ISCOR
flat steel

ISCOR VANDERBIJLPARK STEEL

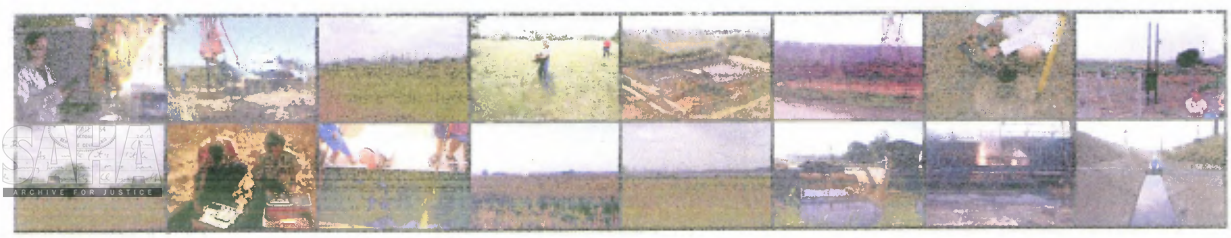
ENVIRONMENTAL MASTER PLAN

SPECIALIST REPORT

# TERRESTRIAL ECOLOGY: NATURAL VEGETATION AND PLANT LIFE

BY
JASPER MÜLLER ASSOCIATES

SERIES IV
DOCUMENT IVS/SR/034
DECEMBER 2002



# ISCOR VANDERBIJLPARK STEEL

# ENVIRONMENTAL MASTER PLAN

## SPECIALIST REPORT

# TERRESTRIAL ECOLOGY: NATURAL VEGETATION AND PLANT LIFE


## BY
## JASPER MÜLLER ASSOCIATES



**SERIES IV**
**DOCUMENT IVS/SR/034**
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# FINAL

# ISCOR VANDERBIJLPARK STEEL

## MASTER PLAN SPECIALIST REPORT

## IVS/SR/034

## TERRESTRIAL ECOLOGY
## NATURAL VEGETATION AND PLANT LIFE

## DATE: DECEMBER 2002


**COMPILED BY:**

JASPER MULLER ASSOCIATES CC
P O BOX 883
DELMAS
2210

JMA PROJECT NO: 10193

TEL: (013) 665-1788/5343/1285
FAX: (013) 665-2364
E-mail: webmaster@jma-cc.co.za


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## EXECUTIVE SUMMARY

This report represents one of a series of specialist Base Line Study Reports, compiled in fulfilment of the terms of reference for the compilation of an Environmental Master Plan for Iscor Vanderbijlpark Steel (IVS). Although this report represents a stand-alone document, the results generated during this study will be integrated into the Environmental Management and/or Environmental Monitoring actions proposed in the IVS Master Plan.

It is important that the results of this study be interpreted in context with the situation as it developed over a period of several decades at IVS. It is obvious that most of the developments which took place at the site, until very recently, did not focus formally on the protection of the terrestrial ecology, partly because the site was seen as an industrial site, and partly because Environmental Legislation and Guidance on the protection of the terrestrial ecosystems, only developed fairly recently. It is therefore not reasonable to expect all historical actions to be fully ecologically "friendly", neither within the bounds of the IVS perimeter, nor for that matter, in the immediate surrounding receiving environment.

The approach and methodology for the current investigation, therefore also took cognizance of the afore-mentioned. The following represent the main conclusions of the natural vegetation and plant life base line study:

- According to the Acocks veld type classification of South Africa, the greater Vanderbijlpark area falls under the Northern Variation of *Cymbopogon -themeda veld.*
- The greater Vanderbijlpark area was subjected to high levels of urban development as well as agricultural activities. The natural grassland areas were mostly used as pastures and for crop farming.
- Using the principals of the Braun-Blanquet vegetation survey techniques, 24 quadrants within the study area, of $25m^2$ each were selected. These quadrants were arranged in a predetermined pattern to ensure objectivity. The flora found in these quadrants were then sampled and identified. They were then grouped in their various vegetation communities.
- The sensitivity of the plant community could then be determined by looking at the sensitivity of its constituent species as well as their conservation status.
- Natural undisturbed grasslands are rarely found, and usually small and fragmented. Therefore, this area is classified as disturbed, with an ecological quality varying from medium to low.
- As expected most of the dominant species occur naturally in disturbed areas. In general, the ecological statuses of the dominant species are that of either **Increaser IIa** or **Increaser IIb**. This means that the species numbers increase as overgrazing/impact increases. A number of exotic and invader species, associated with disturbed areas, also occur within the area. It could therefore be concluded that the study area is currently disturbed.
- No endangered, vulnerable or rare species were observed in the area. The endangered species mentioned in TABLE 5.2.2.1 may occur in this area, though this is unlikely.
- Due to the nature of the industrial activities, the Master Plan sub-zones within the IVS perimeter, are all highly disturbed areas. No communities could be identified within this area. A high level of alien and weedy species were recorded in this area.

- The receiving environment beyond the IVS perimeter, can be divided into two regions by land-use; the region to the north and west of IVS for which the main land-use is agriculture and the region to the east and south of IVS, which is mainly impacted by urbanization and industrial activities.

- The main reason for the disturbed situation in the northern and western regions is impacts associated with agricultural activities.

- The main reason for the disturbed situation in the south and eastern regions is impacts associated with urbanization and industrial activities.

- The following impacts occur throughout the Master Plan study area, for various reasons:

    - Disruption of soil profile
    - Loss of topsoil
    - Destruction of vegetation
    - Trampling
    - Increased of edge effect
    - Invasion of alien species
    - Erosion

- These impacts can only be managed while the cause is still active. Only in the rehabilitation phase can the impacts truly be mitigated/rehabilitated.

- The management objectives should incorporate the principles of integrated management. This means that the floral environment should not be seen as an integral part of the larger environment. Therefore it should be an objective of IVS to effectively protect the floral environment from irreversible damage caused by their activities. Unavoidable negative impacts caused during any of the developmental stages should be mitigated as far as is viable/reasonable.

- Monitoring of the environmental variables are necessary to prevent the degradation of the ecosystem taking place, and is an important mitigation measure. This monitoring can be done by a floral survey conducted once a year, in which a species list is compiled and the abundance of each of the specific species recorded. Throughout the year, any unusual occurrences such as patches of dead grassland should be reported immediately.

- Site visits should co-inside with the rainy season and should consequently be done between November and April each year.

Respectfully submitted

G.M. Cloete (PrSciNat)

# 1. INTRODUCTION

This report represents one of a series of specialist Base Line Study Reports, compiled in fulfilment of the terms of reference for the compilation of an Environmental Master Plan for Iscor Vanderbijlpark Steel (IVS).

Although this report represents a stand-alone document, the results generated during this study will be integrated into the Environmental Management and/or Environmental Monitoring actions proposed in the IVS Master Plan.

# 2. APPROACH AND METHODOLOGY

It is important that the results of this study be interpreted in context with the situation as it developed over a period of several decades at IVS. It is obvious that most of the developments which took place at the site, until very recently, did not focus formally on the protection of the terrestrial ecology, partly because the site was seen as an industrial site, and partly because Environmental Legislation and Guidance on the protection of the terrestrial ecosystems, only developed fairly recently. It is therefore not reasonable to expect all historical actions to be fully ecologically "friendly", neither within the bounds of the IVS perimeter, nor for that matter, in the immediate surrounding receiving environment.

The approach and methodology for the current investigation, therefore also took cognizance of the afore-mentioned.

## 2.1 THE INVESTIGATING TEAM

The terrestrial ecosystems survey (Natural Vegetation and Plant Life) was done by Jasper Müller Associates:

Contact person: Mrs G. Cloete
Tel.: (013) 665 1788

## 2.2 EXTENT AND DETAIL OF INVESTIGATION

The extent and detail of the investigation, was influenced by the following:

- Historical development of the site.
- Current governing Environmental Legislation.
- Terms of reference of the IVS Environmental Master Plan development.
- Requirements for future Environmental Monitoring.

The extent of the study area is shown on FIGURE 1 - APPENDIX I. The following study area delineations are of significance:

- The Regional Study Area
- The Greater Vanderbijlpark Study Area
- The Master Plan Study Area
  - The IVS Plant and Perimeter
  - The Immediate Surrounding Receiving Environment

The extent and detail selected for this study, was primarily selected subject to the provisions of the National Environmental Management Act, Act 107 of 1998, which states the following:

"Sustainable development requires the consideration of all relevant factors including the following:

i) that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied;

ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimized and remedied"

In order to comply with this act, the current situation of the natural environment should be assessed. This assessment, subject to the zoning discussed previously, and subject to the fact that the study area does not represent a "green fields" situation, was made by conducting a reconnaissance vegetation survey on selected areas within the IVS perimeter, as well as in the area surrounding IVS (Receiving Environment beyond the IVS perimeter), using standard vegetation surveying techniques.

The investigation area, together with the sampling localities, is shown on FIGURE 2 - APPENDIX I. During this investigation the following was recorded:

- Veld type
- Dominant species
- Endangered or rare species observed
- Exotic or invader species observed
- Site description

The vegetation survey was conducted using the standard Braun-Blanquet vegetation survey techniques, of the Mont Pellier school of thought. The purpose of this method is to determine vegetation communities and dominant species, and was chosen on the grounds of its accuracy and objectivity.

The Braun-Blanquet method is based on several concepts and assumptions, the first of which is homogeneity. It is imperative that allotments should be chosen which are relatively homogeneous. This means that the allotments within a community should be relatively uniform (Kent, 1996).

The second important concept is that of minimal area, which states that; a sampling area should be big enough in order to take a representative sample of the vegetation. This minimal size differs with life-form and physiognomy of the dominant vegetation type (Kent, 1996).

The fidelity of the community is also a very significant aspect, which varies as the fidelity of its constituent species varies. The fidelity of a species is classified as either exclusive, selective, preferential, indifferent or accidental (Kent, 1996).

## 2.3 LIAISON WITH AUTHORITIES

DWAF and DACEL are represented on the IVS Master Plan steering committee.

# 3. SCOPE AND TERMS OF REFERENCE

This report was compiled by JASPER MÜLLER ASSOCIATES (JMA) as a Specialist Base Line Study Report in support of the IVS Environmental Master Plan.

The following is included in this report:

- Current Situation of the area
  - Site Description
  - Species list
  - Dominant Species
  - Rare and Endangered Species
  - Exotic and Invader Species
- Impact and Risk assessment
- Management measures
- Monitoring actions

This study does not include riparian or aquatic vegetation. These aspects will form part of a separate Aquatic Ecosystems Base Line Study Report - REF: IVS/SR/033.

# 4. ACTIONS PERFORMED

## 4.1 REGIONAL AND GREATER VANDERBIJLPARK STUDY AREAS

These two study area components were assessed on a desk top study basis, with information obtained from literature as well as from the National Botanical Institute of South Africa - regional floral species list attached as APPENDIX II.

## 4.2 MASTER PLAN STUDY AREA

Using the principals of the Braun-Blanquet vegetation survey techniques, 24 quadrants within the Master Plan Study area, of 25 $m^2$, each were selected. These quadrants were arranged in a predetermined pattern to ensure objectivity- see FIGURE 2 - APPENDIX I.

The flora found in these quadrants were then sampled and identified. Then they were grouped in their various vegetation communities using the computer programs, DECORANA and TWINSPAN. These programs are widely used for the ordination and classification of multivariate species data. The Jaccard Similarity Index was used to verify sample associations while the Chi-square Index was used to indicate species associations.

Species diversity and equatability was assessed by using the Shannon Diversity Index. These indices together with the sensitivity of the constituent species of each plant community determine the sensitivity of the plant community.

# 5. DESCRIPTION OF THE CURRENT SITUATION

## 5.1 REGIONAL ECOLOGY

A regional species list was provided to JMA by the National Botanical Institute - attached as APPENDIX II.

The Vanderbijlpark region lies within the Grassland biome. The pristine vegetation here is physiognomically monolithic and is characterized by a strong dominance of hemichryptophytes of the Poaceae. The canopy cover is moisture dependent and decreases with lower mean annual rainfall.(Rutherford,1994)

Acocks's veld type classification system verify this classification by classifying the regional veld type as veld type No.48 (*Cymbopogon-Themeda* veld). This veld type is a pure grassland type.

**Pure Grassland**

Regionally, pure grassland types occur on the upper plateau and mountain tops at altitudes ranging from 1050 *m* over 3050 *m* above sea level. These grasslands develop in regions which are too dry and/or too frosty for the development of any kind of forest. Only on rocky hills, which are rare on the plains, and on the mountains, will a few scattered shrubs be found (Acocks, 1988).

***Cymbopogon - Themeda* veld**

This is the veld of the sandy parts of the wetter higher-lying portion of the high-veld in the north eastern Cape, Orange Free State and south-central Transvaal, undulating to flat country. Altitude ranges from 1350 *m* - 2000 *m* above sea level and rainfall from 450 *mm* - 750 *mm* per annum, falling in summer. Winters are severely frosty. Under these conditions, a mixed to sour grassland is the climax, much of it has been ploughed up and the sandy soil is beginning to break down into sand. (Acocks, 1988)

Two variations can be recognized:

- 48a Southern Variation in the Orange Free State and north-eastern Cape
- 48b Northern Variation in the Transvaal

The Vanderbijlpark area falls under the Northern Variation.

## 5.2 ECOLOGY OF THE GREATER VANDERBIJLPARK AREA

Using the same desk top sourced information, the natural vegetation and plant life situation closer to the study area, can be described.

### 5.2.1 Site Classification

According to the Acocks veld-type classification of South Africa, the Vanderbijlpark area falls under the Northern Variation of *Cymbopogon -themeda veld.*

### 5.2.2 48b - Northern Variation

This is sparser, more tufted than the southern variation. Altitude ranges from 1300 *m* - 1500 *m* above sea level and the rainfall from 500 *mm* - 700 *mm* per annum, falling in summer. Winters are frosty, as usual on the high-veld. The veld type merges easily into the western variation of the Brakenveld (Acocks, 1988).

**Generally occurring species**

*Setaria flabellata*
*Themeda Triandra*
*Heteropogon contortus*
*Eragrostis racemosa*
*Eragrostis chloromelas*
*Elionurus muticus*
*Cymbopogon plurinodis*
*Brachiaria serrata*

**Dominant species**

Grasses are classified into seven groups according to their Ecological Status:

**Decreaser Species**: Species dominant in an undisturbed veld. Decreases as the condition of the veld deteriorates.
**Increaser I-species:** Species which are dominant in poor veld and increase with underutilization or selective grazing
**Increaser Ia-species:** Herbaceous species that increase during medium underutilization or selective grazing.
**Increaser Ib-species:** Herbaceous species that increase during high levels of underutilization or selective grazing.
**Increaser IIa-species:** Herbaceous species that increase during low levels of overutilization (overgrazing).
**Increaser IIb-species:** Herbaceous species that increase during medium levels of overutilization (overgrazing).
**Increaser IIc-species:** Herbaceous species that increase during high levels of overutilization (overgrazing).

