria indica L.	LC
MENISPERMACEAE	Antizoma angustifolia (Burch.) Miers ex Harv.	LC
MESEMBRYANTHEMACEAE	Prepodesma orpenii (N.E.Br.) N.E.Br.	LC
MOLLUGINACEAE	Hypertelis salsoloides (Burch.) Adamson var. salsoloides	LC
MOLLUGINACEAE	Limeum aethiopicum Burm.f. var. aethiopicum	Not Evaluated
MOLLUGINACEAE	Limeum aethiopicum Burm.f. var. intermedium Friedrich	Not Evaluated
MOLLUGINACEAE	Limeum arenicolum G.Schellenb.	LC
MOLLUGINACEAE	Limeum fenestratum (Fenzl) Heimerl var. fenestratum	LC
MOLLUGINACEAE	Limeum viscosum (J.Gay) Fenzl	LC
MOLLUGINACEAE	Mollugo cerviana (L.) Ser. ex DC. var. cerviana	LC
MOLLUGINACEAE	Suessenguthiella scleranthoides (Sond.) Friedrich	LC
NYMPHAEACEAE	Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.	LC
OLEACEAE	Olea europaea L. subsp. africana (Mill.) P.S.Green	LC
OROBANCHACEAE	Alectra pumila Benth.	LC
OROBANCHACEAE	Striga bilabiata (Thunb.) Kuntze subsp. bilabiata	LC
OROBANCHACEAE	Striga elegans Benth.	LC
OROBANCHACEAE	Striga gesnerioides (Willd.) Vatke	LC
OXALIDACEAE	*Oxalis corniculata L.	Not Evaluated
OXALIDACEAE	Oxalis depressa Eckl. & Zeyh.	LC
PAPAVERACEAE	*Argemone ochroleuca Sweet subsp. ochroleuca	Not Evaluated
PASSIFLORACEAE	Adenia repanda (Burch.) Engl.	LC
PEDALIACEAE	Ceratotheca triloba (Bernh.) Hook.f.	LC
PEDALIACEAE	Harpagophytum procumbens (Burch.) DC. ex Meisn.	Not Evaluated
PEDALIACEAE	Sesamum capense Burm.f.	LC
PHYLLANTHACEAE	Phyllanthus parvulus Sond.	LC
PHYLLANTHACEAE	Phyllanthus parvulus Sond. var. parvulus	LC
PHYLLANTHACEAE	Phyllanthus pentandrus Schumach. & Thonn.	LC
POACEAE	Agrostis lachnantha Nees var. lachnantha	LC
POACEAE	Andropogon chinensis (Nees) Merr.	LC

POACEAE	Andropogon eucomus Nees	LC
POACEAE	Andropogon schirensis Hochst. ex A.Rich.	LC
POACEAE	Anthephora argentea Gooss.	LC
POACEAE	Anthephora pubescens Nees	LC
POACEAE	Aristida congesta Roem. & Schult. subsp. barbicollis	LC
POACEAE	Aristida congesta Roem. & Schult. subsp. congesta	LC
POACEAE	Aristida engleri Mez var. ramosissima De Winter	LC
POACEAE	Aristida meridionalis Henrard	LC
POACEAE	Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis	LC
POACEAE	Aristida stipitata Hack. subsp. spicata (De Winter) Melderis	LC
POACEAE	Aristida stipitata Hack. subsp. stipitata	LC
POACEAE	Brachiaria marlothii (Hack.) Stent	LC
POACEAE	Brachiaria nigropedata (Ficalho & Hiern) Stapf	LC
POACEAE	Brachiaria serrata (Thunb.) Stapf	LC
POACEAE	Bromus pectinatus Thunb.	LC
POACEAE	Cenchrus ciliaris L.	LC
POACEAE	Coelachyrum yemenicum (Schweinf.) S.M.Phillips	LC
POACEAE	*Cymbopogon pospischilii (K.Schum.) C.E.Hubb.	Not Evaluated
POACEAE	Cynodon dactylon (L.) Pers.	LC
POACEAE	Digitaria eriantha Steud.	LC
POACEAE	Digitaria polyphylla Henrard	LC
POACEAE	Digitaria seriata Stapf	LC
POACEAE	Diheteropogon amplectens (Nees) Clayton var. amplectens	LC
POACEAE	Eleusine coracana (L.) Gaertn. subsp. africana	LC
POACEAE	Elionurus muticus (Spreng.) Kunth	LC
POACEAE	Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.	LC
POACEAE	Enneapogon desvauxii P.Beauv.	LC
POACEAE	Eragrostis amabilis (L.) Hook. & Arn.	LC
POACEAE	*Eragrostis barrelieri Daveau	Not Evaluated
POACEAE	Eragrostis chloromelas Steud.	LC
POACEAE	Eragrostis curvula (Schrad.) Nees	LC
POACEAE	Eragrostis echinochloidea Stapf	LC
POACEAE	Eragrostis homomalla Nees	LC
POACEAE	Eragrostis lehmanniana Nees var. lehmanniana	LC
POACEAE	*Eragrostis mexicana (Hornem.) Link subsp. virescens	Not Evaluated
POACEAE	Eragrostis micrantha Hack.	LC
POACEAE	Eragrostis nindensis Ficalho & Hiern	LC
POACEAE	Eragrostis pallens Hack.	LC
POACEAE	Eragrostis procumbens Nees	LC
POACEAE	Eragrostis rigidior Pilg.	LC
POACEAE	Eragrostis trichophora Coss. & Durieu	LC
POACEAE	Eragrostis viscosa (Retz.) Trin.	LC

