GAS TO POWER PLANT ON A SITE WITHIN THE RICHARDS BAY INDUSTRIAL DEVELOPMENT ZONE KWAZULU-NATAL PROVINCE

Specialist Terrestrial Ecological Assessment Report




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SPECIALIST ASSESSMENT REPORT DETAILS AND DECLARATION OF INDEPENDENCE

This is to certify that the following report has been prepared as per the requirements of Appendix 6 (1) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the Environmental Impact Assessment Regulations 2014 as per Government Notice No. 38282 Government Gazette, 04 December 2014.

Document Title:	***Specialist Terrestrial Ecological Assessment Report:*** Gas to Power Plant on a site within the Richards Bay Industrial Development Zone, KwaZulu-Natal
Report prepared by:	**Mr. Adam Teixeira-Leite** *Senior Scientist with Eco-Pulse Consulting* Professional Natural Scientist (Pr. Sci. Nat.) registered with SACNASP (registration number: 400332/13)
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I Adam Teixeira-Leite hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Agriculture and Environmental Affairs.

Signed:  Date: 26 April 2016

EXECUTIVE SUMMARY

This report sets out the findings of a specialist terrestrial ecological survey and impact assessment to inform the Environmental Assessment process for a proposed gas to power plant to be established and operated by an Independent Power Producer 'Richards Bay Gas Power 2 (Pty) Ltd'. The development is to be located on three erven within the Richards Bay Industrial Development Zone (RBIDZ) Phase 1F site, which is zoned general industrial, in the vicinity of the Tata Steel factory in Alton, Richards Bay, Kwazulu Natal (KZN). The approximate extent of the proposed development site is to be 7.5 hectares and will be located on terrestrial (untransformed) grassland. The main findings of the specialist ecological assessment undertaken by Eco-Pulse Consulting in March 2016 have been summarized below as follows:

Baseline Ecological Assessment:

The site is located within a fragmented and previously transformed Maputaland Wooded Grassland community (Endangered threat status, moderately protected in KZN) which was found to be dominated by two indigenous plant communities, namely (i) ***Aristida junciformis subsp. junciformis – Helichcrysum kraussii*** wooded grassland and (ii) ***Themeda triandra - Parinari capensis subsp. incohata*** wooded grassland. The focus of the ecological survey was therefore on the terrestrial grassland community and habitat only. Most species of plants identified (including grasses/graminoids, small herbs and woody shrubs/small trees) were identified as locally common species of Least Concern (SANBI) with two plant species of conservation significance recorded: ***Crinum delagoense*** ('*Declining' threat status, specially protected in KZN*) and ***Ledebouria ovatifolia*** (SA Endemic species*, specially protected in KZN*). These plants species were observed in patches within the broader grassland community, with approximately 20 to 30 individual plants estimated for the site. Signs of past disturbance at the site were evident, with remnant stumps of *Eucalyptus sp.* trees scattered throughout the vegetation unit assessed, evidence of the past use of the site for commercial forestry plantation. Tarmac, old dilapidated brick buildings and fences within the eastern sections of the site are evidence of the small model airfield that once operated at the site. Other onsite disturbances include numerous vehicle, human and animal tracks and fill material deposited on the site as well as the maintained (mowed) firebreaks around the Tata steel factory perimeter to the south of the site. As a result of the disturbance created by forestry and other human activities a number of Invasive Alien Plants (IAPs) and exotic weeds characterise the site, with the most abundant woody alien plant being *Psidium guajava* (Guava). Livestock (cattle) grazing was evident throughout the vegetation community assessed, with cattle tracks/paths and heavily grazed grass tussocks identified.

The modified/secondary wooded grassland vegetation community sampled at the site was determined to be fairly similar to the benchmark vegetation unit, Maputaland Wooded Grassland when comparing the species composition with the benchmark/reference type. The plant communities defined for the site and study area were assessed qualitatively in

terms of their ecological condition (based on a combination of species composition; structural intactness and existing levels of anthropogenic disturbance) and conservation importance in order to estimate relative floristic sensitivity. Whilst composition has been modified in comparison to the reference grassland type, with an increase in pioneer and alien/weedy/undesirable species and structure appeared patchy with greatly reduced basal cover in places, sections of the grassland appeared more intact and harboured protected plant species. Ecological sensitivity arranged from very low/low within the more degraded areas associated with the old airfield and forestry activities to moderate, with patches containing high densities of protected plants considered moderately high in terms of ecological sensitivity (refer to Figure A and Table A below).

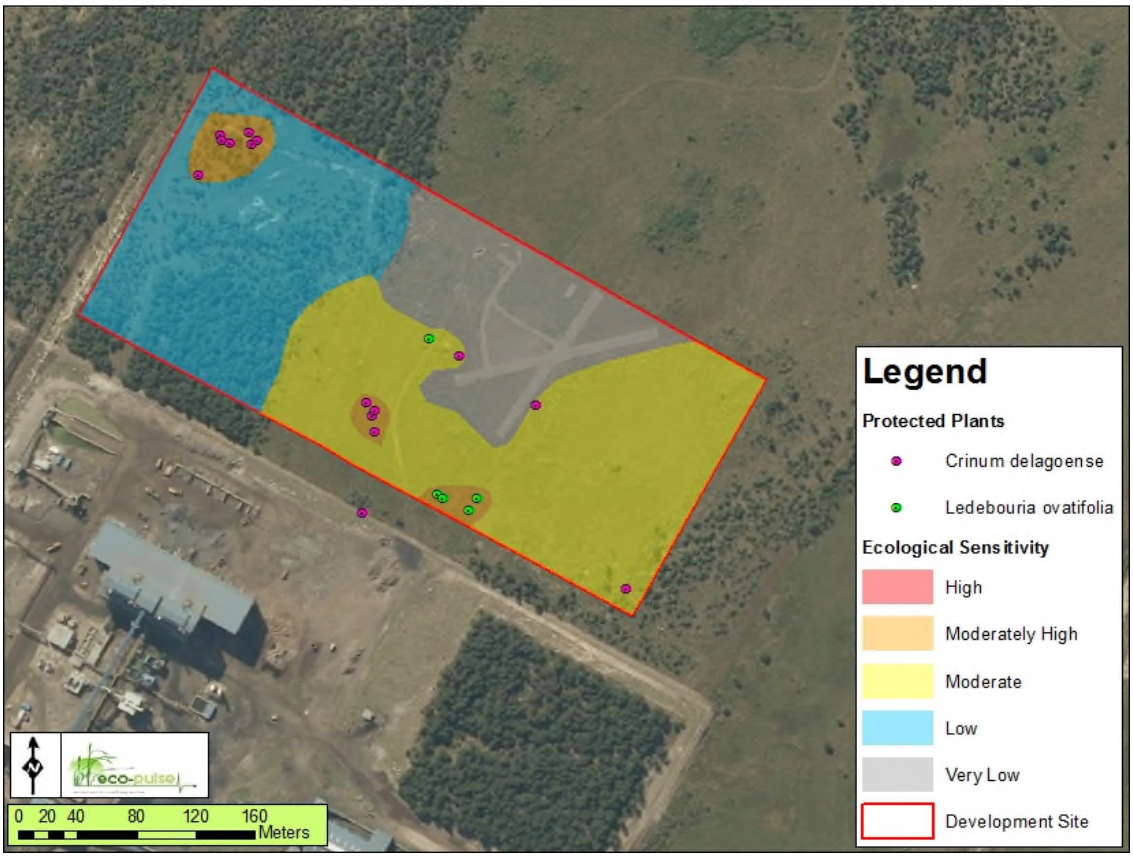

Figure A. Map indicating the ecological sensitivity of the various sections of the wooded grassland vegetation community at the site sampled.

Table A. Summary details of the wooded grassland vegetation community and ecological sensitivity.