During this study this classification will aid in determining the sensitivity of, as well as the quality of, the grassland investigated.

Dominant species within the communities of the Vanderbijlpark study area include:

*Themeda triandra*
*Eragrostis curvula*
*Heteropogon contortus*
*Cynodon dactylon*
*Hyparrhenia hirta*
*Setaria nigrirostris*

*Themeda triandra*

This perennial species grows on all soil types and occurs in every veld type in the country, but is especially abundant in undisturbed climax grasslands. "Rooigras" is seen as one of the best grazing grasses, especially on the Highveld. The reason being the high potability of young leaves as well as the plants high leaf production. It is also resistant to veld fires if regrowth is not constantly over utilized. The Ecological status of this species is that of a **Decreaser**.

*Eragrostis curvula*

The Weeping Love Grass can mainly be found in disturbed areas, on well drained soil with a high fertility value. This is one of the most economically important artificial pastures in the country. The ecological status if this grass is mostly a **Increaser IIb**.

*Heteropogon contortus*

Spear grass is widely distributed in open grasslands and bushveld. This grass grows particularly well on rocky soil, and occurs usually on rocky slopes and on disturbed places. It has a **variant** ecological status and an average to high grazing value.

*Cynodon dactylon*

This creeping grass occurs in almost any soil types with a preference for soil with a high nitrogen component. Occurs in disturbed areas, common on moist places. With an ecological status of **Increaser IIb**, this grass plays an important role in soil erosion management and control.

*Hyparrhenia hirta*



The Common Thatching grass occurs in open grasslands and on rocky slopes next to rivers. It grows on most soil types, but prefers well drained rocky soil. This grass also occurs in disturbed places such as old agricultural fields and next to roads. Plays an important role in

stabilization of barren soil and sand and protects it from erosion. The ecological status of this perennial grass is an **Increaser I**.

*Setaria nigrirostris*

Commonly occurs on open grassland or on open spaces in the bushveld on black turftsoil. It often occurs in moist areas. With a high grazing capacity, this species ecological status is that of a **Decreaser**.

**Other species present**

The species which may occur within the study area were identified by using information compiled through National Botanical Institute Research. This information is attached in APPENDIX II.

**Threatened and protected taxa (Endangered species)**

The endangered species which might potentially occur within the study area were identified by using National Botanical Institute Research information and the Red Data List for plants of South Africa. The following TABLE lists the protected plant species which may occur in the study area.

**TABLE 5.2.2.1: Protected plant species which may occur in the Vanderbijlpark area**

| Species Name | Observed during field visits | Likely to occur in study area | Conservation Status |
|---|---|---|---|
| *Brachystelma schinzii* (K.Schum.) N.E.Br. | | ✓ | Insufficiently known |
| *Cynanchum virens* D.Dietr. | | ✓ | Vulnerable |
| *Parapodium costatum* E.Mey. | | ✓ | Insufficiently known |

Notes on above table:
**Vulnerable**: Taxa believed likely to move into the Endangered category in the near future if the factors causing the decline continue operating. Included here are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that are still abundant but are under threat from serious adverse factors throughout their range.
**Insufficiently known:** Taxa are suspected but not definitely known to belong to any of the following categories: Extinct, Endangered, Vulnerable, Rare or Indeterminate.

## Invader or exotic species

A number of invader or exotic species were recorded in the study area, this can be expected, considering its high degree of disturbance.

The following are the main invader species observed in the study area:

*Verbena bonariensis*
*Solanum elaeagnifolium*
*Pseudognaphalium luteo-album*
*Bidens bipinnata*

*Verbena bonariensis*

Native from South America, this plant is a weed of gardens, roadsides, waste places and fallow lands.

*Solanum elaeagnifolium*

Indigenous to the Americas, this plant is a problem in agricultural areas as a result of its spreading root system form which new stems grow. Control is very difficult as disbursement occurs via seed as well as fragmented roots. Currently, no herbicides are available for the chemical control of this plant.

*Pseudognaphalium luteo-album*

The Jersey cutweed is a widespread and common annual weed from Europe. It invades old land and also occurs in waste places and roadsides. This weed is tolerant to herbicides when mature, but susceptible to shallow cultivation as a seedling.

*Bidens bipinnata*

This Species was introduced during the last century from Eurasia. They are very troublesome weeds which can be found in most crops and disturbed areas. As blackjacks often germinate in dense mats, they can be relatively easily controlled, especially with post-emergence herbicides.

## Current Ecological quality of the community

The greater Vanderbijlpark area is subjected to high levels of formal and informal residential development, heavy and light industrial development as well as informal, intensive and extensive agricultural activities. Very few natural grassland areas currently exist in their pristine state, as they were mostly used as pastures and for crop farming. Natural undisturbed grasslands are therefore rarely found, and usually small and fragmented. Therefore, this greater area is classified as disturbed, with a ecological quality varying from medium to low.

A Land Use map for the greater Vanderbijlpark area, indicating the extensive disturbance of the natural vegetation and plant life, due to residential, agricultural and industrial activities, is attached as FIGURE 3 - APPENDIX I.

## 5.3 ECOLOGY OF THE MASTER PLAN STUDY AREA

According to the Acocks veld type classification of South Africa, the Vanderbijlpark area falls under the Northern Variation of *Cymbopogon - themeda veld*. This was confirmed during the on-site assessment. As this area is already highly disturbed and is continuously undergoing new disturbances, only a list of species occurring in the area was compiled. This list is attached in APPENDIX III.

The Master Plan Study Area comprise 9 sub-divisions:

Within Iscor Perimeter:

- Consolidated Residue Management Facility (CRMF)
- Consolidated Plant Area
- Open Veld Area - Central
- Southern Slag Processing Area - South-West
- Southern Slag Processing Area - South-East
- Open Veld Area - South East
- South-Western Park Area
- Kiewiet Area

Receiving Environment Beyond Iscor Perimeter:

- Adjacent area to the west, north, east and south

The areas including and immediately adjacent to the Rietkuilspruit to the west and the Leeuwspruit to the east, are discussed in the Aquatic Ecosystems Base Line Study Report.

### 5.3.1 Consolidated Residue Management Facility (CRMF)

The CRMF area is a fully operational residue management facility, and by its very nature, therefore constantly experiences high levels of disturbance. This area is characterized by several evaporation dams as well as solid waste dumps and product storage areas, separated by patches of pioneer grassland - see FIGURE 2 - APPENDIX I.

Because of the high level of disturbance, only a species list were compiled for this area.

**TABLE 5.3.1.1: Locations where species lists were compiled**

| Number on Map | Location description | Characteristics | MP Zone |
|---|---|---|---|
| SpList 1 | Inside IVS Works - Dams 1-4 | Pioneer grassland | CRMF |
| SpList 2 | Inside IVS Works -South of Dams 1-4 | Pioneer grassland | CRMF |
| SpList 3 | Inside IVS Works | Pioneer grassland | CRMF |
| SpList 4 | Inside IVS Works | Pioneer grassland | CRMF |

## Species Composition

**TABLE 5.3.1.2: Site description - inside CRMF**

| | | Number | Percentage |
|---|---|---|---|
| Growth form | ▸ Trees & Shrubs | **5** | **9.62%** |
| | ▸ Herbaceous / Weakly woody | **47** | **90.38%** |
| | - Grasses | 20 | 42.55% |
| | - Forbs | 23 | 48.94% |
| | - Sedges & restios | 2 | 4.26% |
| | - Bulbous plants | 1 | 2.13% |
| | - Succulents | 1 | 2.13% |
| | TOTAL | **[52]** | |
| Origin | ▸ Indigenous | 36 | 56.25% |
| | ▸ Aliens | 16 | 25.00% |
| | ▸ Declared weeds | 12 | 18.75% |
| Ecological status | ▸ Weedy species | 15 | 28.85% |
| | ▸ Non-weedy species | 37 | 71.15% |
| Habitat | ▸ Hydrophilous species | 2 | 3.85% |
| | ▸ Terrestrial species | 50 | 96.15% |

It was found that 55,77 % of the species observed within the CRMF area commonly occur in disturbed areas. 16 Alien species are present in this area and 15 weedy species. This can be expected because of the high level of disturbance occurring in this area.

*Tragus berteronianus* occurs within this area which is an indicator of deterioration in grassland quality. *Eragrostis echinocloidea*, an indicator of disturbed grassland, also occurs in this area.

## Threatened species

No endangered, rare or vulnerable species were recorded during any of the site visits. A list of the threatened species possibly occurring within the Vanderbijlpark area can be found in TABLE 5.2.2.1. It is unlikely however that any of these species will occur within the study area as it is already highly disturbed.

**Invader or exotic species**

Sixteen (16) invader or exotic species were recorded in the study area. This can be expected, considering its high degree of disturbance.

**Ecological quality of the community**

Within the CRMF no species communities could be identified due to its high level of disturbance. As previously mentioned a large number of alien and weedy species were recorded in the area as well as species associated with disturbed conditions. This area is therefore classified as disturbed, with a ecological quality varying from medium to low.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld.* Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The physical landscape comprise a flat topography, gently sloping towards the west and south-west, with operational dumps, stockpiles and evaporation dams superimposed on the topography.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species observed prefer moist areas.

**Utilization of land**

Large areas of the CMRF are used for waste disposal, product storage, as well as evaporation processes and slag reclamation.

### 5.3.2 Consolidated Plant Area (CPA)

The CPA area represents the IVS plant area and as such is a highly industrialized area, consisting of different plants and processes. Stockpiling of materials also occurs within this area. (FIGURE 2 - APPENDIX I).

Because of the limited area covered by vegetation, only one location was identified where a species list could be compiled.

**TABLE 5.3.2.1: Locations where species lists were compiled**

| Number on Map | Location description | Characteristics | MP Zone |
|---|---|---|---|
| SpList 5 | Inside IVS Works - West of Dam | Pioneer grassland | CPA |

## Species Composition

From the table below it can clearly be seen that the Herbaceous species dominate this area, as can be expected in a grassland area.

**TABLE 5.3.2.2: Site description - inside IVS Works - CPA**

| | | Number | Percentage |
|---|---|---|---|
| Growth form | ▸ Trees & Shrubs | **2** | **8.00%** |
| | ▸ Herbaceous / Weakly woody | **23** | **92.00%** |
| | - Grasses | 10 | 43.48% |
| | - Forbs | 13 | 56.52% |
| | TOTAL | **[25]** | |
| Origin | ▸ Indigenous | 19 | 63.33% |
| | ▸ Aliens | 6 | 20.00% |
| | ▸ Declared weeds | 5 | 16.67% |
| Ecological status | ▸ Weedy species | 6 | 24.00% |
| | ▸ Non-weedy species | 19 | 76.00% |
| Habitat | ▸ Hydrophilous species | 0 | 0.00% |
| | ▸ Terrestrial species | 25 | 100.00% |

It was found that 44,00 % of the species observed within the CPA area commonly occur in disturbed areas. 6 of the 25 species identified were alien and/or weedy species. This can be expected because of the high level of disturbance occurring in this area.

## Threatened species

No endangered, rare or vulnerable species were recorded during any of the site visits. A list of the threatened species possibly occurring within the Vanderbijlpark area can be found in TABLE 5.2.2.1. It is unlikely however that any of these species will occur within the study area as it is already highly disturbed.

## Invader or exotic species

Six (6) invader or exotic species were recorded in the study area. This can be expected, considering its high degree of disturbance.

**Ecological quality of the community**

Within the CPA no species communities could be identified due to its high level of disturbance. As previously mentioned a large number of alien and weedy species were recorded in the area as well as species associated with disturbed conditions. This area is therefore classified as disturbed, with a low ecological quality.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld*. Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The physical landscape is typical that of heavy industry, comprising large and small buildings, roads, railway lines, paved areas, gardens and only isolated small areas of natural/disturbed vegetation.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species observed, prefer moist areas.

**Utilization of land**

The CPA is utilized for Iron and Steel production processes, material storage and other plant activities.

### 5.3.3 Open Veld Area (OVA) - Central

The Central Open Veld area consists mainly of pioneer grassland fragmented by several railway lines. Even though no species lists were compiled for this area, the species found in localities Splist 3 and Splist 4 can be used to describe the area as both localities lie on the perimeter of the CRMF, next to OVA - Central - see FIGURE 2 - APPENDIX I).

**TABLE 5.3.3.1: Locations where species lists were compiled**

| Number on Map | Location description | Characteristics | MP Zone |
|---|---|---|---|
| SpList 3 | Inside IVS Works | Pioneer grassland | CRMF |
| SpList 4 | Inside IVS Works | Pioneer grassland | CRMF |

## Species Composition

As in the other areas, the herbaceous species dominate with a relative equal amount of grasses and forbs present.

**TABLE 5.3.3.2: Site description - inside IVS Works - OVA Central**

| | | Number | Percentage |
|---|---|---|---|
| Growth form | ▸ Trees & Shrubs | **2** | **10.53%** |
| | ▸ Herbaceous / Weakly woody | **17** | **89.47%** |
| | - Grasses | 7 | 41.18% |
| | - Forbs | 10 | 58.82% |
| | TOTAL | **[19]** | |
| Origin | ▸ Indigenous | 12 | 57.14% |
| | ▸ Aliens | 5 | 23.81% |
| | ▸ Declared weeds | 4 | 19.05% |
| Ecological status | ▸ Weedy species | 4 | 21.05% |
| | ▸ Non-weedy species | 15 | 78.95% |
| Habitat | ▸ Hydrophilous species | 0 | 0.00% |
| | ▸ Terrestrial species | 19 | 100.00% |

It was found that 57,89 % of the species observed within the OVA Central area commonly occur in disturbed areas. 23,81 % of species identified were alien species and 21,05 % weedy species. This can be expected because of the high level of disturbance occurring in this area.

## Threatened species

No endangered, rare or vulnerable species were recorded during any of the site visits. A list of the threatened species possibly occurring within the Vanderbijlpark area can be found in TABLE 5.2.2.1. It is unlikely however that any of these species will occur within the study area as it is already highly disturbed.

## Invader or exotic species

Five (5) invader or exotic species were recorded in the study area, this can be expected, considering its high degree of disturbance.