POACEAE	Eragrostis x pseud-obtusa De Winter	Not Evaluated
POACEAE	Eustachys paspaloides (Vahl) Lanza & Mattei	LC
POACEAE	Fingerhuthia africana Lehm.	LC
POACEAE	Heteropogon contortus (L.) Roem. & Schult.	LC
POACEAE	Leptochloa fusca (L.) Kunth	LC
POACEAE	Megaloprotachne albescens C.E.Hubb.	LC
POACEAE	Melinis repens (Willd.) Zizka subsp. grandiflora (Hochst.) Zizka	LC
POACEAE	Melinis repens (Willd.) Zizka subsp. repens	LC
POACEAE	Panicum coloratum L. var. coloratum	LC
POACEAE	Panicum kalaharense Mez	LC
POACEAE	Panicum stapfianum Fourc.	LC
POACEAE	*Paspalum dilatatum Poir.	Not Evaluated
POACEAE	Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC
POACEAE	Schizachyrium sanguineum (Retz.) Alston	LC
POACEAE	Schmidtia pappophoroides Steud.	LC
POACEAE	Sporobolus acinifolius Stapf	LC
POACEAE	Sporobolus fimbriatus (Trin.) Nees	LC
POACEAE	Stipagrostis amabilis (Schweick.) De Winter	LC
POACEAE	Stipagrostis hirtigluma subsp. patula (Hack.) De Winter	LC
POACEAE	Stipagrostis uniplumis (Licht.) De Winter	LC
POACEAE	Stipagrostis uniplumis (Licht.) De Winter var. uniplumis	LC
POACEAE	Themeda triandra Forssk.	LC
POACEAE	Tragus koelerioides Asch.	LC
POACEAE	Tragus racemosus (L.) All.	LC
POACEAE	Trichoneura grandiglumis (Nees) Ekman	LC
POACEAE	Triraphis andropogonoides (Steud.) E.Phillips	LC
POACEAE	Triraphis schinzii Hack.	LC
POACEAE	Urelytrum agropyroides (Hack.) Hack.	LC
POLYGALACEAE	Polygala leptophylla Burch. var. leptophylla	LC
POLYGONACEAE	Oxygonum alatum Burch. var. alatum	LC
POLYGONACEAE	*Persicaria lapathifolia (L.) Gray	Not Evaluated
POLYGONACEAE	*Rumex crispus L.	Not Evaluated
PORTULACACEAE	Anacampseros filamentosa (Haw.) Sims subsp. filamentosa	LC
PORTULACACEAE	Portulaca quadrifida L.	LC
POTTIACEAE	Syntrichia ammonsiana (H.A.Crum & L.E.Anderson) Ochyra	
PTERIDACEAE	Actiniopteris radiata (J.König ex Sw.) Link	LC
RHAMNACEAE	Helinus spartioides (Engl.) Schinz ex Engl.	LC
ROSACEAE	*Rubus rosifolius Sm.	Not Evaluated
RUBIACEAE	Kohautia caespitosa Schnizl.	LC
RUBIACEAE	Vangueria infausta Burch. subsp. infausta	LC
SCROPHULARIACEAE	Aptosimum elongatum Engl.	LC
SCROPHULARIACEAE	Aptosimum marlothii (Engl.) Hiern	LC