Extent of proposed development site surveyed	7.5ha
Reference vegetation type	Maputaland Wooded Grassland (Endangered status)
Current vegetation communities	1. ***Aristida junciformis subsp. junciformis – Helichcrysum kraussii*** wooded grassland 2. ***Themeda triandra - Parinari capensis subsp. incohata*** wooded grassland
Ecological Condition	Low to Moderate

Protected Plants	*Crinum delagoense* *Ledebouria ovatifolia*
Conservation Value	Low to Medium
Ecological Sensitivity	Low to Medium

A desktop review of potential fauna of conservation significance that could be present at the site (based on existing datasets and published information for the region) was undertaken and used to assess the potential occurrence of a number of threatened/ red data species based on species distributional ranges, habitat requirements and the condition/ suitability of the existing grassland habitat provided at the site. Based on this assessment, a number of threatened small mammals (shrews and mice mainly) and endangered and vulnerable grassland birds could utilise the more intact grassland habitat at the site. The majority of larger mammal species are likely to have been eradicated or have moved away from the area due to high levels of habitat transformation and degradation. This is mainly a result of historical disturbance (forestry), increased development pressure and human disturbances in the area. Smaller mammal species (such as shrews and moles) are also extremely vulnerable to existing impacts at the site (e.g. poaching and dogs/feral cats, etc.). It is therefore highly unlikely that the site constitutes significant habitat for any species of threatened mammal species as well as for mammal species in general. Reptiles and amphibians of conservation importance could potentially occur but alterations to the original reptilian fauna are expected to have already occurred to a great extent with the disappearance of reptile diversity in the area, as well as on the site, as a result of human presence; coupled with extensive habitat transformation (industrial area) and high levels of disturbance. The site was notably depauperate in terms of wildlife/ fauna, with only locally common species of invertebrates of 'Least Concern' (including butterflies, grasshoppers and Net-winged beetle) observed during the field survey. No reptile or mammal species were observed during the brief site survey. Previous surveys undertaken in 2015 by NEMAI Consulting recorded only a handful of common species of mammals, birds and reptiles (species of Least Concern).

Ecological impacts and impact management/mitigation:

According to the NEMA, natural ecosystems are inherently vulnerable to human activities and these activities can often lead to irreversible damage or longer term, gradual/ cumulative changes to ecosystems. Threats to terrestrial ecosystems and biodiversity include processes and activities which reduce system persistence, affect landscape structure and composition and alter community diversity and patterns, including reduced genetic diversity. Impacts related to the proposed development on terrestrial ecosystems and biodiversity were identified and assessed for each phase of the development, from pre-construction through to decommissioning and rehabilitation of the site, with the principle ones being:

1. Destruction/damaging of indigenous vegetation
2. Loss/degradation and fragmentation of habitat
3. Establishment of weeds/alien plants

4. Soil erosion and sedimentation
5. Pollution of soils and habitat
6. Direct impacts to fauna/wildlife
7. Artificial noise and light disturbance

The significance of potential construction-related ecological impacts are estimated to range from **Low to Medium** ecological significance, with the direct disturbance/degradation and loss of vegetation/habitat during pre-construction stripping and clearing of vegetation being the most significant. The spread of Invasive Alien Plants (IAPs), weeds and other undesirable plants post-construction (due to disturbance created) is likely to be of a **Medium** ecological significance and will affect areas adjacent to the facility over the operational life-span of the project most probably. During the decommissioning phase of the project, impacts are unlikely to be of much significance, with the potential of the project to have a net positive ecological impact on the habitat and biodiversity when the artificial infrastructure is removed and the grassland vegetation/habitat is properly reinstated at the site.

Cumulative impacts associated with the development were identified and assessed, in the context of past historic disturbance at the site and future industrial expansion within the broader Phase 1F site. Cumulative impacts on ecosystem conservation targets, loss of ecological functioning and ecosystem services supply, and impacts to species of conservation concern ranged from **Medium to High** significance in light of the threat status and irreplaceability value of the Maputaland Wooded Grassland vegetation type and the presence of protected/threatened plant species at the site. Cumulative impacts are likely to remain Moderately-High to High even when considering these impacts without the planned gas power plant development (due to the extensive industrial development planned for the Phase 1 F area).

With adequate mitigation and impact management, most direct and indirect impacts can be effectively managed and reduced to estimated low significance levels. The cumulative loss of threatened/protected species can be effectively managed by rescuing and translocating species to suitable conservation sites outside of the developable area, reducing the impact on the local population of these species to a low significance level. Other on-site impacts can be quite easily mitigated through appropriate practical on-site impact mitigation and best practice management measures which have been outlined in this report. These include the implementation of an alien plant management programme and revegetation/rehabilitation plan for areas disturbed during construction. The cumulative, permanent and irreversible loss of vegetation and habitat will be difficult to mitigate, and the consequences in terms of meeting targets set for Maputaland Wooded Grassland (Endangered vegetation type) as well as the resultant loss of ecosystem functioning, goods and services will be unavoidable. In order to compensate for the loss of habitat and ecosystem functioning/services supply, an investigation into the need and desirability for biodiversity offsets is recommended for the broader IDZ Phase 1F

development project and the Richards Bay Industrial Development Zone Company should consult further with Ezemvelo KZN Wildlife in this regard.

It is further recommended that **Section 5.4 of this report which deals with 'Impact Mitigation/Management'** be referenced in the Environmental Authorisation (EA) for this project as a specific condition of the EA.

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DEFINITION OF TERMS

Biodiversity	The wide variety of plant and animal species occurring in their natural environment (habitats). The term encompasses different ecosystems, landscapes, communities, populations and genes as well as the ecological and evolutionary processes that allow these elements of biodiversity to persist over time.
Conservation	The safeguarding of biodiversity and its processes (often referred to as Biodiversity Conservation).
Ecosystem	An ecosystem is essentially a working natural system, maintained by internal ecological processes, relationships and interactions between the biotic (plants & animals) and the non-living or abiotic environment (e.g. soil, atmosphere). Ecosystems can operate at different scales, from very small (e.g. a small wetland pan) to large landscapes (e.g. an entire water catchment area).
Ecosystem Goods and Services	The goods and benefits people obtain from natural ecosystems. Various different types of ecosystems provide a range of ecosystem goods and services. Aquatic ecosystems such as rivers and wetlands provide goods such as forage for livestock grazing or sedges for craft production and services such as pollutant trapping and flood attenuation. They also provide habitat for a range of aquatic biota.
Ezemvelo KZN Wildlife	Ezemvelo KwaZulu-Natal Wildlife, the local conservation authority for the Province of KwaZulu-Natal.
Endemic	Refers to a plant, animal species or a specific vegetation type which is naturally restricted to a particular defined region (not to be confused with indigenous). A species of animal may, for example, be endemic to South Africa in which case it occurs naturally anywhere in the country, or endemic only to a specific geographical area within the country, which means it is restricted to this area and grows naturally nowhere else in the country.
Function/functioning/functional	Used here to describe natural systems working or operating in a healthy way, opposed to dysfunctional, which means working poorly or in an unhealthy way.
Grassland	A grassland is a vegetation community in which grasses are the most conspicuous plants
Habitat	The general features of an area inhabited by animal or plant which are essential to its survival (i.e. the natural "home" of a plant or animal species).
Indigenous	Naturally occurring or "native" to a broad area, such as South Africa in this context.
Intact ecosystems/ environments	Used here to describe natural environment that is not badly damaged, and is still operating healthily.
Invasive alien species	Invasive alien species means any non-indigenous plant or animal species whose establishment and spread outside of its natural range threatens natural ecosystems, habitats or other species or has the potential to threaten ecosystems, habitats or other species.
Mitigate/Mitigation	Mitigating wetland impacts refers to reactive practical actions that minimize or reduce in situ wetland impacts. Examples of mitigation include "changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or

	rehabilitation of sites". Mitigation actions can take place anywhere, as long as their effect is to reduce the effect on the site where change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).
Pristine	Unspoiled, used here to describe the natural environment in its undisturbed state.
Red Data Book or Red List	Provides information on the status of threatened species: endangered species are most at risk of extinction, followed by rare and vulnerable species
Residual Impacts	Impacts that remain after the proponent has made all reasonable and practicable changes to the location, siting, scale, layout, technology and design of the proposed development, in consultation with the environmental assessment practitioner and specialists (including a biodiversity specialist), in order to avoid, minimize, and/or repair/restore negative impacts on, amongst others, biodiversity (DEA&DP, 2007). That is, after consideration has been given to the first three measures in the mitigation hierarchy.
Risk	A prediction of the likelihood and impact of an outcome; usually referring to the likelihood of a variation from the intended outcome.
Systematic conservation plan	An approach to conservation that prioritises actions by setting quantitative targets for biodiversity features such as broad habitat units or vegetation types. It is premised on conserving a representative sample of biodiversity pattern, including species and habitats (the principle of representation), as well as the ecological and evolutionary processes that maintain biodiversity over time (the principle of persistence).
Threatened ecosystem	In the context of this document, refers to Critically Endangered, Endangered and Vulnerable ecosystems.
Threat Status	Threat status (of a species or community type) is a simple but highly integrated indicator of vulnerability. It contains information about past loss (of numbers and / or habitat), the number and intensity of threats, and current prospects as indicated by recent population growth or decline. Any one of these metrics could be used to measure vulnerability. One much used example of a threat status classification system is the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (BBOP, 2009).
Transformation (habitat loss)	Refers to the destruction and clearing an area of its indigenous vegetation, resulting in loss of natural habitat. In many instances, this can and has led to the partial or complete breakdown of natural ecological processes.
Translocation	The human-mediated movement of living organisms from one area, with release in another.