## Ecological quality of the community

Within the OVA-Central no species communities could be identified due to its high level of disturbance. As previously mentioned a large number of alien and weedy species were recorded in the area as well as species associated with disturbed conditions. This area is therefore classified as disturbed, with a low ecological quality.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld*. Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The physical landscape comprise a flat topography, gently sloping towards the west and south-west, with some railway lines and isolated soil stockpiles occurring in the area.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species prefer moist areas.

**Utilization of land**

The OVA Central is a open veld area. The only infrastructure comprise some railway lines, and two tar storage tanks, the latter located right in the south-eastern most corner of the area.

### 5.3.4 Southern Slag Processing Area - South-West

The Southern Slag Processing area is characterized by slag cooling and related slag processing activities. Due to the nature of the area, localities were not selected here to compile species lists - see FIGURE 2, APPENDIX I.

**Threatened species**

As mentioned previously, no species lists were compiled for this area. However, it is unlikely that any of these species will occur within the study area as it is already highly disturbed. A list of the threatened species possibly occurring within the Vanderbijlpark area can be found in TABLE 5.2.2.1.

**Invader or exotic species**

Because of the high level of disturbance, it can be expected that invader and exotic species would occur in the area.

**Ecological quality of the community**

Due to the high level of disturbance, the area's ecological quality is classified as low.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld.* Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The area now represents an industrial area.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species in the greater study area prefer moist areas.

**Utilization of land**

The Southern Slag Processing area is utilized for slag cooling and general slag processing activities.

### 5.3.5 Southern Slag Processing Area - South-East

This Southern Slag Processing area consists of scrap yards, skull yards, storage facilities as will as hot metal and slag pits. Due to the nature of the area, no localities were selected in this area to compile species lists - see FIGURE 2, APPENDIX I.

**Threatened species**

As mentioned previously, no species lists were compiled for this area. However, it is unlikely that any of these species will occur within the study area as it is already highly disturbed. A list of the threatened species possibly occurring within the Vanderbijlpark area can be found in TABLE 5.2.2.1.

**Invader or exotic species**

Because of the high level of disturbance, it can be expected that invader and exotic species would occur in the area.

**Ecological quality of the community**

Due to the high level of disturbance, the area's ecological quality is classified as low.

**Nature of habitat and physical landscape**



This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld.* Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The area now represents an industrial area.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species prefer moist areas.

**Utilization of land**

The Southern Slag Processing area is utilized for scrap metal disposal dumps, storage facilities as well as the cooling and processing of hot metals and slag.

### 5.3.6 Open Veld Area - South East

The South Eastern Open Veld area is characterized by marshy areas and flood attenuation areas - see FIGURE 2, APPENDIX I).

There were no species identification localities selected in this area because of the high level of fragmentation of dry grassland and the location of the area.

**Threatened species**

As mentioned previously, no species lists were compiled for this area. However, it is unlikely that any of these species will occur within the study area as it is already highly disturbed. A list of the threatened species possibly occurring within the Vanderbijlpark area can be found in TABLE 5.2.2.1.

**Invader or exotic species**

Because of the high level of disturbance, it can be expected that invader and exotic species would occur in the area.

**Ecological quality of the community**

Due to the high level of disturbance, the area's ecological quality is classified as medium to low.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld.* Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The topography is very flat with a gentle slope towards the south-east.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species found in the greater study area prefer moist areas.

**Utilization of land**

The South Eastern Open Veld area represents a flood attenuation area. Several canals, weirs and sumps are also located in the area.

### 5.3.7 South-Western Park Area

The South Western Park area is characterized by large areas covered by lawns. This area's vegetation has been artificially introduced and was therefore not included in the study - see FIGURE 2, APPENDIX I.

**Ecological quality of the community**

Because this is a manmade feature, the ecological quality is classified as very low.

**Nature of habitat and physical landscape**

This area is a manmade landscape with artificially introduced vegetation.

**Utilization of land**

The South Western Park area is utilized as a park area for esthetic purposes.

### 5.3.8 Kiewiet Area

The Kiewiet Area is currently being rehabilitated and several grass species have been introduced. This is currently classified as a pioneer grassland - see FIGURE 2, APPENDIX I.

Six vegetation sampling localities were identified. These are listed in the table below.

**TABLE 5.3.8.1. Description of sampling localities**

| # on Map | Location description | Characteristics | Importance | % of study area |
|---|---|---|---|---|
| Sample 5 | Southern Kiewiet site area | Pioneer grassland | Low ecological importance | 3% |
| Sample 6 | South-eastern Kiewiet site area | Pioneer grassland | Low ecological importance | 3% |
| Sample 7 | Eastern Kiewiet site area | Pioneer grassland | Low ecological importance | 3% |
| Sample 8 | North-eastern Kiewiet site area | Pioneer grassland | Low ecological importance | 3% |
| Sample 9 | Northern Kiewiet site area | Pioneer grassland | Low ecological importance | 3% |
| Sample 10 | Western Kiewiet site area | Pioneer grassland | Medium - low ecological importance | 3% |

## Species Composition

**TABLE 5.3.8.2: Site description - inside Kiewiet Area**

| | | Number | Percentage |
|---|---|---|---|
| Growth form | ▸ Trees & Shrubs | **4** | **8.89%** |
| | ▸ Herbaceous / Weakly woody | **41** | **91.11%** |
| | - Grasses | 21 | 51.22% |
| | - Forbs | 24 | 58.54% |
| | TOTAL | **[45]** | |
| Origin | ▸ Indigenous | 39 | 78.00% |
| | ▸ Aliens | 6 | 12.00% |
| | ▸ Declared weeds | 5 | 10.00% |
| Ecological status | ▸ Weedy species | 7 | 15.56% |
| | ▸ Non-weedy species | 38 | 84.44% |
| Habitat | ▸ Hydrophilous species | 4 | 8.89% |
| | ▸ Terrestrial species | 41 | 91.11% |

It was found that 37,78 % of the species observed within the Kiewiet area commonly occur in disturbed areas, this is significantly lower than in the rest of the IVS Works. 6 Alien species are present in this area and 5 weedy species. As this area is still in the pioneer phase, the presence of alien and weedy species can be expected.

**Threatened species**

No endangered, rare or vulnerable species were recorded during any of the site visits. A list of the threatened species possibly occurring within the greater Vanderbijlpark area can be found in Table 5.2.2.1. It is unlikely however that any of these species will occur within the study area as it was, and still is highly disturbed.

**Invader or exotic species**

Six (6) invader or exotic species were recorded in the study area. This can be expected, considering that this is still a pioneer community.

**Ecological quality of the community**

Within the Kiewiet species communities could not be identified due to the early stage of the community. As previously mentioned a large number of alien and weedy species were recorded in the area as well as species associated with disturbed conditions. This area is therefore classified as disturbed, with a medium to low ecological quality.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld.* Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The topography is fairly flat and slopes gently towards the east and south-east.

**Role of water in the habitat**

Grassland biome are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2.0 and 3.9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species occurring in the greater study area prefer moist areas.

**Utilization of land**

The Kiewiet Area is currently being rehabilitated. It was previously used as a shooting range, for effluent irrigation, whilst some borrow pits were also located in the area. After the rehabilitation is completed it will be utilized as an open veld area and game farm.

### 5.3.9 Receiving Environment beyond IVS Perimeter



Subject to the major land use of the area, the receiving environment beyond the IVS perimeter can be divided into two main regions:

- West and North of IVS Works - Mainly used for agricultural activities

- South and East of IVS Works - Mainly influenced by urbanization (industrial and residential)

### 5.3.9.1 West and North of IVS Works

This area is characterized by small holdings and cultivated land. Large sections of formerly cultivated land are currently used for the grazing of cattle.

The impact of the agricultural activities that took place there in the past is still clearly visible in the type of species present as well as the species composition of the sampling localities. Signs of a veld fire were also still visible in certain sections of the study area. Because of the amount of time elapsed since the community was disturbed by the fire, it can be expected that the effect thereof on the current vegetation community has declined.

The presence of many roads throughout the study area increases the edge-effect, thereby decreasing the quality of a community.

**Description of sampling localities**

Each sampling locality occurring in the area is described in the following table.

**TABLE 5.3.9.1: Description of sampling localities**

| # on Map | Location description | Characteristics | Importance | % of study area |
|---|---|---|---|---|
| Sample 11 | North of IVS in open veld | Grassland | Medium - low ecological importance | 5% |
| Sample 12 | South-west of IVS in artificial pasture | Pioneer grassland | Low ecological importance | 10% |
| Sample 13 | West of IVS next to dam | Grassland | Low - medium ecological importance | 5% |
| Sample 14 | West of IVS in Steel valley small holdings area | Grassland | Low - medium ecological importance | 5% |
| Sample 15 | West of IVS in Drakeville small holdings area | Grassland | Low - medium ecological importance | 5% |
| Sample 16 | West of IVS in Linkholm small holdings area | Grassland | Low - medium ecological importance | 5% |
| Sample 17 | West of IVS in Linkholm small holdings area | Grassland | Low - medium ecological importance | 5% |

| | | | | |
|---|---|---|---|---|
| Sample 20 | Southwest of IVS in open veld near Rietspruit | Grassland | Medium ecological importance | 5% |
| Sample 21 | West of IVS in Louisrus small holdings area | Grassland | Low - medium ecological importance | 5% |
| Sample 22 | Northwest of IVS in open veld | Grassland | Low - medium ecological importance | 5% |
| Sample 23 | North of IVS in open veld | Grassland | Low - medium ecological importance | 5% |
| Sample 24 | Far East of IVS in open grassland (Reference Site) | Grassland | Medium ecological importance | 5% |

**TABLE 5.3.9.2: Locations in area where species lists were compiled**

| Number on Map | Location description | Characteristics | Importance |
|---|---|---|---|
| SpList 6 | Artificial Pasture West of IVS | Pioneer grassland | Low ecological importance |
| SpList 7 | Artificial Pasture North-west of IVS | Pioneer grassland | Low ecological importance |
| SpList 8 | Artificial Pasture West of IVS | Pioneer grassland | Low ecological importance |

The following species dominate old cultivated land which has been converted to pastures:

- *Panicum maximum*
- *Paspalum dilatum*
- *Cynodon dactylon*
- *Eragrostis curvula*

All of these grasses' natural distribution ranges include the greater Vanderbijlpark area although only *Cynodon dactylon* was recorded in the Acocks botanical survey of South Africa.

**PHOTO 1: Old cultivated land converted into pastures**

**Dominant species**

The persistence of a plant community is influenced by the tolerance ranges of its constituent species. Therefore, dominant species reflect the persistence of that community.

Only one plant community was identified encompassing the Vanderbijlpark area. This *Hyparrhenia hirta - Heteropogon contortus* community can however be divided into four sub-communities.

- *Setaria nigrirostris* sub-community
- *Cynodon dactylon* sub-community
- *Eragrostis plana* sub-community
- *Eragrostis gummiflua* sub-community

The *Hyparrhenia hirta - Heteropogon contortus* vegetation community

*Hyparrhenia hirta* is an **Increaser I** which occurs in open grasslands and on rocky slopes next to rivers. It grows on most soil types, but prefers well drained rocky soil. This grass also occurs in disturbed places such as old agricultural fields and next to roads. It plays an important role in stabilization of barren soil and sand and protects it from erosion.

*Heteropogon contortus* (Spear grass) is widely distributed in open grasslands and bushveld. This grass grows particularly well on rocky soil, and occurs usually on rocky slopes and on disturbed places. It has a **variant** ecological status and an average to high grazing value.

As can be clearly seen, this plant community's dominant species are therefore species which generally occur in disturbed areas. This disturbance is most probably caused by agricultural activities.

This community has a medium to low species diversity and species richness. Species associations were measured by the Chi-square which found no significant species associations, which supports the theory that this area is highly disturbed. The Shannon diversity index showed a relatively low species diversity, with the average diversity being 1,817 from a range between 1,5 and 3,5. This further supports the theory of this area being a area of high disturbance.

The sub-communities will be discussed synoptically:

*Setaria nigrirostris* vegetation sub-community

Black seed bristle grass is a perennial grass that commonly occurs on open grassland or on open spaces in the bushveld on black turf soil. It often occurs in moist areas. With a high grazing capacity, this species ecological status is that of a **Decreaser**.

*Cynodon dactylon* vegetation sub-community

*Cynodon dactylon* is a creeping grass occurring on almost any soil types with a preference for soil with a high nitrogen component. It occurs in disturbed areas, and is common in moist places. With an ecological status of **Increaser IIb**, this grass plays an important role in soil erosion management and control.

The presence of *Themeda triandra* in the area, is surprising due to the fact that this is a **Decreaser** species, therefore it must be concluded that there are still areas not subjected to high levels of disturbance. Even though the distribution of *Themeda triandra* is patchy, it is indicative of a good veld type. One of these patches can be seen on PHOTO 2, APPENDIX I.

*Eragrostis plana* vegetation sub-community

Tough love grass is a perennial grass which grows on all soil types in disturbed areas such as old agricultural areas and trampled places. It prefers moist soil, especially in drier parts of the country. This grass has a low potability and is a **Increaser IIc**.

*Eragrostis gummiflua* vegetation sub-community

*Eragrostis gummiflua* is mostly an **Increaser IIc** species which occur commonly in regions with high rainfall. It prefers open grassland or bushveld and has a very low grazing value.

Several transitional species, including the following, were identified as well:

*Wahlenbergia virgata*
*Commelina livingstonii*
*Walafrida densiflora*

These species occur in the transitional zone between the *Cynodon dactylon* and *Eragrostis plana* vegetational sub-communities, and are also commonly found in disturbed areas.

**Species Composition**

As can clearly be seen in the table below, the herbaceous or weakly woody species dominate the area with the trees and shrubs only constituting a small percentage of the total species composition. When considering the origin of the species, it can be seen that even though the indigenous species dominate, the presence of alien and weedy species can not be overlooked. The percentage of indigenous species in the area, as well as the percentage non-weedy species, is higher in this area than in the Southern and Eastern regions, and therefore it could be concluded that this area has a higher ecological quality.