SCROPHULARIACEAE	Jamesbrittenia atropurpurea (Benth.) Hilliard	LC
SCROPHULARIACEAE	Jamesbrittenia aurantiaca (Burch.) Hilliard	LC
SCROPHULARIACEAE	Jamesbrittenia integerrima (Benth.) Hilliard	LC
SCROPHULARIACEAE	Peliostomum leucorrhizum E.Mey. ex Benth.	LC
SCROPHULARIACEAE	Selago mixta Hilliard	LC
SINOPTERIDACEAE	Cheilanthes eckloniana (Kunze) Mett.	LC
SINOPTERIDACEAE	Cheilanthes hirta Sw. var. brevipilosa W.& N.Jacobsen	
SINOPTERIDACEAE	Cheilanthes multifida (Sw.) Sw. var. multifida	Not Evaluated
SINOPTERIDACEAE	Pellaea calomelanos (Sw.) Link var. calomelanos	LC
SOLANACEAE	Lycium schizocalyx C.H.Wright	LC
SOLANACEAE	Solanum catombelense Peyr.	LC
SOLANACEAE	Solanum retroflexum Dunal	LC
SOLANACEAE	Solanum supinum Dunal var. supinum	LC
SOLANACEAE	Solanum tomentosum L. var. tomentosum	LC
THEOPHRASTACEAE	Samolus valerandi L.	LC
THYMELAEACEAE	Gnidia polycephala (C.A.Mey.) Gilg	LC
VERBENACEAE	Chascanum adenostachyum (Schauer) Moldenke	LC
VERBENACEAE	Chascanum hederaceum (Sond.) Moldenke var. hederaceum	LC
VERBENACEAE	Chascanum pinnatifidum (L.f.) E.Mey. var. pinnatifidum	LC
VERBENACEAE	Lantana rugosa Thunb.	LC
VERBENACEAE	*Verbena brasiliensis Vell.	Not Evaluated
ZYGOPHYLLACEAE	Tribulus zeyheri Sond. subsp. zeyheri	LC
ZYGOPHYLLACEAE	Zygophyllum pubescens Schinz	LC

ANNEXURE C: EMP FOR THE METALS INDUSTRIAL CLUSTER DEVELOPMENT NEAR KURUMAN

1	PLANNING PHASE	Person/s responsible
A	During the planning phase the Camel Thorn Trees (*Acacia erioloba*) which will have to be removed must be identified and a permit must be obtained from the Department of Forestry and Fisheries (DAFF) before removal.	Project manager, contractor & ECO
B	During the planning phase the protected plant species must be identified and marked. They must then be transplanted in a similar habitat nearby, if possible.	Project manager, contractor & ECO

2	CONSTRUCTION PHASE	Person/s responsible
2.1	**Orientation of staff**	
A	An environmental induction programme must be presented to the employees present during the construction phase. The aim is to make them aware of the hazards of polluting the environment and littering.	Project manager, contractor & ECO
2.2	**Water management**	
A	Potable water must be available at all times and at various points within the Contractors' Camp and on site.	Contractor & ECO
B	Care must be taken to close all dripping taps and to fix all leaking water pipes.	Contractor & ECO
C	Care must always be taken to prevent the pollution of surface and ground water resources.	Project manager, contractor & ECO
2.3	**Cooking and Eating Areas**	
A	Provision must be made for adequate cooking and eating facilities within the Contractors' Camp.	Contractor & ECO
B	Gas or electricity must be used for cooking purposes to avoid the use of open fires and potential clearing of the surrounding vegetation for use as a fuel source.	Contractor & ECO