ABBREVIATIONS USED

CARA	Conservation of Agricultural Resources Act No. 43 of 1983
CR	Critically Endangered (threat status)
DAFF	Department of Forestry and Fisheries
DEARD	Department of Environment, Agriculture and Rural Development
DEAT	Department of Environmental Affairs & Tourism (now DEA)
EIA	Environmental Impact Assessment: EIA regulations promulgated under section 24(5) of NEMA and published in Government Notice R.594 in Government Gazette 38282 of 04 December 2014
EKZNW	Ezemvelo KwaZulu-Natal Wildlife: as defined in Act 9 of 1997 to be the KZN Nature Conservation Service
EMPr	Environmental Management Programme
EN	Endangered (threat status)
GIS	Geographical Information Systems
GPS	Global Positioning System
IAPs	Invasive Alien Plants
IUCN	International Union for Conservation of Nature
KZN	Province of KwaZulu-Natal
LT	Least Threatened (threat status)
NEMA	National Environmental Management Act No.107 of 1998
NEM:BA	National Environmental Management: Biodiversity Act No.10 of 2004
NT	Near Threatened (threat status)
POSA	Plants of Southern Africa
SANBI	South African National Biodiversity Institute
TOPS	Threatened or Protected Species
TSCP	Terrestrial systematic conservation plan
VU	Vulnerable (threat status)

1. INTRODUCTION

1.1 Background to the assessment and area of study

Savannah Environmental is currently undertaking the EIA (Environmental Impact Assessment) for the proposed Gas to Power Plant to be located within the Richards Bay Industrial Development Zone (RBIDZ) Phase 1F in the vicinity of the Tata Steel factory in Alton, Richards Bay. The site is zoned as general industrial and is owned by the Richards Bay Industrial Development Zone Company SOC Ltd. The purpose of the RBIDZ is to develop an industrial estate in order to attract local and foreign investors who will create production capacity to beneficiate South Africa's raw materials prior to export and will thereby create employment and improve the skills base (NEMAI Consulting, 2015a).

The development site (roughly 7.5ha) consists of three properties: Erf 17455 (~2.8ha), Erf 17443L (~2.4ha) and Erf 17442 (~2.3ha), as shown below in Figure 1. Eco-Pulse Environmental Consulting Services (Eco-Pulse) was appointed by Savannah to undertake the necessary specialist 'Terrestrial Ecological Baseline and Impact Assessment' to inform the EIA for the project.

Figure 1 Google Earth™ map showing the location and extent of the three (3) properties/land parcels (shown outlined in "Yellow" investigated as part of the terrestrial ecological assessment within the broader RBIDZ Phase 1F area (shaded in "Blue").

1.2 Proposed Development Activities

In response to the need for additional electricity supply to support the national grid, and the Department of Energy's (DoE's) request for projects to be developed by Independent

Power Producers (IPP) in order to provide alternative power generation technologies as part of the technology mix for South Africa, the IPP 'Richards Bay Gas Power 2 (Pty) Ltd' is proposing to establish a gas-fired power plant and associated infrastructure on a site located within the RBIDZ 1F (see Figure 1). The site has been zoned for 'general industrial development' as part of the planning for this IDZ area. Due to the nature of the development (i.e. a gas to power station), the location of the project is largely dependent on technical factors such as the extent and access of the site, available grid connection and available fuel supply. The proposed site was identified by the project developer as being technically feasible and, given its attributes, is also thought to be commercially feasible i.e. able to offer electricity to consumers at a highly competitive tariff, with industries located within the RBIDZ as the main target market. The facility will have a maximum capacity of 400MW, to be developed in two (2) phases to operate with liquid fuel such as diesel and/ or Liquefied Petroleum Gas (LPG)[1] in Phase 1 and ultimately Liquid Natural Gas (LNG) or Natural Gas in Phase 2 of the development. It is anticipated that 300MW will be fuel/ gas generated energy and 100MW will be heat/ steam generated energy.

The main infrastructure associated with the facility includes the following:

» Up to six (6) Gas Turbines (GT)
» 1-2 steam turbines utilising the heat from all the engines for power production in a steam cycle.
» The power plant will comprise multiple engine halls, each of ~50MW. Each engine hall will typically comprise one engine. Stacks associated with engine halls will be up to 20m in height.
» Access roads within project locality boundaries.
» Three (3) fuel tanks with a capacity of 2000m^3 each which will be used as an interim fuel storage facility until the gas infrastructure is constructed by the DoE and Transnet. Two (2) fuel unloading stations will be associated with these tanks.
» Water storage facilities for process water and fire-fighting purposes.
» An HV-Yard and Substation, adjacent to the power plant.
» A new 132kV power line to connect into the Municipal grid, connecting directly to the Indus Substation bordering the site.
» Guard house, admin building, workshops and a warehouse.

Water volumes of between 50 000m^3 and 270 000m^3 per annum are expected to be required for the project[2]. The volume of water required will be supplied via the Richards Bay IDZ water supply network that has an allotment from the local water authority. The Richards Bay IDZ has undertaken to provide the water to the site under its long-term lease agreement with Richards Bay Gas to Power 2 (Pty) Ltd.

[1] In response to comments received on the draft scoping report, Light Fuel Oil (LFO) and Heavy Fuel Oil (HFO) have been excluded as fuel sources due to their high emissions.
[2] Exact water requirements are unconfirmed at this stage and are therefore best estimates. Once the final technology has been selected, water volumes will be confirmed.

The various life-cycle phases of the proposed power plant include:

» **Phase 1: Construction –** Expected to take between 14-18 months and will involve surveys, access road establishment, site preparation (clearing of surface vegetation and excavations), civil works for establishment of infrastructure, mechanical/electrical work and ancillary infrastructure such as guard houses, admin building, workshops and warehouse.

» **Phase 2: Operation –** Prior to the operation of the power station, testing and trails will need to be undertaken. In order to operate a gas to power plant, resources are required (input), and processes and outputs occur from the electricity generation process. Inputs include diesel /LPG (ultimately LNG/ NG) and water. The outputs of the process are electricity, wash waste and oily water and by-products. The power station will operate for 24 hours a day and 7 days a week for up to 8000 hours/ annum at base load and 3000 hours/ annum at mid-merit.

» **Phase 3: Decommissioning –** The lifespan of the proposed power station is anticipated to be 24 – 40 years. Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life or if it is no longer required. It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly and disposal of the infrastructure. This would include the disassembly of the production units and ancillary infrastructure, demolishing of buildings, removal of waste from the site and rehabilitation to the desired end-use.

1.3 Purpose of the assessment and scope of work

The gas to power plant project has the potential to impact on the environment, triggering the need for an EIA (Environmental Impact Assessment) in terms of the NEMA (the National Environmental Management Act No. 107 of 1998) and the NEMA EIA regulations of 2014. The proposed development will trigger listed activity 27 (among other listed activities) which involves '*The clearance of an area of 1ha or more, but less than 20ha of indigenous vegetation'* and a terrestrial ecological assessment has been identified during the scoping phase (refer to the Final Scoping Report by Savannah, January 2016) as necessary to inform the EIA and is the subject of this report.