**TABLE 5.3.9.3: Site Description of Northern and Western Regions**

| | | Number | Percentage |
|---|---|---|---|
| Growth form | • Trees & Shrubs | 8 | **9.76%** |
| | • Herbaceous / Weakly woody | 74 | **90.24%** |
| | - Grasses | 28 | 37.84% |
| | - Forbs | 54 | 72.97% |
| | TOTAL | **[47]** | |
| Origin | ▸ Indigenous | 67 | 72.04% |
| | ▸ Aliens | 14 | 15.05% |
| | ▸ Declared weeds | 12 | 12.90% |
| Ecological status | ▸ Weedy species | 13 | 15.85% |
| | ▸ Non-weedy species | 68 | 82.93% |
| Habitat | ▸ Hydrophilous species | 9 | 6.10% |
| | ▸ Terrestrial species | 111 | 93.90% |

**Threatened species**

No endangered, rare or vulnerable species were recorded during any of the site visits. A list of the threatened species possibly occurring within the greater Vanderbijlpark area can be found in Table 5.2.2.1. It is unlikely though that any of these species will occur within this study area as it is already highly disturbed.

**Invader or exotic species**

A number of invader or exotic species were recorded in the study area. This can be expected, considering its high degree of disturbance.

The following are the main invader species observed within the study area:

*Verbena bonariensis*
*Solanum elaeagnifolium*
*Pseudognaphalium luteo-album*
*Bidens bipinnata*

*Verbena bonariensis*

Native from South America, this plant is a weed of gardens, roadsides, waste places and fallow lands.

*Solanum elaeagnifolium*

Indigenous to the Americas, this plant is a problem in agricultural areas as a result of its spreading root system from which new stems grow. Control is very difficult as disbursement occurs via seed as well as fragmented roots. Currently, no herbicides are available for the chemical control of this plant.

*Pseudognaphalium luteo-album*

The Jersey cut-weed is a widespread and common annual weed from Europe. It invades old land and also occurs in waste places and roadsides. This weed is tolerant to herbicides when mature, but susceptible to shallow cultivation as a seedling.

*Bidens bipinnata*

This Species was introduced during the last century from Eurasia. They are very troublesome weeds which can be found in most crops and disturbed areas. As blackjacks often germinate in dense mats, they can be relatively easily controlled, especially with post-emergence herbicides.

**Ecological quality of the community**

This region of the Vanderbijlpark area was subjected to high levels agricultural activities. The natural grassland areas were mostly used as pastures and some crop farming. Natural undisturbed grasslands are rarely found, and are usually small and fragmented. Therefore, this area is classified as disturbed, with a ecological quality varying from medium to low. FIGURE 2 in APPENDIX I shows the land-use for the area under investigation.

**Nature of habitat and physical landscape**

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld.* Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The topography is fairly flat and slopes gently towards the surface drainage features mainly in the west - Rietkuil Spruit and Riet Spruit.

**Role of water in the habitat**

Grassland biomes are limited to summer and strong summer rainfall areas with Summer Aridity Index (SAI) between 2,0 and 3,9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species occurring in the area, prefer moist areas.

**Utilization of land**

As previously mentioned the area is utilized for agricultural purposes comprising small holdings, limited crop farming and pastures - see FIGURE 2, APPENDIX I.

### 5.3.9.2 South and East of IVS Works

This area is characterized by a high level of urbanization. Formal as well as informal settlement cover the largest part of this area, whilst light industries are also present. Isolated patches of agricultural activities also occur. Signs of trampling, clearing of plant material and solid, liquid and air pollution, emphasizes the impact these activities have on the region.

**Description of sampling localities**

Each sampling locality occurring in the area is described in the following table.

**TABLE 5.3.9.4: Description of sampling localities**

| # on Map | Location description | Characteristics | Importance | % of study area |
|---|---|---|---|---|
| Sample 1 | South of IVS in open veld | Grassland | Low ecological importance | 5% |
| Sample 2 | South of IVS in open veld | Grassland | Low - medium ecological importance | 5% |
| Sample 3 | East of IVS in old agricultural areas | Pioneer grassland | Low ecological importance | 7.5% |

| | | | | |
|---|---|---|---|---|
| Sample 4 | East of IVS in old agricultural areas | Pioneer grassland | Low ecological importance | 7.5% |
| Sample 18 | South-west of IVS in open veld near squatter camp | Grassland | Low ecological importance | 5% |
| Sample 19 | Southwest of IVS in open veld near airstrip | Pioneer Grassland | Low - medium ecological importance | 5% |

**TABLE 5.3.9.5: Locations where species lists were compiled**

| Number on Map | Location description | Characteristics | Importance |
|---|---|---|---|
| SpList 9 | Artificial Pasture East of IVS | Pioneer grassland | Low ecological importance |

**Dominant species**

The persistence of a plant community is influenced by the tolerance ranges of its constituent species. Therefore, dominant species reflect the persistence of that community.

Only one plant community was identified encompassing the greater Vanderbijlpark area. This *Hyparrhenia hirta - Heteropogon contortus* community can however be divided into four sub-communities.

- *Setaria nigrirostris* sub-community
- *Cynodon dactylon* sub-community
- *Eragrostis plana* sub-community
- *Eragrostis gummiflua* sub-community

The *Cynodon dactylon* sub-community & *Eragrostis gummiflua* sub-community dominate this region, and will therefore be discussed.

The *Hyparrhenia hirta - Heteropogon contortus* vegetation community

*Hyparrhenia hirta* is an **Increaser I** which occurs in open grasslands and on rocky slopes next to rivers. It grows on most soil types, but prefers well drained rocky soil. This grass also occurs in disturbed places such as old agricultural fields and next to roads. It plays an important role in stabilization of barren soil and sand and protects it from erosion.

*Heteropogon contortus* (Spear grass) is widely distributed in open grasslands and bushveld. This grass grows particularly well on rocky soil, and occurs usually on rocky slopes and on disturbed places. It has a **variant** ecological status and an average to high grazing value.

As can be clearly seen, this plant community's dominant species are therefore species which generally occur in disturbed areas. This disturbance is most probably caused by agricultural activities.

This community has a medium to low species diversity and species richness. Species associations were measured by the Chi-square which found no significant species associations, which supports the theory that this area is highly disturbed. The Shannon diversity index showed a relatively low species diversity, with the average diversity being 1,817 from a rage between 1,5 and 3,5. This further supports the theory of this area being a area of high disturbance.

The sub-communities will be discussed synoptically.

*Cynodon dactylon* vegetation sub-community

*Cynodon dactylon* is a creeping grass occurring on almost any soil types with a preference for soil with a high nitrogen component. It occurs in disturbed areas, and is common in moist places. With an ecological status of **Increaser IIb**, this grass plays an important role in soil erosion management and control.

The presence of *Themeda triandra* in the area, is surprising due to the fact that this is a **Decreaser** species, and therefore it must be concluded that there are still areas not subjected to high levels of disturbance. Even though the distribution of *Themeda triandra* is patchy, it is indicative of a good veld type. One of these patches can be seen in PHOTO 2.

**PHOTO 2: *Themeda triandra* grassland**

*Eragrostis gummiflua* vegetation sub-community

*Eragrostis gummiflua* is mostly an **Increaser IIc** species which occur commonly in regions with high rainfall. It prefers open grassland or bushveld and has a very low grazing value.

Several transitional species, including the following, were identified as well:

*Wahlenbergia virgata*
*Commelina livingstonii*
*Walafrida densiflora*

These species occur in the transitional zone between the *Cynodon dactylon* and *Eragrostis plana* vegetational sub-communities, and are also commonly found in disturbed areas.

**Species Composition**

As can clearly be seen in the table below, the herbaceous or weakly woody species dominate the area with the trees and shrubs only constituting a small percentage of the total species composition. When considering the origin of the species, it can be seen that even though the indigenous species dominate, the presence of alien and weedy species can not be overlooked.

**TABLE 5.3.9.6: Site Description**

| | | Number | Percentage |
|---|---|---|---|
| Growth form | ▸ Trees & Shrubs | **4** | **8.51%** |
| | ▸ Herbaceous / Weakly woody | **43** | **91.49%** |
| | - Grasses | 15 | 34.88% |
| | - Forbs | 24 | 55.81% |
| | - Sedges & restios | 4 | 9.30% |
| | TOTAL | [47] | |
| Origin | ▸ Indigenous | 37 | 68.52% |
| | ▸ Aliens | 9 | 16.67% |
| | ▸ Declared weeds | 8 | 14.81% |
| Ecological status | ▸ Weedy species | 24 | 23.40% |
| | ▸ Non-weedy species | 96 | 76.60% |
| Habitat | ▸ Hydrophilous species | 9 | 8.51% |
| | ▸ Terrestrial species | 111 | 91.49% |

**Threatened species**



No endangered, rare or vulnerable species were recorded during any of the site visits. A list of the threatened species possibly occurring within the greater Vanderbijlpark area can be found in Table 5.2.2.1. It is

unlikely though that any of these species will occur within the study area as it is already highly disturbed.

**Invader or exotic species**

A number of invader or exotic species were recorded in the study area. This can be expected, considering its high degree of disturbance.

The percentage of invader species observed is higher than the average observed for the total area investigated.

The following are the main invader species observed within the study area:

*Verbena bonariensis*
*Pseudognaphalium luteo-album*
*Bidens bipinnata*

*Verbena bonariensis*

Native from South America, this plant is a weed of gardens, roadsides, waste places and fallow lands.

*Pseudognaphalium luteo-album*

The Jersey cut-weed is a widespread and common annual weed from Europe. It invades old land and also occurs in waste places and roadsides. This weed is tolerant to herbicides when mature, but susceptible to shallow cultivation as a seedling.

*Bidens bipinnata*

This Species was introduced during the last century from Eurasia. They are very troublesome weeds which can be found in most crops and disturbed areas. As blackjacks often germinate in dense mats, they can be relatively easily controlled, especially with post-emergence herbicides.

**PHOTO 3: Sampling locality 18 showing exotic species and poor veld condition**

## Ecological quality of the community

This section of the Vanderbijlpark area is subjected to high levels of urbanization. Natural undisturbed grasslands are rarely found, and are usually small and fragmented. Therefore this area is classified as disturbed, with an ecological quality varying from medium to low. FIGURE 2 in APPENDIX I shows the land-use for the area under investigation.

## Nature of habitat and physical landscape

This area was originally a grassland area which falls under the Northern Variation of *Cymbopogon -themeda veld*. Rainfall varies from 450 - 750 mm per annum, falling in summer. Winters in this area are severely frosty. The topography is fairly flat and slopes gently from south and north towards the Leeuw Spruit, which represents the main surface water drainage feature in the area.

## Role of water in the habitat

Grassland biomes are limited to summer and strong summer rainfall areas with the Summer Aridity Index (SAI) between 2,0 and 3,9 (Acocks, 1988). This means that water is a crucial part of this habitat. This theory is supported by the fact that several of the dominant species occurring in the area, prefer moist areas.

**Utilization of land**

As previously mentioned the area is highly urbanized. The open areas which still exist are utilized for agricultural purposes, limited crop farming and pastures - see FIGURE 2, APPENDIX I.

# 6. BIOLOGICAL IMPACT ASSESSMENT

It is quite apparent from the report up till this point, that the entire study area represents an already impacted situation as a result of a range of activities varying from residential, agricultural, industrial and other anthropogenic activities. The impact assessment to be performed now, will attempt to put the causes and impacts into perspective and to highlight those aspects which could be managed to minimize or perhaps even prevent future impacts. The impact assessment will focus on the current land use applications for essentially the medium term, that is for the duration of activities as they exist today.

## 6.1 IMPACT ASSESSMENT METHODOLOGY

The criteria used to determine the significance of an impact on the environment is that used in Carter, 1977 and Munn, 1979. These criteria can be found in APPENDIX IV.

The causes for the impacts observed are all related to physical activities associated with urbanization, agriculture and industry, and are therefore fairly generic. This implies that the impacts can be discussed almost generically for the main activities listed, i.e. industry, urbanization and agriculture.

The impact assessment will therefore not focus on the individual Master Plan zones, but will rather be structured according to the nature of the activities. The discussion will be done for the following zones:

- Area within the IVS Perimeter - industrial
- Receiving Environment beyond the IVS Perimeter - urbanization and agriculture. This zone will have two subdivisions:
  - West and North of IVS Works - agriculture
  - East and South of IVS Works - urbanization, light industrial

## 6.2 IMPACT ASSESSMENT

### 6.2.1 Areas within the IVS Perimeter

The area within the IVS Works is a highly disturbed area. These disturbances are mainly caused by industrial activities including the stockpiling of raw materials, the deposition of waste and waste water, construction and usage of buildings, plants, access roads, rail lines and dams.

The following impacts are those that mainly contributed to the current situation:

- Disruption of soil profile
- Loss of topsoil
- Destruction of vegetation
- Trampling
- Increase of edge effect
- Invasion of alien species

Each of the listed impacts will now be discussed in more detail. It should be noted that the area in which these impacts occur, is zoned for heavy industrial activity.

| **Nature of impact:** | Disruption of soil profile |
|---|---|
| Cause of impact: | Excavation activities caused by construction of dumps, stockpiles, dams, buildings, plants, roads, rail-lines, etc. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Very little can be done during the operational phase. Ongoing rehabilitation of certain dumps is possible and should be considered during the operational phase. Soils excavated for construction purposes must be stockpiled and used for rehabilitation. |
| Significance: | Medium Significance. |

| **Nature of impact:** | Loss of topsoil |
|---|---|
| Cause of impact: | Clearing of site, construction activities, roads. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Stockpile soil where possible. Limit area to be cleared. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Destruction of vegetation |
| Cause of impact: | Industrial activities including the stockpiling of raw materials, the deposition of waste and waste water, construction and usage of buildings, plants, access roads, rail lines and dams. |
| Duration: | Medium Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Compile seed bank of vegetation naturally occurring in the area. This seed bank can be used to re-introduce these species during the rehabilitation phase. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Trampling |
| Cause of impact: | Vehicular traffic, activities of workers. |
| Duration: | Medium Term. |
| Extent: | Local. |
| Intensity: | Low. |
| Probability: | Probable. |
| Mitigation options: | Restrict vehicular traffic to roads. |
| Significance: | Low Significance. |

| | |
|---|---|
| **Nature of impact:** | Increased edge effect |
| Cause of impact: | Roads, Fragmentation of vegetation. |
| Duration: | Medium Term. |
| Extent: | Regional. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Limit the number of roads. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Invasion of alien species |
| Cause of impact: | Construction activities, accidental introduction of seed of invader species by construction and other vehicles. |
| Duration: | Medium Term. |
| Extent: | Regional. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Control of invader species, manually, chemically or biologically. |
| Significance: | Medium Significance. |

### 6.2.2 Receiving Environment beyond the IVS Perimeter

Subject to the major land use of the area, the receiving environment beyond the IVS perimeter can be divided into two main regions:

- West and North of IVS Works - Mainly used for agricultural activities
- South and East of IVS Works - Mainly influenced by urbanization (industrial and residential)

#### 6.2.2.1 West and North of IVS Works

The main impacts in this region are associated with agricultural activities. Impacts associated with construction of houses also exist, but to a lesser extent.