C	Eating areas must be restricted to the site offices and the Contractors' Camp. If employees are to eat elsewhere on the site, the Contractors must, in consultation with the ECO, designate restricted places for eating in the working areas, and must provide adequate refuse bins at all these places, which must be cleaned on a daily basis.	Contractor & ECO
D	The Project Manager must regulate the establishment of informal food stalls.	Project manager
2.4	**Toilet and Ablution Facilities**	
A	An adequate number of self-contained chemical toilets must be established on the site, which must be easily accessible to construction workers. At least one toilet for every 30 workers should be provided for.	Contractor & ECO
B	Contractors must supply toilet paper at all toilets, and will be responsible for its maintenance and servicing.	Contractor & ECO
C	Contractors must ensure that no spillage occurs when chemical toilets are cleaned, and that the contents are properly stored and removed off-site	Contractor & ECO
D	Toilets must be placed outside areas susceptible to standing or flowing water in summer, and siting must be done in consultation with the ECO and PM.	Contractor & ECO & PM
E	If applicable, the Contractors are to provide ablution facilities (wash basins, showers, etc.) for the workers. The wastewater from the ablution facilities must be captured and contained until such time that it can be disposed of appropriately. It will not be acceptable to allow wastewater to drain uncontrolled from the ablution facilities.	Contractor & ECO
F	Performing ablutions outside toilet/ablution facilities is strictly prohibited.	Contractor, ECO, and Employees
2.5	**Delivery and Storage of Materials**	

A	Building materials are to be stored in the agreed areas (e.g. stockpile/storage area)	Project manager, Contractor & ECO
B	Erodible materials (e.g. building sand) are to be stockpiled in an area where they will not be prone to wind and water erosion. The offloading of erodible materials is not to take place during windy conditions.	Contractor & ECO
C	Only appropriate volumes of building materials should be stored on site at any one time. The building material storage area(s) are to be maintained in a neat and orderly state	Contractor & ECO
D	Suppliers are to be made aware of the delivery and off-loading requirements. Persons operating delivery trucks carrying steel for the pylons, conductors and other building materials are to abide by the speed regulations on site are to ensure that tarpaulins are used for the transport of materials over long distances, and are to clean public roads should any spillages occur.	Contractor & ECO
1.6	**Solid Waste Management**	
A	An adequate number of properly marked waste containers must be available at strategic locations around the Contractors' Camp for gathering all domestic refuse, and to minimise littering	Contractor & ECO
B	Building waste and other solid waste may not be dumped on neighbouring vacant properties	Contractor & ECO
C	Refuse refers to all solid waste, including construction debris (cement bags, old cement, tags, wrapping materials, timber, cans, wire, nails, etc.), waste and surplus food, food packaging, organic waste, etc.	Contractor & ECO

D	Contractors must ensure that all employees deposit refuse in refuse bins, and these must be emptied on a regular basis to prevent them from overflowing. Bins must be watertight, wind-proof and scavenger-proof, and must be placed at regular intervals throughout the site. The Project Manager and ECO must approve the design of the bins.	Contractor & ECO & PM
E	Wherever feasible, refuse must be separated into suitable categories and re-cycled.	Contractor & ECO
F	Refuse may not be burnt or buried on the site or in the vicinity.	Contractor & ECO
G	Construction debris such as scrap metal, concrete and waste building materials must be collected in a skip or stockpiled in an approved area in a neat and orderly manner. Construction debris must be disposed of at a permitted disposal site. Construction debris may not be buried on site	Contractor & ECO
H	Contractors must identify a permitted disposal site for the various categories of waste likely to be generated on site and must provide the Project Manager and ECO with documentary proof of the type and volume of waste disposed of at these sites.	Project Manager, Contractor & ECO
I	All wastewater and contaminated runoff from the storage and working areas of the Contractors' Camp must be channeled into an appropriately sized, designed and located collection sump (such as a sunken PVC lined container). The size, design and location of the polluted runoff capture system/sump are to be assessed and approved by the ECO. The sump must be adequately sized, properly managed and regularly cleared to prevent overflows. Contaminated liquids and sediments from the sump must be disposed of at a permitted disposal site.	Contractor & ECO