The purpose of the terrestrial ecological assessment is to present a description of the development site area's existing flora and fauna characteristics, identify sites and species of conservation importance that occur (or potentially may occur) or that may be affected by the proposed project, identify and assess potential negative ecological impacts associated with the proposed development project and recommend management measures to mitigate impacts. The following scope of work informed the specialist terrestrial vegetation/ ecological survey:

- Desktop assessment of conservation context based on available provincial, regional and local conservation planning information including:
  - Ezemvelo KZN Wildlife's Terrestrial Systematic Conservation Plan (CPLAN, 2010);
  - Ezemvelo KZN Wildlife's Provincial Vegetation Map (2012);
  - National Vegetation Types (Mucina & Rutherford, 2006);
  - Data from the Strategic Environmental Assessment of the Province (EKZNW, 2010);
  - The uMhlathuze Municipality Environmental Management Framework (EMF), Strategic Environmental Assessment (SEA), Integrated Development Plan (IDP) and Environmental Services Management Plan (ESMP);
  - Review of any documented and available studies/information for the site and surrounding areas (existing RBIDZ studies, biodiversity studies, etc.); and
  - Desktop identification of species of conservation concern (flora/fauna) potentially occurring on the property based on available species records for the region (i.e. SANBI's online threatened species database: PRECIS and EKZNW's CPLAN) and considering the habitat preferences of these species in light of the habitat represented at the site.
- Site visit to the study area on 14th April 2016 to undertake fieldwork, including:
  - Field survey of vegetation and habitat along transects across the terrestrial habitat types (grassland) occurring on the various properties to be investigated (includes species identification and status, relative abundance of different species, identification of pioneer and alien plant species and description of habitat and vegetation type and ecological condition rating);
  - Identification and mapping of the geographic location of any terrestrial species of conservation concern (rare/protected plants and trees) noted during the site assessment; and
  - Basic survey of the fauna occurring in the area (where possible) using visual observations of species as well as evidence of their occurrence on the site (e.g. burrows, nests, excavations, animal tracks, etc.).
- Comparison of the vegetation found on the site with reference vegetation type where applicable.
- Provision of an ecological sensitivity map for the site, including the location of sensitive habitat/vegetation types, protected plants and any recommended terrestrial biodiversity buffer zones (development set-backs) with motivation to be provided.
- Identification and description of the various direct and indirect ecological impacts for the various phases of the development project (includes planning and design, construction, operation, decommissioning and rehabilitation of the site), including a broad comment on the cumulative ecological impacts likely to arise from the project on the broader region.
- Recommendations for managing and mitigating ecological impacts for the various project phases.
- Discuss any permit/licensing requirements that may be relevant to the site.

» Describe any assumptions made and any uncertainties or gaps in knowledge, as well as identifying the need for any future specialist inputs should these be deemed relevant to the project.
» Reporting: *Specialist Ecological Assessment Report*, including all relevant maps and supporting information.

Note that a wetland study for the IDZ Phase 1F site has already been carried out and as such wetlands were not included as part of the scope of this ecological assessment which focused solely on terrestrial vegetation and habitat.

1.4 The importance of biodiversity and conservation

The term 'biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only all living things, but also the series of interactions that sustain them, which are termed 'ecological processes'. South Africa ranks as the third most biologically diverse country in the world, based on an index of species diversity and endemism, and is one of twelve (12) "mega-diverse" countries which collectively contain more than two-thirds of global biodiversity (Endangered Wildlife Trust and DEA *et al.,* 2013). South Africa's biodiversity is considered important for the following reasons:

» It provides an important basis for economic growth and development;
» Keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services that are if benefit to society, including the provision of clean air, water, food, medicine and fibre;
» The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver *et al.,* 2012);
» It plays an important role in addressing South Africa's priorities of sustainable rural communities, service delivery and job creation; and
» Biodiversity forms the foundation of ecological infrastructure (ecosystems or habitats which deliver the ecosystem services that underpin economic and social development and are increasingly recognised as having market value).

We need to be mindful of the fact that without the integrity of our natural systems, there will be no sustained long-term economic growth or life (DEA *et al.,* 2013). Pressures and threats to biodiversity are increasing globally and the continuous decline in biodiversity loss may have damaging consequences in terms of local opportunity cost such as the production of clean water, carbon storage to counteract global warming, etc. The loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces long-term socio-economic options for future generations. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, with the most important being the National Environmental Management: Biodiversity Act No. 10 of 2004 (NEM: BA). In terms of NEM: BA, sustainable development requires the consideration of all relevant factors including disturbance of ecosystems and loss of biodiversity, both of which should be

avoided or, if that is not possible, should be minimized and remedied. Given the limited resources available for biodiversity management and conservation in South Africa, as well as the need for development, efforts to manage and conserve biodiversity need to be strategic, focused and support the notion of sustainable development.

1.5 Relevant environmental legislation

Terrestrial ecosystems, their relevant species, vegetation, habitats and biodiversity in general are governed in South Africa by the following legislation:

» Section 24 of The Constitution of the Republic of South Africa;
» Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
» National Environmental Management Act No. 107 of 1998 (NEMA) inclusive of all amendments;
» National Environmental Management: Biodiversity Act No. 10 of 2004 (NEM: BA);
» Conservation of Agricultural Resources (Act No. 43 of 1983 (CARA); and
» National Forests Act No. 84 of 1998 (NFA).

At a Provincial level, flora and fauna (plants and animals) are protected by the Natal Nature Conservation Ordinance (No. 15 of 1974).

2. APPROACH AND METHODS

2.1 Approach to the assessment

The approach to the ecological assessment involved four phases:

1. **Collation of baseline information on the affected environment:** Untransformed terrestrial habitat was identified at a desktop level using available digital imagery and available datasets (see Table 2) in a Geographical Information System (GIS).
2. **Field verification of mapped desktop mapped features/areas:** Untransformed habitat and biodiversity features identified and mapped at a desktop level were then verified in the field in order to determine:
    a. Condition of ecosystems/habitat;
    b. Vegetation type and ecosystem status;
    c. Vegetation composition and structure;
    d. Species/features of special concern;
    e. Sensitivity of biodiversity features;
    f. Potential occurrence of threatened species of fauna/flora;
    g. Importance of spatial components of ecological processes (e.g. ecological corridors);
    h. Key ecological processes and ecosystem services.

3. **The identification and assessment of potential impacts**: An assessment of potential ecological impacts was undertaken based on the development information provided by the Client, with respect to the baseline status of habitat/ecosystems.
4. **Recommendations for mitigation**: Site-specific management and mitigation recommendations were compiled to assist with addressing the range of impacts identified and other ecological concerns related to actions, activities and processes associated with the proposed development project.

The assessment of biodiversity was guided by current best-practice guidelines for biodiversity assessment in KZN and the principles contained in:

» Biodiversity Impact Assessment Handbook for KwaZulu-Natal. Version 1.0, Final Draft. (EKZNW, 2011);
» Norms and standards for Biodiversity Offsets: KwaZulu-Natal Province, South Africa (EKZNW, 2009); and
» Biodiversity Offset Design Handbook-Updated. BBOP, Washington, D.C. (BBOP, 2012).

Aspects of biodiversity that were used to guide the assessment are summarized in Table 1, below.

Table 1. Summary of the different aspects of biodiversity considered (adapted from BBOP, 2012).

Intrinsic/ecological value
Species level aspects of biodiversity
Protected species of fauna/flora; Threatened species (Red Data List); Keystone species performing a key ecological role (e.g. key predator, primary producer); Large or congregatory species populations; Endemic species or species with restricted ranges; and Previously unknown species.
Community and ecosystem level aspects of biodiversity
Distinct or diverse communities or ecosystems; Unique ecosystems; Locally adapted communities or assemblages; Species-rich or diverse ecosystems; Communities with a high proportion of endemic species or species with restricted ranges; Communities with a high proportion of threatened and/or declining species; and The main uses and users of the area and its ecosystem goods and services: important ecosystem services (e.g. important water yield area, coastal buffer), valued ecosystem goods (e.g. harvestable goods important for lives and / or livelihoods), valued cultural areas.
Landscape level aspects of biodiversity
Key ecological processes (e.g. seed dispersal, pollination, primary production, carbon sequestration); Areas with large congregations or species and/or breeding grounds;

Migration routes/corridors; Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas; and Importance and role in the landscape with regard to a range of 'spatial components of ecological processes', comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland gradients and macro-climatic gradients), as well as important movement or migration corridor for species.

The following data sources and GIS spatial information provided in Table 2 (below) were consulted to inform the assessment. The data type, relevance to the project and source of the information has been provided.