The following impacts are those that mainly contributed to the current situation:

- Disruption of soil profile
- Loss of topsoil
- Destruction of vegetation
- Decrease in species diversity and richness
- Trampling
- Increased of edge effect
- Invasion of alien species
- Erosion

The listed impacts will be discussed in detail below:

| **Nature of impact:** | Disruption of soil profile |
|---|---|
| Cause of impact: | Constructions of farmsteads, houses on small holdings, roads and ploughing for crop farming and artificial pastures. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Rehabilitation after decommissioning. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Loss of topsoil |
| Cause of impact: | Clearing of protective natural vegetation for replacement by crops, followed by erosion and soils loss if not controlled properly. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Limit area to be cleared, and institute proper surface run-off controls. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Destruction of vegetation |
| Cause of impact: | Constructions of farmsteads, houses on small holdings, roads and ploughing for crop farming and artificial pastures. |
| Duration: | Medium Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Compile seed bank of vegetation naturally occurring in the area. This seed bank can be used to re-introduce these species during the rehabilitation phase. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Decrease in species diversity and richness |
| Cause of impact: | Ploughing for crop farming and artificial pastures, resulting in replacement of diverse and species rich natural grassland with a single crop species. |
| Duration: | Medium Term. |
| Extent: | Local. |
| Intensity: | High. |
| Probability: | Highly probable. |
| Mitigation options: | Compile seed bank of vegetation naturally occurring in the area. This seed bank can be used to re-introduce these species during the rehabilitation phase. |
| Significance: | High Significance. |

| | |
|---|---|
| **Nature of impact:** | Trampling |
| Cause of impact: | Traffic, activities of workers and overgrazing. |
| Duration: | Medium Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Probable. |
| Mitigation options: | Restrict vehicular traffic to access roads. Do not exceed carrying capacity of grassland. |
| Significance: | Low Significance. |

| | |
|---|---|
| **Nature of impact:** | Increased edge effect |
| Cause of impact: | Access roads, fragmentation of natural vegetation. |
| Duration: | Medium Term. |
| Extent: | Regional. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Limit the number of access roads, optimize/consolidate land use. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Invasion of alien species |
| Cause of impact: | Construction activities, accidental introduction of seed of invader species by construction and other vehicles, as well as alien seed mixed with seeds of crops. The unstable community caused by single species creates opportunity for invasion by alien species. |
| Duration: | Medium Term. |
| Extent: | Regional. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Control of invader species, manually, chemically or biologically. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Erosion |
| Cause of impact: | Clearing of protective natural vegetation for replacement by crops, overgrazing and poor veld management. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Implement sound veld management protocols. |
| Significance: | Medium Significance. |

### 6.2.2.2 South and East of IVS Works

This area is characterized by a high level of urbanization. Formal as well as informal settlement cover the largest part of this area, whilst light industries are also present. Isolated patches of agricultural activities also occur. Signs of trampling, clearing of plant material and solid, liquid and air pollution, emphasizes the impact these activities have on the region.

The following impacts are those that mainly contributed to the current situation:

- Disruption of soil profile
- Loss of topsoil
- Destruction of vegetation
- Trampling
- Increased of edge effect
- Invasion of alien species
- Erosion

The listed impacts will now be discussed in detail:

| **Nature of impact:** | Disruption of soil profile |
|---|---|
| Cause of impact: | Excavation activities caused by building of houses, industries, cemeteries, schools and other buildings. Landscaping of areas. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | High. |
| Probability: | Highly probable. |
| Mitigation options: | Rehabilitation after decommissioning. |
| Significance: | Medium Significance. |

| **Nature of impact:** | Loss of topsoil |
|---|---|
| Cause of impact: | Clearing of sites, construction activities, gravel roads. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Limit area to be cleared. |
| Significance: | Medium Significance. |

| | |
|---|---|
| **Nature of impact:** | Destruction of vegetation |
| Cause of impact: | Clearing of site for urbanization, building of access roads, uncontrolled dumping of waste material, manmade fires. Replacing natural grassland with landscaped parks, lawns, sports fields, et cetera. |
| Duration: | Long Term. |
| Extent: | Local. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Compile seed bank of vegetation naturally occurring in the area. This seed bank can be used to re-introduce these species during the rehabilitation phase. |
| Significance: | High Significance. |
| **Nature of impact:** | Trampling |
| Cause of impact: | Vehicular traffic, activities of residents. |
| Duration: | Medium Term. |
| Extent: | Local. |
| Intensity: | Low. |
| Probability: | Probable. |
| Mitigation options: | Restrict vehicular traffic to access roads. |
| Significance: | Low Significance. |
| **Nature of impact:** | Increased edge effect |
| Cause of impact: | Access roads, fragmentation of vegetation. |
| Duration: | Medium Term. |
| Extent: | Regional. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Limit the number of access roads. |
| Significance: | Medium Significance. |
| **Nature of impact:** | Invasion of alien species |
| Cause of impact: | Construction activities, accidental introduction of seed of invader species by construction and other vehicles. Disturbance of natural community. Introduction of alien species in gardens. |
| Duration: | Long Term. |
| Extent: | Regional. |
| Intensity: | Medium. |
| Probability: | Highly probable. |
| Mitigation options: | Control of invader species, manually, chemically or biologically. |
| Significance: | Medium Significance. |

# 7. BIOLOGICAL MANAGEMENT OBJECTIVES

The activities occurring on the IVS site represents heavy industrial activities and therefore significant impacts on the natural vegetation and plant life is to be expected. Similarly, the surrounding residential, agricultural and light industrial areas, also cause significant impacts on vegetation and plant life. This statement is clearly borne out by the description of the current situation and the impact assessment performed in preceding sections of this report.

Despite all this, the principles of integrated management should nevertheless be implemented where possible. This means that the vegetational environment should be seen as an integrated part of the total environment. Therefore it should be an objective of IVS to effectively protect the vegetational environment from irreversible damage caused by their activities, within the bounds applicable to industrial site utilization. Other contributors to the impact on the natural vegetation and plant life should of course also strive towards the same goals. The unavoidable negative impacts caused by IVS during any of their activities should be mitigated as far as is economically and practically viable.

Due to the fact that the impact on the natural vegetation and plant life will continue throughout the operational life time of IVS, the short term and medium term management objectives proposed, relate primarily to preparatory work and monitoring to support rehabilitation actions over the long term.

## 7.1 SHORT TERM MANAGEMENT OBJECTIVES

Identify and protect all threatened species present in the area surrounding the IVS works.

These species can be prioritized as follow:

- Critically endangered species
- Endangered species
- Vulnerable species
- Rare species
- Indeterminate species
- Insufficiently known species

## 7.2 MEDIUM TERM MANAGEMENT OBJECTIVES

Along with the general health of the flora surrounding the IVS works, it should be an objective to monitor the progress and health of the threatened species occurring in the area. Medium term objectives are applicable for the entire operational phase of any IVS related activity.

## 7.3 LONG TERM MANAGEMENT OBJECTIVES

During the rehabilitation phase it should be attempted to restore the vegetational regime to a healthy condition, where communities within the rehabilitated area have a high species richness as well as a high species diversity.

It should also be the aim of IVS to control invader and exotic species invading the recovering vegetational community.

# 8. AVAILABLE/ PROPOSED MANAGEMENT MEASURES

## 8.1 AREAS WITHIN THE IVS PERIMETER

Due to the generic nature of impacts and objectives for natural vegetation and plant life, generic management measures will be given. These measures are to be selected subject to the actual activity and resulting impact within a specific Master Plan zone, for implementation according to the life cycle phase of the specific activity and impact.

| IMPACT | MANAGEMENT MEASURE |
|---|---|
| Disruption of soil profile | Stockpile different layers of soil to decrease mixing thereof. This soil can then be used during rehabilitation of the development. |
| Loss of topsoil | Stockpile different layers of soil to decrease mixing thereof. This soil can then be used during rehabilitation of the development.<br><br>Cover areas where topsoil is exposed, with vegetation. |
| Destruction of vegetation | Compile seed bank of natural species present and store seed under suitable storage conditions.<br><br><u>Risk to Threatened Species</u><br><br>Identify all threatened species occurring in the area, create locality maps of these species. Record abundances of species. Implement protection measures. Depending on the locality, the area could be fenced, or marked as a protected area.<br><br>Ensure that no activity of IVS negatively affects the health of the species.<br><br>Any incident of unauthorized removal of plant material as well as accidental damage to these priority plants, must be documented.<br><br><u>Seeding of covered site</u><br><br>The seeds of the species included in the seed bank, compiled during the preconstruction phase, should be used to seed the area.<br><br>Water and nutrients should be provided to increase the growth rate of the vegetation, thus increasing the rehabilitation rate and decreasing the time of exposure of open soil sensitive to erosion. |

| IMPACT | MANAGEMENT MEASURE |
|---|---|
| | *Cynodon dactylon* and *Hyparrhenia hirta* are two important species which should be included in those used for seeding. They are both tolerant to disturbance and plays an important role in erosion management |
| Trampling | Limiting access of vehicular traffic by creating buffer zones along access roads, will mitigate this impact. |
| Increase of edge effect | Mitigate this impact by limiting the access roads cutting through the natural vegetation. |
| Invasion of alien species | The replacement of indigenous species by invader species can be mitigated by physical, chemical or biological measures. When using either chemical or biological measures, caution must be carried out when choosing the control agent. Chemical and biological agents used must be species specific, not threatening the survival or health of the indigenous species present in the area.<br><br>A registered weed control officer must be appointed to chemically treat any invader species. Care must be taken to avoid the spread of seeds of alien vegetation. |

## 8.2 RECEIVING ENVIRONMENT BEYOND THE IVS PERIMETER

### West and North of IVS Works

| IMPACT | MANAGEMENT MEASURE |
|---|---|
| Disruption of soil profile | Stockpile different layers of soil to decrease mixing thereof. This soil can then be used during rehabilitation of the development. |
| Loss of topsoil | Stockpile different layers of soil to decrease mixing thereof. This soil can then be used during rehabilitation of the development<br><br>Cover areas where topsoil is exposed, with vegetation. |
| Destruction of vegetation | Compile seed bank of natural species present and store seed under suitable storage conditions.<br><br>Employ sound veld management measures where the carrying capacity of an area is determined and not exceeded.<br><br>Risk to Threatened Species<br><br>Identify all threatened species occurring in the area, create locality maps of these species. Record abundances of species. Implement protection measures. Depending on the locality, the area could be fenced, or marked as a protected area.<br><br>Ensure that no activity negatively affects the health of the species.<br><br>Any incident of unauthorized removal of plant material as well as accidental damage to these priority plants, must be documented.<br><br>Seeding of rehabilitated area |

| IMPACT | MANAGEMENT MEASURE |
|---|---|
| | The seeds of the species included in the seed bank, compiled during the preconstruction phase, should be used to seed the area.<br><br>Water and nutrients should be provided to increase the growth rate of the vegetation, thus increasing the rehabilitation rate and decreasing the time of exposure of open soil sensitive to erosion.<br><br>*Cynodon dactylon* and *Hyparrhenia hirta* are two important species which should be included in those used for seeding. They are both tolerant to disturbance and plays an important role in erosion management. |
| Decrease in species diversity and richness | Compile seed bank of natural species present and store seed under suitable storage conditions. |
| Trampling | Limiting access of vehicular traffic by creating buffer zones along access roads will mitigate this impact.<br><br>Employ sound veld management measures where the carrying capacity of an area is determined and not exceeded. |
| Increase of edge effect | Mitigate this impact by limiting the access roads cutting through the natural vegetation. |
| Invasion of alien species | The replacement of indigenous species by invader species can be mitigated by physical, chemical or biological measures. When using either chemical or biological measures, caution must be carried out when choosing the control agent. Chemical and biological agents used must be species specific, not threatening the survival or health of the indigenous species present in the area. |
| Erosion | Cover all exposed topsoil with vegetation. Limit trampling of sensitive areas by keeping cattle away from those areas. |

## South and East of IVS Works

| IMPACT | MANAGEMENT MEASURE |
|---|---|
| Disruption of soil profile | Stockpile different layers of soil to decrease mixing thereof. This soil can then be used during rehabilitation of the development. |
| Loss of topsoil | Stockpile different layers of soil to decrease mixing thereof. This soil can then be used during rehabilitation of the development.<br><br>Cover areas where topsoil is exposed, with vegetation. |
| Destruction of vegetation | Compile seed bank of natural species present and store seed under suitable storage conditions.<br><br>Rather than lawned parks, use vegetation naturally occurring in the area. Also promote natural open veld area.<br><br>Educate the community on the positive aspects of protecting the environment. Also promote the use of naturally occurring species in gardens. |

| IMPACT | MANAGEMENT MEASURE |
|---|---|
| | Risk to Threatened Species<br><br>Identify all threatened species occurring in the area, create locality maps of these species. Record abundances of species. Implement protection measures. Depending on the locality, the area could be fenced, or marked as a protected area.<br><br>Ensure that no activity negatively affects the health of the species.<br><br>Any incident of unauthorized removal of plant material as well as accidental damage to these priority plants, must be documented.<br><br>Seeding of rehabilitated area<br><br>The seeds of the species included in the seed bank, compiled during the preconstruction phase, should be used to seed the area.<br><br>Water and nutrients should be provided to increase the growth rate of the vegetation, thus increasing the rehabilitation rate and decreasing the time of exposure of open soil sensitive to erosion.<br><br>*Cynodon dactylon* and *Hyparrhenia hirta* are two important species which should be included in those used for seeding. They are both tolerant to disturbance and plays an important role in erosion management. |
| Trampling | Limiting access of vehicular traffic by creating buffer zones along access roads will mitigate this impact.<br><br>Employ sound veld management measures where the carrying capacity of an area is determined and not exceeded.<br><br>Create environmental awareness in community by educating them. |
| Increase of edge effect | Mitigate this impact by limiting the access roads cutting through the natural vegetation. |
| Invasion of alien species | The replacement of indigenous species by invader species can be mitigated by physical, chemical or biological measures. When using either chemical or biological measures, caution must be carried out when choosing the control agent. Chemical and biological agents used must be species specific, not threatening the survival or health of the indigenous species present in the area.<br><br>Involve community in control of alien plants. |
| Erosion | Cover all exposed topsoil, with vegetation. |

## 9. MONITORING ACTIONS

The environmental variables, which influence the suitability of the environment, for the vegetation currently occurring in the study area, can at any stage, change, causing a replacement of current species and possibly even communities with species or communities more adapted to the changed environment. In the case where the environment becomes more impacted, more tolerant species will replace the more sensitive species. These tolerant species are often weeds or exotic species, which will effectively lower the ecological quality of the veld.