J	The construction site must be kept clean and tidy at all times. All litter and waste generated is to be collected at the end of a day's work and transferred to the designated collection area(s). The Contractors must also instruct workers to clean up the site on a daily basis. If necessary, a team of workers should be appointed whose specific function is to keep the site neat and tidy.	Contractor & ECO
K	The general cleanliness of the site will form part of the site inspections undertaken by the ECO.	Contractor & ECO
2.7	**Equipment/Machinery**	
A	The Contractors must stand any equipment that may leak on watertight drip trays to catch any pollutants. The drip trays must be of a size to allow the equipment to be placed inside it, must be cleaned regularly, and must not be allowed to overflow.	Contractor & ECO
B	Chemicals collected in the drip trays must be collected and disposed of at permitted disposal site and not be buried.	Contractor & ECO
C	Any generators used on the site must also be placed on an impermeable surface or a drip trays must be used.	Contractor & ECO
D	Drip trays must also be put under concrete mixers, generators or any other diesel or petrol driven equipment to be used on site or in the Contractors' Camp.	Contractor & ECO
E	Concrete mixers, generators must be regularly inspected for oil and fuel leaks	Contractor & ECO
2.8	**Fuel and oil management**	
A	The fuel tank(s) must be located in an area, which is easily accessible to vehicles.	Contractor & ECO

B	Diesel and petrol tanks must be placed within an adequately sized bund wall with an impermeable base and sides. The volume of the bund must be two times the volume of the storage tanks An overflow pipe to the grease trap must be fitted to the concrete bund wall in case of a tank rupturing	Contractor & ECO
C	The fuel dispensers must be hung within the bunded area while not in use	Contractor & ECO
D	Vehicles must be regularly inspected for oil and fuel leaks	Contractor & ECO
E	Vehicles must be parked on an impermeable surface (e.g. concrete slab) fitted with a grease/oil trap. In case the vehicles are parked elsewhere a drip tray must be put under the engine to prevent oil and diesel spillages	Contractor & ECO
F	Special care must be taken at the diesel tanker where vehicle will refuel. Drip trays must be put under the tanker and the vehicle to prevent diesel spillages	Contractor & ECO
G	Paints, solvents and other potentially hazardous and flammable materials must be properly stored in a safe container which must be locked at all times	Contractor & ECO
H	Containers must always be properly marked indicating its contents	Contractor & ECO
2.9	**Spills of Fuels and Hazardous Substances**	
A	Asbestos and similar potentially hazardous materials must be appropriately handled to ensure that they do not enter the surrounding environment and do not pose a health threat to the workers.	Contractor & ECO
B	The accidental or negligent spillage of any fuels or potentially hazardous substances must be cleaned up immediately using the most appropriate methodologies, equipment and materials.	Contractor & ECO

C	The Contractors must ensure that the necessary materials and equipment and chemicals are available on the site to deal with spills of any of the hazardous materials present.	Contractor & ECO
D	The Contractors must devise a procedure for dealing with spills, which has to be approved by the Project Manager and ECO. The procedure must distinguish between those spills that can be cleaned up by the Contractors and those that will require specialist input. This procedure must also include a provision to notify the Project Manager and ECO of any spills	Project manager, Contractor & ECO
E	The clean-up of spills and damage caused by a spill will be for the Contractors' accounts.	Contractor & ECO
F	Any contaminated soil or water must be removed and stored in a container until it can be disposed of at a permitted disposal site.	Contractor & ECO
G	Old paint may not be discarded into the sewage system	Contractor & ECO
H	Paint-contaminated solvents such as Thinners may not be discarded into the sewage system or outside onto the soil. The Thinners in the Thinners-paint mix must be allowed to evaporate and then the dried paint can be disposed of as solid waste	Contractor & ECO
2.10.	**Contaminated Sites**	
A	The Contractors are to advice the ECO in advance of areas where potential contamination sites are likely to develop.	Contractor & ECO
B	All wastewater and polluted runoff from the contaminated areas must be channelled into appropriately sized, designed and located collection sumps such as a sunken PVC container. The size, design and location of the polluted runoff capture system must be assessed by the ECO. The collection sump must be properly managed and regularly cleared to prevent overflows.	Contractor & ECO
C	Contaminated water/sediment from the sump must be disposed of at a permitted disposal site.	Contractor & ECO