Table 2. Information and data coverage's used to inform the wetland assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Colour Aerial Photography (2009)	*Mapping of habitat, vegetation and other features*	National Geo-Spatial Information
Latest Google Earth ™ imagery	*To supplement available aerial photography where needed*	Google Earth™ On-line
Terrestrial Systematic Conservation Plan for KZN	*Used to identify and interrogate terrestrial biodiversity concerns at a desktop level*	EKZNW (20010)
KZN Vegetation Layer 2012	*Used to classify vegetation type and threat status*	EKZNW (2012)
SANBI On-line threatened species database	*Used to identify potentially occurring threatened plant species for the region*	SANBI on-line database (2013)
uMhlatuze Environmental Management Framework (EMF)	*Provides information on sensitive natural ecosystems to support the decision-making process in respect of development activities that may potentially harm the environment in the study area at Richards Bay.*	DAERD (2011)
Environmental Services Management Plan (ESMP)	*Spatial dataset that shows areas of conservation importance and ecological linkages between important natural areas*	Future Works (2007)
uThungulu Biodiversity Sector Plan (BSP)	*Spatial dataset outlining biodiversity conservation priorities and management recommendations for the project areas and surrounds, as contained within the Biodiversity Sector Plan for the uThungulu District Municipality.*	Elliott & Escott (2013)

2.2 Methods used

2.2.1 Assessing species of conservation importance

Species of conservation concern (SCC) are species that have a high conservation importance in terms of preserving South Africa's high biological diversity. If a subpopulation of an SCC is found to occur on a proposed development site, it would be one indicator that development activities could result in significant loss of biodiversity, bearing in mind that loss of subpopulations of these species will either increase their extinction risk or may in fact contribute to their extinction (see Figure 2, below). A description of the different South African National Biodiversity Institute (SANBI) categories of SCC is provided in Table 3 below

Flora and fauna of conservation significance (including threatened, protected and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of:

» SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database for the quarter degree grid 2832CA (http://posa.sanbi.org);
» Outputs of the KZN Terrestrial Conservation Plan (CPLAN) (EKZNW, 2010);
» Outputs of the South African Bird Atlas Project (SABAP) for the quarter degree grid 2832CA (http://sabap2.adu.org.za/);
» Data from the Animal Demography Unit (ADU, 2013);
» Various resources and references for Red Data listed species in South Africa (such as the Red Data Lists of Plants, Mammals, Reptiles and Amphibians); and
» Specialist knowledge and experience on the fauna of KZN, their ranges and habitat requirements.

The habitat requirements/preferences for each plant/animal SCC was reviewed (based on available literature) and was then compared with the habitat occurring on the site in order to estimate the likelihood of these species occurring on the target property. The presence/absence of these species was then verified during field surveys.

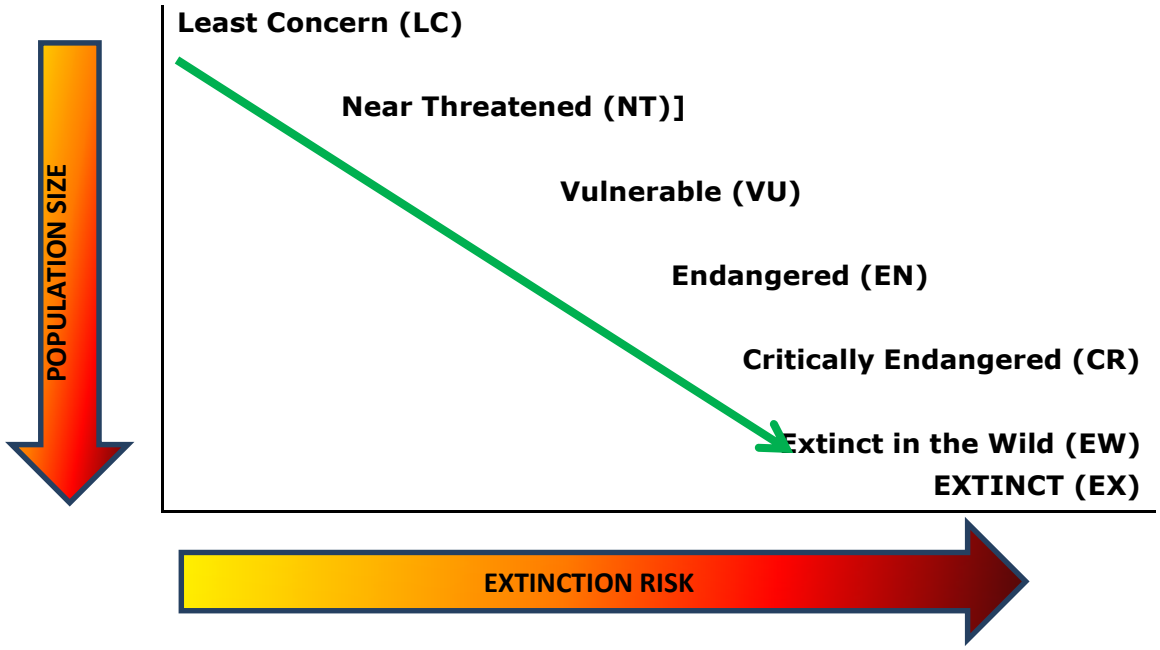

Figure 2 Graph showing the relationship between population size and extinction risk, distinguishing between the various species threat statuses (after SANBI, 2010).

Table 3. South African Red List Categories for species of conservation significance (after SANBI, on-line at http://redlist.sanbi.org/eiaguidelines.php).

	Status	Category	Description
INCREASING RISK OF EXTINCTION	SPECIES OF CONSERVATION CONCERN	**Critically Endangered, Possibly Extinct (CR PE)**	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
		Critically Rare	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.

	Data Deficient - Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
OTHER	**Data Deficient - Taxonomically Problematic (DDT)**	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
	Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
	Not Evaluated (NE)	A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

2.2.2 Field survey

A field survey of the vegetation and habitat at the target site was undertaken on a single day in late summer/autumn (early April 2016). A number of transects were walked across the site (the three properties/land parcels shown in Figure 1), providing good coverage of the project area habitats and vegetation/species. The following data was collected in the field:

» Species inventory of all species of plants identified in the field, tree and shrub layers as well as the ground cover;
» Estimation of the relative abundance of each species was also undertaken;
» Identification of different habitats and vegetation communities present, including species composition, structure and general condition and suitability for harbouring specie of fauna/flora of conservation significance;
» Identification of any species of fauna (animals), through direct visual siting's and indirectly through audible calls and other signs of wildlife such as burrows, nests, tracks, etc.
» Identification and description of any existing anthropogenic impacts to the vegetation communities; and
» The location of any SCC (listed protected trees/threatened species) was recorded using a GPS (Global Positioning System).

Where species could not be identified in the field, samples and photographs were taken to confirm at a later stage using available literature.

2.2.3 Assessment of ecological impacts

The information from the baseline terrestrial vegetation assessment was used to inform an assessment of the likelihood and significance of potential impacts to terrestrial vegetation and habitat associated with the proposed development project. For the purposes of this assessment, the rating of impact significance was undertaken according to an ecological impact assessment methodology developed for EIAs, which is based on the Guideline Document on EIA Regulations of Environmental Affairs and Tourism (DEAT, 1998) and the Integrated Environmental Management Information Series: Impact Significance (DEAT, 2002). This process routinely includes the following tasks: impact identification, impact prediction and impact evaluation.

2.3 Assumptions and Limitations

The following limitations and assumptions apply to the studies undertaken for this report:

- This report deals exclusively with a defined area and the extent and nature of the vegetation and habitat/ecosystems in that area.
- The location of SCC was recorded using a Garmin Oregon™ GPS and captured on a map of the area using a Geographical Information System (GIS). GPS accuracy was limited to 3-5m.
- The field assessment was undertaken in late summer/autumn (early April 2016). The assessment therefore does not cover the seasonal variation in conditions that may occur at the site.
- Limitation to a base-line ecological survey for only 1 day (8 hours) during the summer. Due to financial as well as time constraints no comprehensive vegetation or faunal surveys were conducted but merely a basic ecological/habitat assessment based on the brief one day site visit.
- Ecological studies are usually undertaken over a period of a number of seasons or years in order to obtain long-term and significant ecological data that takes into account the effects of unusual/abnormal conditions prevailing at the study (associated with climatic conditions for example). Due to time and budget constraints in the case of this project and report, such long term studies are impossible and unrealistic and conclusions are therefore drawn from data collected over a much shorter time period and the limitations and assumptions that therefore apply.
- With ecology generally being dynamic and complex, there is a possibility that some aspects could have been overlooked.
- Sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified. Due to the small extent of the site, the area was intensively sampled, reducing the risk of overlooking species.
- While an assessment of the potential occurrence of SCC has been undertaken, and is informed by readily available information, this provides only a surrogate indicator of the likelihood of such species occurring. This is however regarded as appropriate given the level of habitat degradation/transformation across much of the project area

- No detailed survey of fauna was conducted during this assessment. Any fauna documented in this report are based on site observations during a limited time spent in the field and doesn't reflect the overall faunal composition of the site.
- The majority of plant and animal species are extremely seasonal only emerging after sufficient heavy early summer rainfall (October-November).
- The majority of threatened faunal species are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons/years. The presence of threatened species on site was therefore assessed mainly on habitat availability and suitability as well as desktop assessments to inform potential species occurrence (literature, personal records) and previous surveys undertaken in similar habitats in the region.
- The fact that a species is not recorded during a survey (or surveys) cannot support the assumption that the species in question does not occur in the area. It can only indicate a decreased probability of the species being present. This is particularly pertinent if the species has been recently recorded in the area.
- Limitations associated with historic data and available databases for the area apply. Note that data and information obtained from published articles, reference books, field guides, official databases or any other official published or electronic sources are assumed to be correct and no review of such data was undertaken by Eco-Pulse.
- Due to the complexities of ecological systems and the sensitive dependence on initial conditions, any predictions of the effects of perturbation are made with very low confidence.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the vegetation field surveys and based on the assessor's working knowledge and experience with similar development projects.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the Province/Local Municipality at the time of the assessment.