Monitoring of the environmental variables are therefore necessary to prevent this degradation taking place. This monitoring can be done by a vegetational survey conducted once a year, during which a species list is compiled and the abundance of each of the constituent species recorded.

This information should be enclosed in an annual floral monitoring report. The findings of these monitoring reports should be evaluated and management decisions made.

Site visits should co-inside with the growth season and should therefore be done between November and April each year.

## 10. SUMMARY AND CONCLUSION

The following represent the main conclusions of the natural vegetation and plant life base line study:

- According to the Acocks veld type classification of South Africa, the greater Vanderbijlpark area falls under the Northern Variation of *Cymbopogon - themeda veld.*

- The greater Vanderbijlpark area was subjected to high levels of urban development as well as agricultural activities. The natural grassland areas were mostly used as pastures and for crop farming.

- Using the principals of the Braun-Blanquet vegetation survey techniques, 24 quadrants within the study area, of 25m$^2$ each were selected. These quadrants were arranged in a predetermined pattern to ensure objectivity. The flora found in these quadrants were then sampled and identified. They were then grouped in their various vegetation communities.

- The sensitivity of the plant community could then be determined by looking at the sensitivity of its constituent species as well as their conservation status.

- Natural undisturbed grasslands are rarely found, and usually small and fragmented. Therefore, this area is classified as disturbed, with an ecological quality varying from medium to low.

- As expected most of the dominant species occur naturally in disturbed areas. In general, the ecological statuses of the dominant species are that of either **Increaser IIa** or **Increaser IIb**. This means that the species numbers increase as overgrazing/impact increases. A number of exotic and invader species, associated with disturbed areas, also occur within the area. It could therefore be concluded that the study area is currently disturbed.

- No endangered, vulnerable or rare species were observed in the area. The endangered species mentioned in TABLE 5.2.2.1 may occur in this area, though this is unlikely.

- Due to the nature of the industrial activities, the Master Plan sub-zones within the IVS perimeter, are all highly disturbed areas. No communities could be identified within this area. A high level of alien and weedy species were recorded in this area.

- The receiving environment beyond the IVS perimeter, can be divided into two regions by land-use; the region to the north and west of IVS for which the main land-use is agriculture and the region to the east and south of IVS, which is mainly impacted by urbanization and industrial activities.

- The main reason for the disturbed situation in the northern and western regions is impacts associated with agricultural activities.

- The main reason for the disturbed situation in the south and eastern regions is impacts associated with urbanization and industrial activities.

- The following impacts occur throughout the Master Plan study area, for various reasons:

  - Disruption of soil profile
  - Loss of topsoil
  - Destruction of vegetation
  - Trampling
  - Increased of edge effect
  - Invasion of alien species
  - Erosion



- These impacts can only be managed while the cause is still active. Only in the rehabilitation phase can the impacts truly be mitigated/rehabilitated.

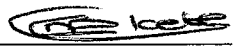
- The management objectives should incorporate the principles of integrated management. This means that the floral environment should not be seen as an integral part of the larger environment. Therefore it should be an objective of IVS to effectively protect the floral environment from irreversible damage caused by their activities. Unavoidable negative impacts caused during any of the developmental stages should be mitigated as far as is viable/reasonable.

- Monitoring of the environmental variables are necessary to prevent the degradation of the ecosystem taking place, and is an important mitigation measure. This monitoring can be done by a floral survey conducted once a

year, in which a species list is compiled and the abundance of each of the specific species recorded. Throughout the year, any unusual occurrences such as patches of dead grassland should be reported immediately.

- Site visits should co-inside with the rainy season and should consequently be done between November and April each year.

Respectfully submitted



G.M. Cloete (PrSciNat)

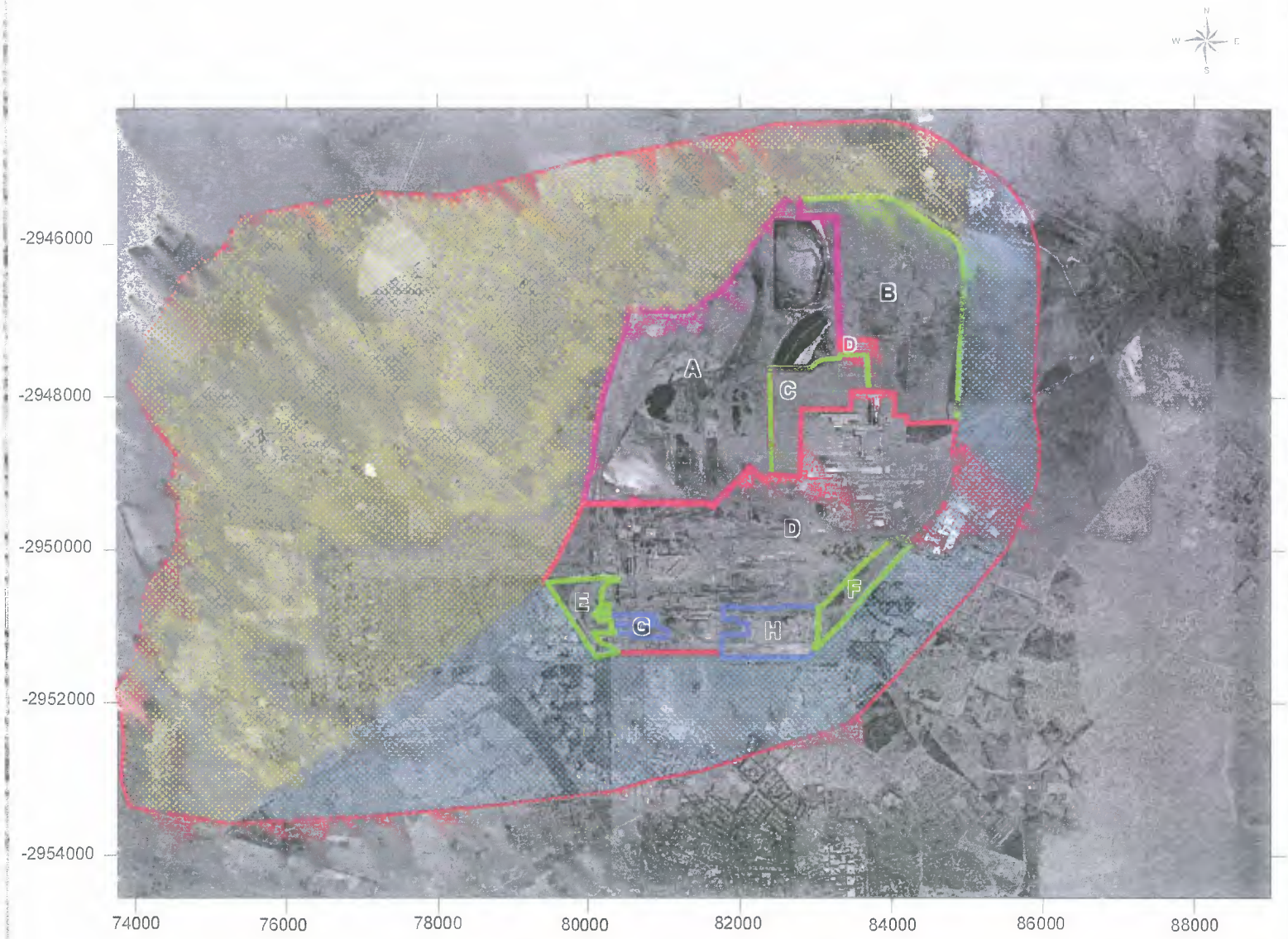
Projek/Prj1732A

APPENDIX I

FIGURE 1: Extent of the Study Area

FIGURE 2: Study Area showing Sampling Localities

FIGURE 3: Current Landuse in the Study Area




## LEGEND

- Masterplan Study Area
- IFSP Works Area
- Receiving Environment - North & West
- Receiving Environment - South & East

### Masterplan Zones within IVS

A - CRMF
B - Kiewiet Area
C - Open Veld Area - Central
D - CPA
E - Open Veld Area - South East
F - Open Veld Area - South West
G - Southern Slag processing area South West
H - Southern Slag Processing area South East

Scale 1 : 82 000

Client: ISCOR Vanderbijl Steel
Project: Master plan Baseline Studies
Map Status: Final
Compiled by: G. Cloete
Checked by: R. Grobbelaar

JASPER MÜLLER ASSOCIATES CC

| Project no: | Date: |
|---|---|
| 10193 | October 2002 |

# FIGURE 1

## Extent of Study Area


## LEGEND

- Masterplan Study Area
- IVS Works Area
- Vegetation sampling locality

A - CRMF
B - Kiewiet Area
C - Open Veld Area - Central
D - CPA
E - Open Veld Area - South East
F - Open Veld Area - South West
G - Southern Slag processing area South West
H - Southern Slag Processing area South East

Scale 1 : 82 000

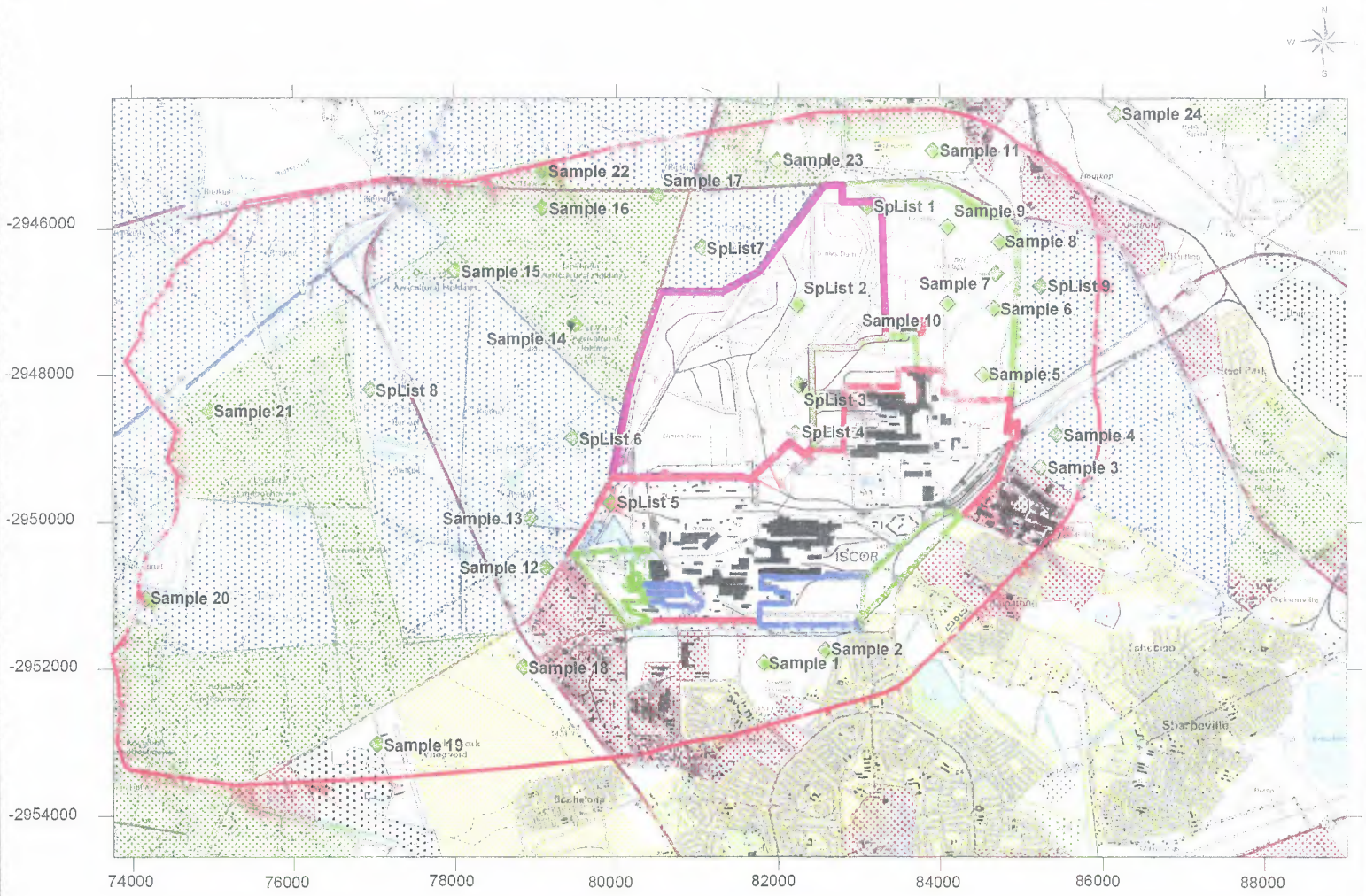
Client: ISCOR Vanderbijl Steel
Project: Master plan Baseline Studies
Map Status: Final
Compiled by: G. Cloete
Checked by: R. Grobbelaar

JASPER MÜLLER ASSOCIATES CC

| Project no: | Date: |
|---|---|
| 10193 | October 2002 |

**FIGURE 2**

**Study area showing sampling localities**




## LEGEND

- Masterplan Study Area
- IVS Works Area
- Vegetation sampling locality
- Agricultural Activities
- Small Holdings
- Residential Areas
- Industrial Activities

Scale 1 : 82 000

Client: ISCOR Vanderbijl Steel
Project: Master plan Baseline Studies
Map Status: Final
Compiled by: G. Cloete
Checked by: R. Grobbelaar

JASPER MÜLLER ASSOCIATES CC

| Project no: | Date: |
|---|---|
| 10193 | October 2002 |

## FIGURE 3

**Current land use in study area**

Draft for discussion
CONFIDENTIAL
Research for IVS

APPENDIX II

FLORAL SPECIES LIST

**Species list of 2627DA according to PRECIS:**

*Ancylobothrys capensis (Oliv.) Pichon*
*Barleria pretoriensis C.B.Clarke*
*Becium obovatum (E.Mey. ex Benth.) N.E.Br. subsp. obovatum var. obovatum*
*Cenia microglossa DC.*
*Convolvulus sagittatus Thunb.*
*Cuscuta campestris Yunck.*
*Cyperus semitrifidus Schrad. var. semitrifidus*
*Dichondra repens J.R.& G.Forst.*
*Eragrostis curvula (Schrad.) Nees*
*Fallopia convolvulus (L.) Holub*
*Ipomoea crassipes Hook.*
*Ipomoea ommaneyi Rendle*
*Lantana rugosa Thunb.*
*Lappula squarrosa (L.) Dumort. subsp. heteracantha (Ledeb.) Chater*
*Lobelia angolensis Engl. & Diels*
*Maerua cafra (DC.) Pax*
*Pavetta zeyheri Sond.*
*Polygonum aviculare L.*
*Pycnostachys reticulata (E.Mey.) Benth.*
*Rhus magalismontana Sond. subsp. magalismontana*
*Rhynchosia sordida (E.Mey.) Schinz*
*Riccia okahandjana S.W.Arnell*
*Rubus rigidus Sm.*
*Rumex sagittatus Thunb.*
*Salvia stenophylla Burch. ex Benth.*
*Scirpoides burkei (C.B.Clarke) Goetgh. ex Goetgh., Muasya & D.A.Simpson*
*Solanum retroflexum Dunal*
*Solanum villosum Mill.*
*Tapiphyllum parvifolium (Sond.) Robyns*
*Triraphis andropogonoides (Steud.) E.Phillips*
*Vernonia natalensis Sch.Bip. ex Walp.*