D	Re - fuelling of vehicles must only take place at these areas, unless otherwise agreed with the ECO. The Contractors will be responsible for ensuring that any party delivering fuels or other chemicals to the site is aware of the appropriate storage/drop-off locations and contamination control procedures.	Contractor & ECO
2.11	**Concrete Mixing**	
A	Concrete mixing is to take place at allocated sites that are decided in consultation with the ECO.	Contractor & ECO
B	Runoff from the concrete mixing areas must be contained and not allowed to drain uncontrolled across the site or enter the adjacent drainage lines	Contractor & ECO
C	If small volumes are mixed (manually), mixing is to be undertaken on a hard surface covered in plastic sheeting so that concrete waste and runoff can be contained	Contractor & ECO
D	Concrete mixing areas need to be concentrated so that the area of contamination is consolidated. *Ad hoc* mixing will not be permitted	Contractor & ECO
E	In case premixed concrete will be used care must be taken to prevent spillage of concrete when the concrete truck is offloading its concrete	Contractor & ECO
F	All concrete spillage and waste is to be collected and removed from the site for disposal at a permitted disposal site	Contractor & ECO
G	When concrete mixers are to be cleaned on site care must be taken to contain the concrete slurry in a dedicated sump. This sump must be properly lined as the study area has very a porous and sandy soil and infiltration of contaminated water could take place easily causing contamination of the ground water	Contractor & ECO
2.12	**Site Clean-Up and Rehabilitation**	

A	The objective of the site closure phase is to ensure that: • the site and areas disturbed by construction are rehabilitated and/or landscaped; • that the site and areas disturbed by construction are visually appealing and are left in a neat and tidy condition; • contaminants/pollution sources are removed from the site or that appropriate measures are in place to control long-term contamination sources; • the site and surrounding disturbed areas are in a stable condition. Listed below are the provisional requirements for closure of the site. These are intended as a guideline and will be augmented and made specific by the ECO at the time of closure. The guidelines provided in the preceding sections still apply during site closure. • Complete the landscaping of the areas within the site including parking areas. • Where possible indigenous plants must be used as part of the landscaping process. The Landscape Contractor is to ensure that adequate planting of parking areas is catered for. The ECO is to review and approve the landscaping plans. • Backfill all remaining voids. • Remove all containers and temporary office structures from the site. • Drain all pollution sumps and dispose of all solid and liquid waste at a permitted landfill site. • Break up all concrete structures, cart concrete from the site and dispose of at a permitted landfill site. • Collect all litter and packaging from within the construction site as well as the peripheral areas and dispose at a permitted landfill site. • Remove all waste building components/parts from the site (whether scrap or not) including metal, wood, drums, plastic, cabling, tubing, etc. • Remove all stockpiled rubble from the site and dispose of at a permitted disposal site. • Ensure that no waste is buried on site. • • Disconnect all temporary power •	Project manager, Contractor & ECO

	• , water and sewerage connections. • Disassemble and remove all ablution facilities. • Ensure that all infrastructure routes are rehabilitated and stable. • Clear weeds from the construction site and peripheral disturbed areas. • Identify actual and potential erosion sites and implement measures for control/prevention of erosion. Ensure that appropriate erosion control measures are installed around storm water outlets and stabilise and re-grass areas around storm water outlets. • Ensure that no bare, unvegetated areas remain. • Rehabilitate all disused tracks and roads. • Clear all litter and rubble from drainage lines and disposes of appropriately. • Make provision for the rehabilitation of peripheral areas not directly included within the site that were disturbed during the construction process. Rehabilitation may entail grading, leveling, fertilizing and re-grassing. • Ensure that all public roads are satisfactorily cleared of rubble and mud. • Repair damaged road curbs or other structures.	

3	**OPERATIONAL PHASE**	**Person/s responsible**
3.1	**Orientation of staff**	
A	An environmental management committee consisting of members of the developer's management team and residents should be formed. The aim is to oversee the environmental management of the residential area and to make the residents aware of the hazards of polluting the environment and littering.	Environmental committee & ECO

B	It is recommended that an environmental control officer (ECO) be appointed as part of the project team to liaise with the environmental committee and to oversee and evaluate the operational phase in terms of its environmental impacts.	Environmental committee & ECO
3.2	**Water management**	
A	Care must be taken to close all dripping taps and to fix all leaking water pipes.	Environmental committee & ECO
3.3	**Cooking and Eating Facilities**	
a	The residents must be made aware of the fact that according to the National Forests Act (Act 84 of 1998) it is illegal to damage, collect firewood or to sell firewood of the Camel Thorn tree Therefore no wood of these tree species may be collected from the veld without a permit.	Environmental committee & ECO