3. TERRESTRIAL ECOLOGICAL ASSESSMENT

3.1 Background Information to the Study Area

3.1.1 Climate

The study area is located within the coastal belt of KZN, which ranges from 15 to 65km wide along the east coast of South Africa, from sea level to an altitude of 450m (Le Roux, 1993). The region experiences a warm, humid sub-tropical climate, with most rainfall being experienced during the summer months. Few dry months occur and very little, or no frost occurs in winter. Richards Bay normally receives about 970mm of rainfall annually, with mainly summer rainfall. It receives the lowest rainfall (38mm) in June and the highest (121mm) in March. Average midday temperatures for Richards Bay range from 23°C in June to 29°C in January. The region is the coldest during July when the mercury drops to 12°C on average during the night (Source: http://www.saexplorer.co.za/south-africa/climate/richards_bay_climate.asp). The combination of a relatively moderate mean annual precipitation of between 1000-1200mm per annum and high mean annual potential evapotranspiration of roughly 1780mm, gives a Mean Annual Precipitation (MAP) to Potential Evapo-Transpiration (PET) ratio between 0.6 – 0.7 (vulnerability index of 0.9), which means that wetlands and other aquatic resources are probably moderately sensitive to hydrological impacts (i.e. changes in water input volumes and patterns) in comparison with wetlands associated with a higher vulnerability index.

3.1.2 Ecoregion

When assessing the ecology of any area it is important to know within which ecoregion the study area is located. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available at this level of assessment to guide the assessment. The study area falls within the Natal Coastal Plain (Ecoregion 13.03) which can be characterized by plains with a low relief (Kleynhans *et al.,* 2005). Drainage density is generally regarded as low with stream frequency being low-medium, with few perennial streams originating in this region (large rivers include the Mfolozi, Mkuze and Mhlatuzane rivers). Coastal bushveld/grassland dominates the vegetation, with limited patches of sand forest and valley thicket also occurring.

3.1.3 Geology and Soils

The study area is located on the Maputaland Coastal Plain, characterised by relatively flat to slightly undulating paeleodune fields conrised of recent (Quaternary Age) sedimentary deposits of Aeolian/marine origin (~18 000 years old) and comprising mainly yellowish and argillaceous redistributed sands (Berea and Muzi Formations of the Maputaland Group, respectively). Soils generally comprise very loose, grey-brown sand.

3.1.4 Vegetation

The study area falls within both the Savanna Biome (one of the four main biomes in KZN as described by Mucina and Rutherford, 2006) and regionally within the Sub-Escarpment Savanna Bioregion (Mucina and Rutherford, 2006). At a local scale, the study area falls within the **Maputaland Wooded Grassland** type according to the KZN Vegetation Map (EKZNW, 2012),which is regarded as ***Endangered*** (EN) in terms of its threat status with a moderate degree of protection, following the revision of the KZN vegetation map (see Figure 3 below). The vegetation type is described according to EKZNW (2012) and Mucina and Rutherford (2006) as follows:

Maputaland Wooded Grassland (CB2)

Conservation/Threat Status:
Endangered (EN), moderately protected with 17% statutorily conserved mainly in the Greater St Lucia Wetland Park as well as in Sileza, Enseleni and Amatikulu Nature Reserves. Much of the vegetation type is agricultural land with very little remaining in a natural state (around 46% transformed for plantations, cultivation and urban sprawl).

Vegetation & Landscape features:
Generally flat landscape of the Maputaland coastal plain, originally probably densely forested in places, supporting coastal sandy grasslands rich in geoxylic suffrutices, dwarf shrubs, small trees and very rich herbaceous flora. Today the vegetation landscape is composed of pockets of primary and secondary grasslands, extensive commercial timber plantations and sugarcane fields.

Important taxa include: **Geoxylic suffrutices -** *Parinari curatellifolia, Salacia krausii, Anclobotrys petersiana, Diospyros galpinii, Eugenia capensis, Syzigium cordatum* **Graminoids** – *Diheteropogon amplectens, Themeda triandra, Aristida stipata subsp. graciflora, Bewsia biflora, Cyperus obtusiflorus, C. tenax, Digitaria natalensis, Eustachya paspaloides, Setaria sphacelata, Sporobolus fimbriatus, S. subulatus, Urelytrum agropyroides* **Herbs** – *Chamaechrista plumosa,* **Geophytic herbs** – *Cyrtanthus galpinii* **Low shrubs –** *Helichrysum kraussii, Agathisanthemum bojeri, Crotalaria monteiroi var. monteiroi* **Small trees/tall shrubs –** *Acridocarpus natalitius var. linearifolius, Dichrostachys cinerea subsp. nyassanam, Diospyros lycoides subsp. sericea, Hyphaene coriacea, Syzigium cordatum*, *Terminalia sericea.*

Known to host a number of Maputaland endemics, including *Ochna sp*., *Syzigium cordatum*, *Aloe sp*. and *Brachystelma vahrmeijeri.*

Geology & Soils:
Quaternary sediments of marine origin, nutritionally poor and well leached.

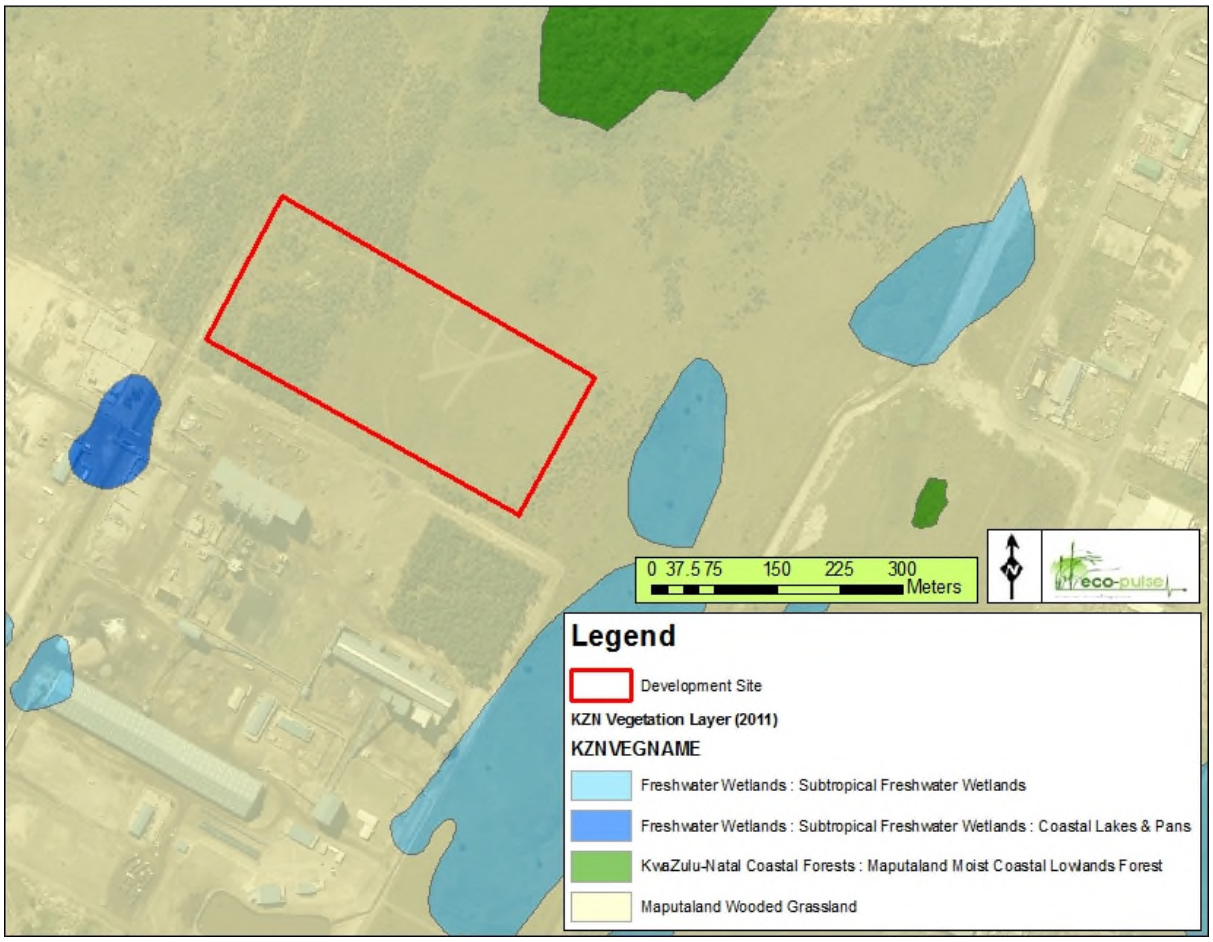

Figure 3 Map showing the different regional vegetation units classified according to Ezemvelo KZN Wildlife's Provincial Vegetation Map (2011), with the location of the proposed site indicated in "red".