*Trachyandra asperata Kunth var. macowanii (Baker) Oberm.*
*Trachyandra asperata Kunth var. nataglencoensis (Kuntze) Oberm.*
*Trachyandra saltii (Baker) Oberm. var. saltii*
*Tribulus terrestris L. var. terrestris*
*Tripteris aghillana DC. var. aghillana*
*Triraphis andropogonoides (Steud.) E.Phillips*
*Tulbaghia acutiloba Harv.*
*Urginea modesta Baker*
*Urginea multisetosa Baker*
*Urochloa brachyura (Hack.) Stapf*
*Ursinia nana DC. subsp. nana*
*Urtica urens L.*
*Vahlia capensis (L.f.) Thunb. subsp. capensis*
*Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. linearis E.Mey. ex Bridson*
*Vernonia galpinii Klatt*
*Vernonia oligocephala (DC.) Sch.Bip. ex Walp.*
*Veronica anagallis-aquatica L.*
*Wahlenbergia undulata (L.f.) A.DC.*
*Withania somnifera (L.) Dunal*
*Xanthium strumarium L.*
*Xysmalobium brownianum S.Moore*
*Zantedeschia albomaculata (Hook.) Baill. subsp. macrocarpa (Engl.) Letty*
*Zinnia peruviana (L.) L.*
*Ziziphus mucronata Willd. subsp. mucronata*
*Ziziphus zeyheriana Sond.*
*Zornia capensis Pers. subsp. capensis*
*Zornia milneana Mohlenbr.*

*Rhynchosia venulosa (Hiern) K.Schum.*
*Riccia cavernosa Hoffm. emend. Raddi*
*Rorippa fluviatilis (E.Mey. ex Sond.) Thell. var. fluviatilis*
*Rorippa nudiuscula Thell.*
*Rumex crispus L.*
*Rumex nepalensis Spreng.*
*Salix sp.*
*Salvia repens Burch. ex Benth. var. repens*
*Salvia repens Burch. ex Benth. var. transvaalensis Hedge*
*Salvia runcinata L.f.*
*Satyrium hallackii Bolus subsp. ocellatum (Bolus) A.V.Hall*
*Scadoxus puniceus (L.) Friis & Nordal*
*Schoenoplectus decipiens (Nees) J.Raynal*
*Scilla nervosa (Burch.) Jessop*
*Scirpoides burkei (C.B.Clarke) Goetgh. ex Goetgh., Muasya & D.A.Simpson*
*Scleria woodii C.B.Clarke*
*Sebaea leiostyla Gilg*
*Seddera capensis (E.Mey. ex Choisy) Hallier f.*
*Selago densiflora Rolfe*
*Senecio laevigatus Thunb. var. integrifolius Harv.*
*Senecio othonniflorus DC.*
*Senecio sp.*
*Setaria incrassata (Hochst.) Hack.*
*Setaria sp.*
*Sida chrysantha Ulbr.*
*Sida ternata L.f.*
*Silene pilosellifolia Cham. & Schltdl.*
*Sisymbrium thellungii O.E.Schulz*
*Solanum nodiflorum Jacq.*
*Solanum panduriforme E.Mey.*
*Solanum rigescens Jacq.*
*Sonchus dregeanus DC.*
*Sporobolus fimbriatus (Trin.) Nees*
*Stachys hyssopoides Burch. ex Benth.*
*Stipagrostis zeyheri (Nees) De Winter subsp. sericans (Hack.) De Winter*
*Striga asiatica (L.) Kuntze*
*Striga gesnerioides (Willd.) Vatke ex Engl.*
*Sutera aurantiaca (Burch.) Hiern*
*Sutherlandia microphylla Burch. ex DC.*
*Talinum caffrum (Thunb.) Eckl. & Zeyh.*
*Tephrosia burchellii Burtt Davy*
*Tephrosia capensis (Jacq.) Pers. var. angustifolia E.Mey.*
*Tephrosia capensis (Jacq.) Pers. var. capensis*
*Tephrosia lupinifolia DC.*
*Tephrosia semiglabra Sond.*
*Teucrium trifidum Retz.*
*Thesium hirsutum A.W.Hill*
*Thesium impeditum A.W.Hill*
*Thesium lesliei N.E.Br.*
*Thesium spartioides A.W.Hill*
*Tolpis capensis (L.) Sch.Bip.*

*Nidorella resedifolia DC. subsp. resedifolia*
*Nolletia rarifolia (Turcz.) Steetz*
*Oenothera tetraptera Cav.*
*Oldenlandia herbacea (L.) Roxb. var. herbacea*
*Ornithogalum juncifolium Jacq.*
*Ornithogalum ornithogaloides (Kunth) Oberm.*
*Ornithogalum tenuifolium F.Delaroche subsp. aridum Oberm.*
*Ornithogalum tenuifolium F.Delaroche subsp. tenuifolium*
*Osteospermum muricatum E.Mey. ex DC. subsp. muricatum*
*Oxalis corniculata L.*
*Oxalis latifolia Humb., Bonpl. & Kunth*
*Oxalis obliquifolia Steud. ex Rich.*
*Pachycarpus schinzianus (Schltr.) N.E.Br.*
*Pachystigma pygmaeum (Schltr.) Robyns*
*Panicum schinzii Hack.*
*Papaver argemone L.*
*Parapodium costatum E.Mey. (Insufficiently known)*
*Pavonia burchellii (DC.) R.A.Dyer*
*Pearsonia cajanifolia (Harv.) Polhill subsp. cajanifolia*
*Pelargonium minimum (Cav.) Willd.*
*Pellaea calomelanos (Sw.) Link var. calomelanos*
*Pentanisia angustifolia (Hochst.) Hochst.*
*Pentzia globosa Less.*
*Pentzia incana (Thunb.) Kuntze*
*Persicaria amphibia (L.) Gray*
*Persicaria lapathifolia (L.) Gray*
*Phytolacca heptandra Retz.*
*Plagiochasma microcephalum (Steph.) Steph.*
*Plantago lanceolata L.*
*Polygala hottentotta C.Presl*
*Polygala transvaalensis Chodat subsp. transvaalensis Paiva*
*Potamogeton crispus L.*
*Potamogeton pectinatus L.*
*Potamogeton schweinfurthii A.W.Benn.*
*Potentilla supina L.*
*Pteris vittata L.*
*Pycreus macranthus (Boeck.) C.B.Clarke*
*Pycreus nitidus (Lam.) J.Raynal*
*Ranunculus multifidus Forssk.*
*Raphionacme hirsuta (E.Mey.) R.A.Dyer ex E.Phillips*
*Requienia pseudosphaerosperma (Schinz) Brummitt*
*Rhus pyroides Burch. var. pyroides*
*Rhynchosia adenodes Eckl. & Zeyh.*
*Rhynchosia minima (L.) DC. var. minima*
*Rhynchosia minima (L.) DC. var. prostrata (Harv.) Meikle*
*Rhynchosia nervosa Benth. & Harv. var. nervosa*
*Rhynchosia nervosa Benth. & Harv. var. petiolata Burtt Davy*
*Rhynchosia pentheri Schltr. ex Zahlbr. var. pentheri*
*Rhynchosia sordida (E.Mey.) Schinz*
*Rhynchosia sp.*
*Rhynchosia totta (Thunb.) DC. var. totta*

*Hibiscus pusillus Thunb.*
*Hibiscus trionum L.*
*Hyparrhenia hirta (L.) Stapf*
*Hypericum aethiopicum Thunb. subsp. sonderi (Bredell) N.Robson*
*Hypericum lalandii Choisy*
*Hypoxis acuminata Baker*
*Hypoxis filiformis Baker*
*Hypoxis hemerocallidea Fisch. & C.A.Mey.*
*Hypoxis iridifolia Baker*
*Indigofera cryptantha Benth. ex Harv. var. cryptantha*
*Indigofera torulosa E.Mey. var. angustiloba (Baker f.) J.B.Gillett*
*Ipomoea crassipes Hook.*
*Ipomoea oblongata E.Mey. ex Choisy*
*Isolepis fluitans (L.) R.Br.*
*Juncus oxycarpus E.Mey. ex Kunth*
*Justicia anagalloides (Nees) T.Anderson*
*Kalanchoe paniculata Harv.*
*Kohautia amatymbica Eckl. & Zeyh.*
*Kohautia virgata (Willd.) Bremek.*
*Kyphocarpa angustifolia (Moq.) Lopr.*
*Lablab purpureus (L.) Sweet subsp. uncinatus Verdc.*
*Lasiospermum pedunculare Lag.*
*Ledebouria cooperi (Hook.f.) Jessop*
*Ledebouria luteola Jessop*
*Ledebouria sp.*
*Leersia hexandra Sw.*
*Lemna gibba L.*
*Linaria vulgaris Mill.*
*Lippia scaberrima Sond.*
*Lithops lesliei (N.E.Br.) N.E.Br. subsp. lesliei var. lesliei*
*Lithospermum cinereum DC.*
*Litogyne gariepina (DC.) Anderb.*
*Lobelia angolensis Engl. & Diels*
*Lotononis laxa Eckl. & Zeyh.*
*Lotononis listii Polhill*
*Lunularia cruciata (L.) Dumort. ex Lindenb.*
*Lycium sp.*
*Mariscus congestus (Vahl) C.B.Clarke*
*Marsilea macrocarpa C.Presl*
*Maytenus heterophylla (Eckl. & Zeyh.) N.Robson subsp. heterophylla*
*Medicago laciniata (L.) Mill. var. laciniata*
*Medicago sativa L.*
*Melilotus indica (L.) All.*
*Melinis nerviglumis (Franch.) Zizka*
*Menodora africana Hook.*
*Microchloa caffra Nees*
*Mimulus gracilis R.Br.*
*Moraea pallida (Baker) Goldblatt*
*Myriophyllum spicatum L.*
*Nemesia fruticans (Thunb.) Benth.*
*Nesaea schinzii Koehne*

*Digitaria tricholaenoides Stapf*
*Dipcadi marlothii Engl.*
*Dipcadi viride (L.) Moench*
*Drimiopsis burkei Baker*
*Echinochloa jubata Stapf*
*Eleocharis palustris R.Br.*
*Elephantorrhiza elephantina (Burch.) Skeels*
*Eragrostis capensis (Thunb.) Trin.*
*Eragrostis cilianensis (All.) F.T.Hubb.*
*Eragrostis curvula (Schrad.) Nees*
*Eragrostis gummiflua Nees*
*Eragrostis lappula Nees*
*Eragrostis racemosa (Thunb.) Steud.*
*Eriosema burkei Harv. var. burkei*
*Erythrina zeyheri Harv.*
*Eulophia hians Spreng. var. hians*
*Eulophia welwitschii (Rchb.f.) Rolfe*
*Euphorbia clavarioides Boiss. var. truncata (N.E.Br.) A.C.White, R.A.Dyer & B.Sloane*
*Euphorbia striata Thunb. var. striata*
*Euryops transvaalensis Klatt subsp. transvaalensis*
*Eustachys paspaloides (Vahl) Lanza & Mattei*
*Falckia oblonga Bernh. ex C.Krauss*
*Fallopia convolvulus (L.) Holub*
*Felicia fascicularis DC.*
*Felicia muricata (Thunb.) Nees subsp. muricata*
*Fimbristylis complanata (Retz.) Link*
*Fuirena coerulescens Steud.*
*Gazania krebsiana Less. subsp. serrulata (DC.) Roessler*
*Gazania sp.*
*Geigeria aspera Harv. var. aspera*
*Geranium multisectum N.E.Br.*
*Gerbera ambigua (Cass.) Sch.Bip.*
*Gisekia pharnacioides L. var. pharnacioides*
*Gladiolus longicollis Baker var. platypetalus (Baker) Oberm.*
*Gladiolus papilio Hook.f.*
*Gnaphalium nelsonii Burtt Davy*
*Gnidia capitata L.f.*
*Gnidia kraussiana Meisn. var. kraussiana*
*Gnidia sp.*
*Gomphrena celosioides Mart.*
*Guilleminea densa (Willd. ex Roem. & Schult.) Moq.*
*Haemanthus montanus Baker*
*Haplocarpha lyrata Harv.*
*Helichrysum argyrosphaerum DC.*
*Helichrysum aureonitens Sch.Bip.*
*Helichrysum caespititium (DC.) Harv.*
*Helichrysum lineare DC.*
*Helichrysum rugulosum Less.*
*Hermannia sp.*
*Heteropogon contortus (L.) Roem. & Schult.*
*Hibiscus microcarpus Garcke*