4	**SPILLAGE PLANS**	**Person/s responsible**
4.1	**Sewage**	
A	Contractors must ensure that no spillage occurs when chemical toilets are cleaned, and that the contents are properly stored and removed off-site.	Contractor & ECO
B	In case of a spillage it must be immediately reported to the supervisor.	Contractor & ECO
C	The contaminated soil must be put in a container and disposed of at the landfill site.	Contractor & ECO
4.2	**Vehicles**	
A	Vehicles must be parked on an impermeable surface (e.g. concrete slab) fitted with a grease/oil trap. In case the vehicles are parked elsewhere a drip tray must be put under the engine to prevent oil and diesel spillages.	Contractor & ECO

B	In case of a spillage it must be immediately reported to the supervisor.	Contractor & ECO
C	The vehicle must be removed from the site and the leak must be reported immediately.	Contractor & ECO
D	The contaminated soil must be put in a container and disposed of at the landfill site.	Contractor & ECO
E	Special care must be taken at the diesel tanker where vehicle will refuel. Drip trays must be put under the tanker and the vehicle to prevent diesel spillages	Contractor & ECO
4.3	**General spills of diesel, oil and other liquid fuels**	
A	The accidental or negligent spillage of any fuels or potentially hazardous substances must be cleaned up immediately using the most appropriate methodologies, equipment and materials depending on the type of chemical.	Developer, Environmental committee & ECO
B	The Contractors must ensure that the necessary materials and equipment and chemicals are available on the site to deal with spills of any of the hazardous materials present.	Developer, Environmental committee & ECO
C	The clean-up of spills and damage caused by a spill will be for the polluter's account.	Contractor & ECO

D	In case of a major spill form a tanker etc. The following steps must be followed: • Alert the nearest Fire Brigade and other emergency services • Stop the tanker from spilling more fuel or oil and remove it from the site • The immediate objective is to recover free liquids and prevent them from contaminating surface water or ground water • Secure the site from catching fire by the fire brigade • Spread fine sawdust or a product such as Enretech over the spill. The wood absorbs oils, and fuels effectively. • Move the sawdust through the spill with a rake until it does not absorb the pollutant any more. • Remove the saturated sawdust and discard it in containers and then at the landfill site • Repeat the application of sawdust until most of the pollutant has been absorbed • Remove the most of the contaminated soil as possible by using front-end loaders or excavators • If contaminated soil extends down into ground water or ground water contamination is otherwise suspected, the Institute for Groundwater Studies at the University of the Free State must be contacted (Tel 051-4019111). If public water supplies are threatened or surface water is impacted, the Department of Water Affairs must be notified. **Soil Excavation:** • For removal of contaminated soil the standard practice is to excavate visible contamination, screen the excavation site for hot spots with a photo ionization device such as a HNU, then take confirmation samples to show that the contaminated soil has been removed. • Contaminated soil should be temporarily containerized or stockpiled on plastic sheeting (minimum 10 mil) and covered and bermed to prevent run-on and run-off.	

	• Later the contaminated soil can be stored in containers at the landfill site for short term storage (no longer than 15 days) until the material can be taken to a fuel refinery for proper cleaning. • If an open pit has to be backfilled due to extenuating circumstances, the floor of the excavation should be covered with plastic sheeting or some other suitable method to clearly define the sidewalls and bottom of the pit in the event test results show the need for further excavation. • Biodegradation (break down by bacteria and other microorganisms into harmless substances such as fatty acids and carbon dioxide) will begin on the components of oil and other biofuels. The natural process can be speeded up by the addition of fertilizing nutrients like nitrogen and phosphorous, which stimulate growth of the microorganisms concerned. Here expert advice will be needed • Act as fast as possible to minimize extent of pollution.	
4.4	**Contaminated Sites**	
A	All wastewater and polluted runoff from the contaminated areas must be channelled into appropriately sized, designed and located collection sumps such as a sunken PVC container. The size, design and location of the polluted runoff capture system must be assessed by the ECO. The collection sump must be properly managed and regularly cleared to prevent overflows.	Contractor & ECO
B	Contaminated water/sediment from the sump must be disposed of at a permitted disposal site.	Contractor & ECO
C	The Contractors will be responsible for ensuring that any party delivering fuels or other chemicals to the site is aware of the appropriate storage/drop-off locations and contamination control procedures.	Contractor & ECO
D	Re-fuelling of vehicles must only take place at dedicated areas, unless otherwise agreed with the ECO.	Contractor & ECO