Table 4. Conservation status of KZN vegetation types (after Jewitt, 2011).

Conservation Status		Threshold	Risk of Extinction
CR	**Critically Endangered**	Remaining natural habitat ≤ biodiversity target	Extremely High
EN	**Endangered**	Remaining natural habitat ≤ (biodiversity target + 15%)	Very High
VU	**Vulnerable**	Remaining natural habitat ≤ 60% of original area of ecosystem	High
LC	**Least Concern**	Remaining natural habitat >60% of original area of ecosystem	Low

Further details on the importance of grassland ecosystems are included in Box 1, below.

Box 1. Importance of Grassland ecosystems

Grasslands typically support a rich diversity of grasses, wild flowers, invertebrates, reptiles, birds and other animals. Other services provided by these ecosystems include their role in reducing runoff and attenuating downstream flooding, assisting with binding topsoil and controlling erosion as well as their role in storing atmospheric carbon, especially in the topsoil.

3.1.5 Existing Land Use and Ecological History of the Site

The proposed development site falls within the Richards Bay Industrial Development Zone (RBIDZ) Phase 1F located in the Alton North Area, south of the North Central Arterial and bordering on the Tata Steel factory to the south, with the eastern edge being industry linked with Alumina Alley. The site is comprised of vacant municipal owned land bordered by mixed-use of industrial developments as well as residential areas and open space areas. The broader area is characterised by intense past land-use modifications from agriculture, mining, tourism, residential, recreational and industrial development activities.

According to the Biodiversity Study of Alton North Richards Bay undertaken in 2005 by O'Connor and Associates, the site has experienced two environmental perturbations that are judged to have had 'an enormous influence on its biodiversity and ecological functioning'. The first is associated with the planting of historic *Pinus and Eucalyptus sp*. tree plantations (Google Earth™ imagery shows the area under plantation forestry between 2004 – 2012, see Figure 4, below). In addition to the direct loss of indigenous vegetation through land transformation, the introduction of evergreen species into seasonal vegetation results in a concomitant increase in transpirational losses and leaves the area susceptible to alien and weed invasion. A second impact has been the canalisation of water flow in the area, with a consequent effect being the lowering of the water table within the pre-existing dryland component of the environment. Based on the history of ecological disturbance at the site (O'Connor and Associates, 2005) remaining open grassland habitat is largely degraded and secondary in nature, with signs of earthworks, vehicle/human tracks, tarred roads (former airfield)and general soil disturbance associated with historic plantation forestry.

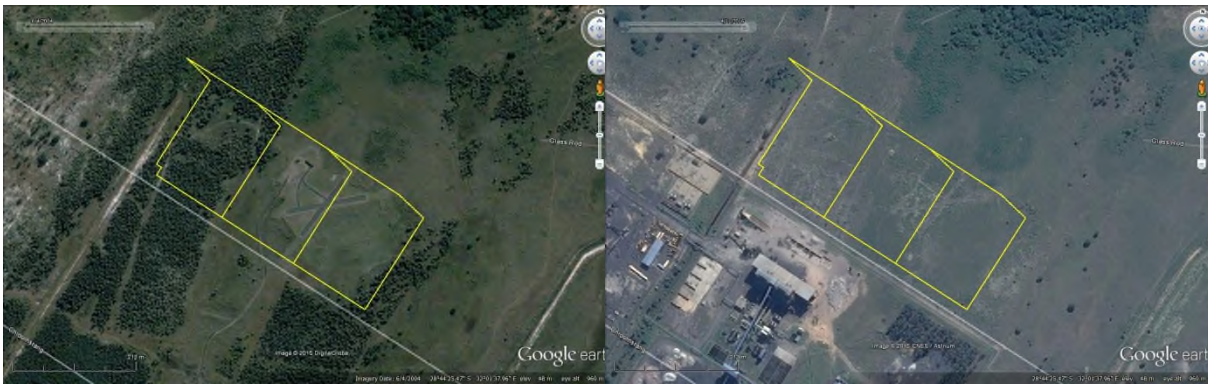

Figure 4 Google Earth™ maps showing the site in 2004 (western half under plantation forestry, eastern half operating as a light airfield).

The key biophysical setting details of the study area and surrounds are summarised in Table 5 below.

Table 5. Key biophysical setting details of the study area.

Biophysical Aspects	Desktop Biophysical Details	Source
Elevation	45 – 50 m above mean sea level (a.m.s.l.)	Google Earth ™
Mean annual precipitation (MAP)	1,284 mm/annum	Schulze, 1997
Rainfall seasonality	Mid to late summer	DWA, 2005
Mean annual temperature	23 - 29 °C	DWAF, 2007
Potential Evaporation (mm) Mean Annual A-pan Equivalent	97 mm / annum	Schulze, 1997
Median Annual Simulated Runoff (mm)	377 mm/annum	Schulze, 1997
Geomorphic Province	Southeastern Coastal Platform	Partridge *et al*., 2010
Geology	The site and much of the surrounding area is underlain by unconsolidated Quaternary-age sediments of marine and Aeolian origin.	Geo-hydrological Study by GeoMeasure Group (2014)
Water management area	Mvoti to uMzimkhulu	DWA
Quaternary catchment	W12F	DWA
Main collecting river(s) in the catchment	uMhlathuze River	CSIR, 2011
DWA Ecoregion	13.03 (Natal Coastal Plain): low-lying area characterized by plains with low relief	DWA, 2005
Biome/Bioregion	Indian Ocean Coastal Belt	Mucina and Rutherford, 2006
National vegetation type	Maputaland Coastal Belt Northern Coastal Forest Subtropical Freshwater Wetlands	Mucina and Rutherford, 2006
Provincial vegetation types	Maputaland Coastal Belt: Maputaland Wooded Grassland	EKZNW, 2010

3.2 Conservation Context

Understanding the conservation context and importance of the site is important to inform decision making regarding future development in the area. In this regard, national, provincial level and local/municipal level conservation planning information is available and was used to obtain an overview of the site.

3.2.1 National level conservation priorities (Threatened Ecosystems)

A national process has been undertaken to identify and list threatened ecosystems that are currently under threat of being transformed by other land uses. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (National Environmental Management: Biodiversity Act or NEM: BA: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011). The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI, 2011). The NEM: BA provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. There are four main types of implications of listing ecosystems:

» Planning related implications which are linked to the requirement in the Biodiversity Act (Act No. 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
» Environmental authorisation implications in terms of NEMA and the EIA regulations;
» Proactive management implications in terms of the National Biodiversity Act;
» Monitoring and reporting implications in terms of the Biodiversity Act.

According to the Threatened Ecosystem coverage for the country, untransformed (vacant) land in the project area has been classified as **Critically Endangered** (CR, Figure 5 below) and associated with the **Coastal or 'KwaMbonambi' Hygrophilous Grasslands'** vegetation type (DEA and SANBI, 2011).