*Cenia microglossa DC.*
*Ceropegia sandersonii Decne. ex Hook.f.*
*Chaetacanthus burchellii Nees*
*Chamaesyce inaequilatera (Sond.) Soják*
*Chascanum adenostachyum (Schauer) Moldenke*
*Cheilanthes hirta Sw. var. brevipilosa W.& N.Jacobsen*
*Cheilanthes hirta Sw. var. hirta*
*Cheilanthes viridis (Forssk.) Sw. var. viridis*
*Chenopodium ambrosioides L.*
*Chenopodium multifidum L.*
*Chlorophytum fasciculatum (Baker) Kativu*
*Chlorophytum transvaalense (Baker) Kativu*
*Chortolirion angolense (Baker) A.Berger*
*Cineraria lyratiformis Cron*
*Clematis brachiata Thunb.*
*Clerodendrum triphyllum (Harv.) H.Pearson*
*Commicarpus pentandrus (Burch.) Heimerl*
*Conium chaerophylloides (Thunb.) Sond.*
*Convolvulus arvensis L.*
*Convolvulus sagittatus Thunb.*
*Conyza canadensis (L.) Cronquist*
*Conyza podocephala DC.*
*Corchorus asplenifolius Burch.*
*Coronopus didymus (L.) Sm.*
*Corrigiola litoralis L. subsp. litoralis var. litoralis*
*Cotula anthemoides L.*
*Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.*
*Cucumis hirsutus Sond.*
*Cycnium tubulosum (L.f.) Engl.*
*Cymbopogon excavatus (Hochst.) Stapf ex Burtt Davy*
*Cynanchum virens D.Dietr.(Vulnerable)*
*Cynoglossum hispidum Thunb.*
*Cyperus difformis L.*
*Cyperus esculentus L. var. esculentus*
*Cyperus fastigiatus Rottb.*
*Cyperus laevigatus L.*
*Cyperus obtusiflorus Vahl var. flavissimus (Schrad.) Boeck.*
*Cyperus semitrifidus Schrad. var. semitrifidus*
*Cyperus usitatus Burch. var. usitatus*
*Cyrtanthus breviflorus Harv.*
*Cyrtanthus contractus N.E.Br.*
*Datura stramonium L.*
*Denekia capensis Thunb.*
*Deverra burchellii (DC.) Eckl. & Zeyh.*
*Diclis rotundifolia (Hiern) Hilliard & B.L.Burtt*
*Dicoma gerrardii Harv. ex F.C.Wilson*
*Dicoma macrocephala DC.*
*Digitaria brazzae (Franch.) Stapf*
*Digitaria eriantha Steud.*
*Digitaria sp.*
*Digitaria ternata (A.Rich.) Stapf*

**Species list of 2627DB according to PRECIS:**

*Abildgaardia ovata (Burm.f.) Kral*
*Acacia karroo Hayne*
*Acalypha angustata Sond.*
*Acalypha caperonioides Baill.*
*Acanthospermum australe (Loefl.) Kuntze*
*Acrotome hispida Benth.*
*Ajuga ophrydis Burch. ex Benth.*
*Albuca setosa Jacq.*
*Alectra pumila Benth.*
*Alloteropsis semialata (R.Br.) Hitchc. subsp. eckloniana (Nees) Gibbs-Russ.*
*Alternanthera pungens Kunth in Humb., Bonpl. & Kunth*
*Amaranthus deflexus L.*
*Amaranthus thunbergii Moq.*
*Ammannia baccifera L. subsp. baccifera*
*Ammannia prieuriana Guill. & Perr.*
*Ammocharis coranica (Ker Gawl.) Herb.*
*Anchusa capensis Thunb.*
*Andropogon appendiculatus Nees*
*Anthospermum rigidum Eckl. & Zeyh. subsp. pumilum (Sond.) Puff*
*Aponogeton junceus Lehm. ex Schltdl. subsp. rehmannii (Oliv.) Oberm.*
*Aptosimum indivisum Burch. ex Benth.*
*Arctotis arctotoides (L.f.) O.Hoffm.*
*Arctotis microcephala (DC.) P.Beauv.*
*Arctotis sp.*
*Argemone ochroleuca Sweet subsp. ochroleuca*
*Argyrolobium pauciflorum Eckl. & Zeyh. var. semiglabrum Harv.*
*Aristida adscensionis L.*
*Aristida congesta Roem. & Schult. subsp. congesta*
*Aristida junciformis Trin. & Rupr. subsp. junciformis*
*Aristida sciurus Stapf*
*Asclepias brevipes (Schltr.) Schltr.*
*Asclepias dregeana Schltr. var. dregeana*
*Asclepias gibba (E.Mey.) Schltr. var. gibba*
*Asclepias meyeriana (Schltr.) Schltr.*
*Asclepias stellifera Schltr.*
*Asparagus laricinus Burch.*
*Aspidoglossum biflorum E.Mey.*
*Becium obovatum (E.Mey. ex Benth.) N.E.Br. subsp. obovatum var. obovatum*
*Boophone disticha (L.f.) Herb.*
*Brachiaria advena Vickery*
*Brachiaria serrata (Thunb.) Stapf*
*Brachystelma ramosissimum (Schltr.) N.E.Br.*
*Brachystelma schinzii (K.Schum.) N.E.Br. (Insufficiently known)*
*Bryum argenteum Hedw.*
*Bulbine abyssinica A.Rich.*
*Bulbine narcissifolia Salm-Dyck*
*Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke*
*Bulbostylis hispidula (Vahl) R.W.Haines*
*Carex glomerabilis Krecz.*

APPENDIX III

LIST OF PLANT SPECIES FOUND DURING THE SITE INVESTIGATION

**Plant species found during site investigation**

*Acacia karoo*
*Acrotome hispida*
*Andropogon appendiculatus*
*Anthericum cooperi*
*Arctotis arctotoides*
*Aristida adscensionis*
*Aristida bipartita*
*Aristida canescens subsp canescens*
*Aristida congesta*
*Aristida stipitata*
*Asclepias eminens*
*Asclepias stellifera*
*Berkeya macrocephala*
*Berkeya radula*
*Bidens bipinnata*
*Bidens pilosa*
*Brachiaria serrata*
*Bromus catharticus*
*Bulbustylis hispida*
*Chamaecrista comosa*
*Chamaecrista mimosoides*
*Commelina africana*
*Commelina livingstonii*
*Conzya bonariensis*
*Corchorus confusus*
*Cordylogne globosa*
*Crepis hypochoeridea*
*Cucumus zeyheri*
*Cyanotis speciosa*
*Cymbopogon plurinodus*
*Cynodon dactylon*
*Cyperus esculentus*
*Cyprus rupestris*
*Digitaria erantha*
*Digitaria tricholaenoides*
*Eleochoris dregeana*
*Elionurus muticus*
*Enneapogon scoparius*
*Eragrostis biflora*
*Eragrostis capensis*
*Eragrostis chloromelas*
*Eragrostis curvula*
*Eragrostis gummiflua*
*Eragrostis lehmannia*
*Eragrostis micrantha*
*Eragrostis nindensis*
*Eragrostis plana*
*Eragrostis trichophora*
*Felicia muricata*
*Gazania krebsiana*
*Geizeria burkei*
*Gomphrena celosoides*
*Guilleminea densa*
*Haplocarpa scaposa*
*Helichrysum kraussi*
*Helichrysum rugulosum*
*Hemizygia canescens*
*Hermannia depressa*
*Heteropogon contortus*
*Hibiscus microcarpus*
*Hyparrhenia hirta*
*Hypoxis acuminata*
*Hypoxis argentea*
*Hypoxis hemerocallidea*
*Indigofera adenoides*
*Indigofera filipes*
*Indigofera hedyantha*
*Ipomoea crassipes*
*Ipomoea ommaneyi*
*Justicia anagalloides*
*Killinga erecta*
*Kohautia anatymbica*
*Lepidium bonariensis*
*Linum thunbergii*
*Lippia rehmannii*
*Lobelia faccida*
*Lotononis calycina*
*Lotononis foliosa*
*Mariscus congestus*
*Mariscus macrocarpus*
*Melinis repens subsp repens*
*Microchloa caffra*
*Nidorella anomala*
*Nidorella auriculata*
*Oenothera indecora*
*Oxalis latifolia*
*Panicum maximum*
*Paspalum dilatum*
*Platago lanceolata*
*Pollichia camprestis*
*Polygala hottentotta*
*Protasparagus laricinus*
*Pseudonaphalium luteo-album*
*Reseda lutea*
*Rhynchosia adenodes*
*Rhynchosia monophylla*
*Schkuhria pinnata*
*Schoenoplectus madagascariense*

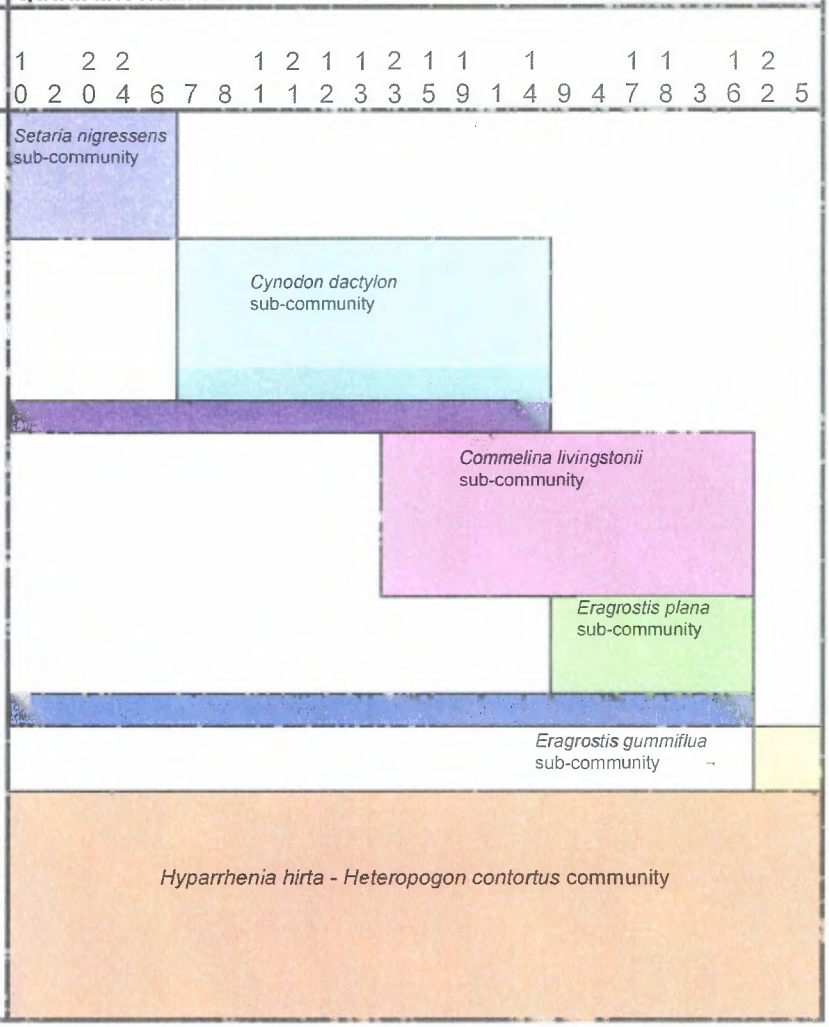
*Schoenoxiphium madagascariense*
*Senecio inaequidens*
*Senecio othonniflorus*
*Setaria nigrostris*
*Setaria pallide-fusca*
*Solanum elaeagnifolium*
*Sonchus asper*
*Sonchus dregeana*
*Sonchus oleraceus*
*Stoebe vulgaris*
*Tagestes munita*
*Themeda triandra*
*Trichoneura grandiglumus*
*Urochloa panicoides*
*Verbena bonariensis*
*Verbena brasiliensis*
*Verbena tenuisecta*
*Vernonia oligocephala*
*Wahlenbergia undulata*
*Wahlenbergia virgata*
*Walafrida densiflora*
*Zinnia peruviana*
*Zornia linearus*

# APPENDIX IV

## THE CRITERIA USED TO DETERMINE THE SIGNIFICANCE OF AN IMPACT ON THE ENVIRONMENT

## Species communities identified during investigation

| Species nr | Species name | Occurance frequency | Quadrant number |
|---|---|---|---|
| 106 | *Set nig* | 5 | |
| 36 | *Dig tri* | 2 | |
| 39 | *Eli mut* | 3 | |
| 107 | *Set pal* | 3 | |
| 33 | *Cyn dac* | 10 | |
| 41 | *Era bif* | 3 | |
| 15 | *Bid bip* | 2 | |
| 9 | *Ari con* | 2 | |
| 48 | *Era nin* | 2 | |
| 114 | *The tri* | 13 | |
| 25 | *Com liv* | 6 | |
| 102 | *Sch pin* | 2 | |
| 122 | *Wah vir* | 3 | |
| 123 | *Wal den* | 3 | |
| 5 | *Arc arc* | 3 | |
| 49 | *Era pla* | 4 | |
| 117 | *Ver bon* | 3 | |
| 120 | *Ver oli* | 3 | |
| 44 | *Era cur* | 18 | |
| 45 | *Era gum* | 2 | |
| 87 | *Nid ano* | 2 | |
| 64 | *Hyp hir* | 12 | |
| 112 | *Sto vul* | 5 | |
| 62 | *Het con* | 9 | |
| 51 | *Fel mur* | 6 | |
| 61 | *Her dep* | 5 | |
| 58 | *Hel rug* | 3 | |
| 3 | *And a[illegible]* | 2 | |



## THE CRITERIA USED TO DETERMINE THE SIGNIFICANCE OF AN IMPACT OF A DEVELOPMENT ON THE ENVIRONMENT

According to Carter, 1977 and Munn, 1979, the significance of the impact on the environment is determined by:

1. **The nature of the impact of the action on the environment:**

   The nature of the impact can have significant impacts on the environment and it is therefor very important to look at this factor when the significance of an impact is being determined.

2. **The extent of the impact. This is the physical and spatial size of the impact, and is classified as follows:**

| | |
|---|---|
| Local: | The impacted area extends only as far as the activity |
| Regional: | The impact could effect the entire development area. |
| National: | The impact could directly or indirectly affect places of international interest |

3. **The duration of the impact. The lifetime of the impact is places in the following categories:**

| | |
|---|---|
| Short term: | The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than any of the project phases. |
| Medium term: | The impact will last up to the end of the phases, where after it will end. |
| Long term: | The impact will continue or last for the entire operation phase, but will be mitigated by direct human action or by natural processes there after. |

4. **The intensity of the impact:**

| | |
|---|---|
| Low: | The natural processes or functions of the environment is not effected by the alterations the impact makes to the affected environment. |
| Medium: | The affected environment is altered in such a way that the functions and processes continue, but in a modified way. |
| High: | The functions and processes of the affected environment is disturbed to the extent where is temporarily or permanently ceases. |

5. **The probability of the impact occurring:**

| | |
|---|---|
| Improbable: | The possibility of the impact occurring is very low , due either to circumstances, design or experience. |
| Probable: | There is a possibility that the impact will occur to the extent that provisions must be made therefor. |
| Highly probable: | The likelihood of the impacts occurring at some or other stage of the development is very high. Plans must therefor be drawn up before undertaking the activity |

6. **Mitigation options:**

The significance of an impact may be decreased with proper mitigation. This option is therefor important in the determination of the significance of an impact.

Using the above criteria the impact is classified as the following level of significance:

I. **No Significance**
The impact is not substantial and does not require any mitigatory action.

II. **Low Significance**
The impact is of importance, but may require limited mitigation.

III. **Medium Significance**
The impact is of importance and therefor considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

IV. **High Significance**
The impact is of great importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefor essential.