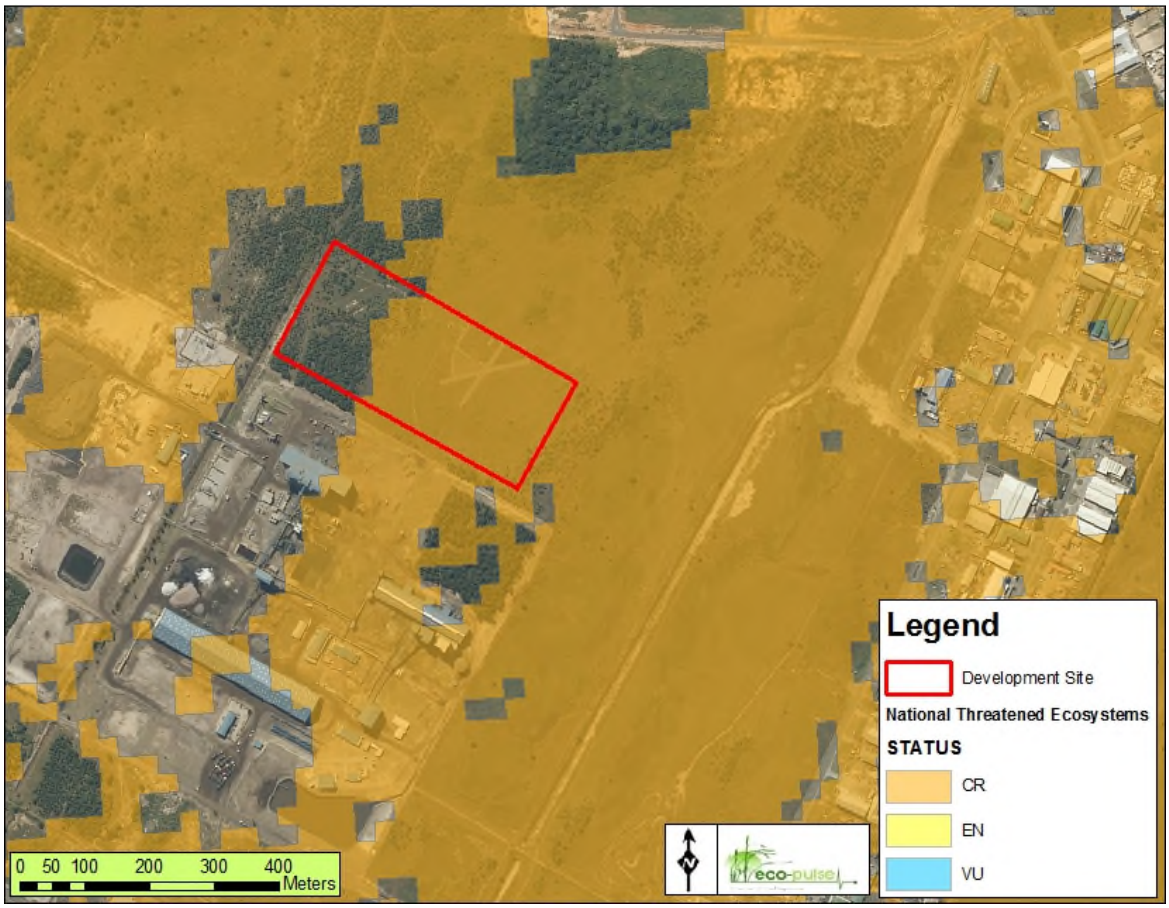

Figure 5 Map showing National listed Threatened Ecosystems Threat Status with the location of the proposed development site indicated (outline in "red").

3.2.2 KZN Systematic Conservation Plan (CPLAN)

The Provincial Terrestrial Systematic Conservation Plan (CPLAN) is a strategic plan developed by the Provincial Conservation Authority: Ezemvelo KZN Wildlife (EKZNW) to ensure that representative samples of biodiversity are conserved and aids in Land Use Decision Support (LUDS) in KwaZulu-Natal. The CPLAN database identifies the minimum number of planning units contained within the Province which are required to meet biodiversity conservation targets. The database spatially classifies planning units into the following categories listed in Table 6 below. Interrogation of the CPLAN GIS layer revealed that the site falls within an 'unshaded planning' unit, suggesting that **the site has no specific conservation status** (See Figure 6 below). Adjacent terrestrial areas have been classified as CBA3: optimal, which indicates the presence or potential presence of one (or more) features with a low irreplaceability score. The following features are highlighted in the CPLAN for adjacent areas to the proposed development site:

» Maputaland wooded grassland (Endangered status);
» KZN Coastal Forests (Endangered status); and
» A number of endemic invertebrate species of conservation significance.

Table 6. CPLAN categories and their descriptions.

Critical Biodiversity Area 1 Mandatory	The CBA 1 Mandatory areas are Identified as having an Irreplaceability value of 1, these planning units represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved i.e. there are no alternative sites available.
Critical Biodiversity Area 2 Mandatory	CBA2 indicate the presence of one (or more) features with a very high irreplaceability score. In practical terms, this means that there are alternate sites within which the targets can be met, but there aren't many. This site was chosen because it represents the most optimal area for choice in the systematic planning process, meeting both the target goals for the features concerned, as well as a number of other guiding criteria such as high agricultural potential area avoidance, falls within a macro-ecological corridor etc.
Critical Biodiversity Area 3 Optimal	CBA3 indicate the presence of one (or more) features with a low irreplaceability score. Derived in the same way as outlined for CBA2 described above, the determination vision of these PU's is driven primarily by the guiding layers.
Biodiversity Area	Unshaded planning units are 'available' to meet conservation targets if any planning units classified as Biodiversity Priority Area 2 or 3 are lost / transformed.
Protected Areas	These area protected areas e.g. nature reserves.
100% Transformed	These are areas which are 100% transformed according to the KZN landcover 2005 coverage.
Outside KwaZulu-Natal	Areas outside KZN.

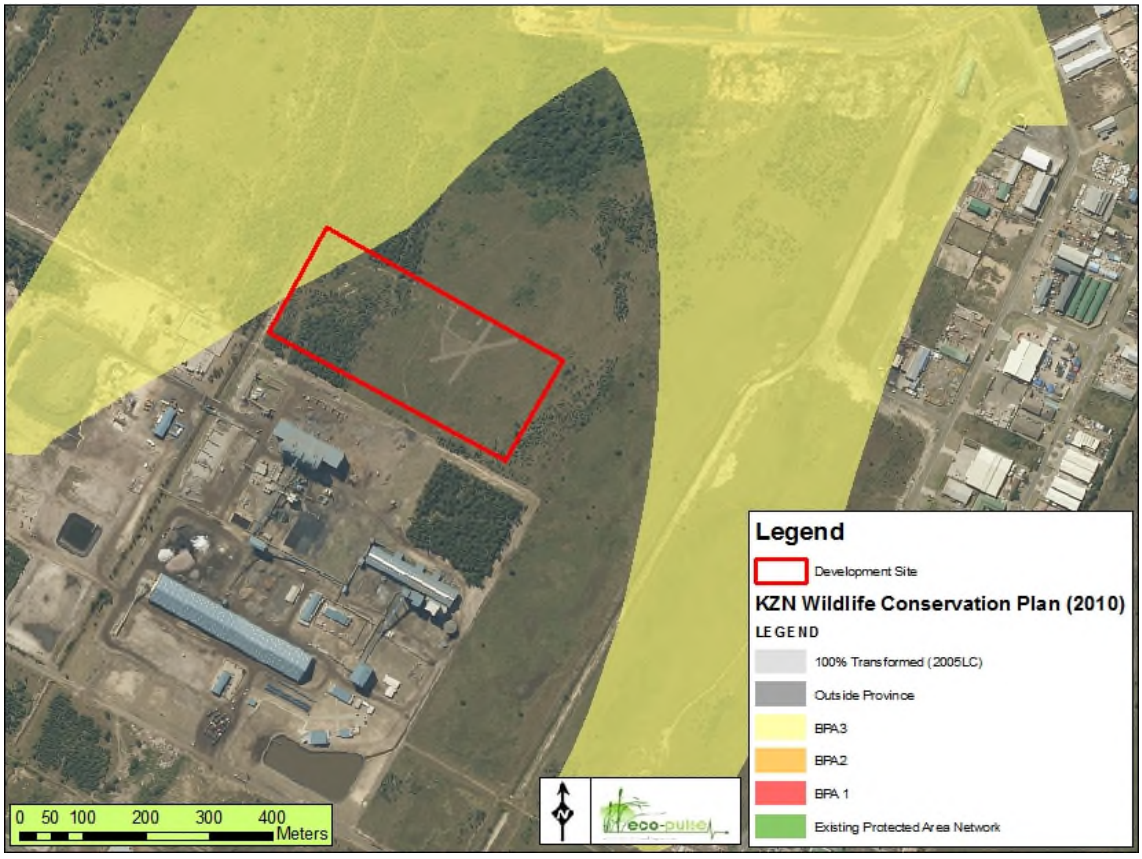

Figure 6 Map showing CPLAN categories with the location of the planned development site indicated (outline in "red").

3.2.3 Local and Regional level conservation priorities, plans and principles

In addition to National and Provincial level conservation priorities, conservation planning information is also available for the uThungulu District and uMhlatuze Local Municipality. This includes the uThungulu District Biodiversity Sector Plan (Elliott & Escott, 2013), an Ecosystem Services Management Plan (ESMP) for the uMhlatuze Local Municipality (Future Works, 2007) as well as an Environmental Management Framework (EMF) developed for the Richards Bay Port Expansion Areas and Industrial Development Zone or IDZ (DAERD, 2011). Each of these is discussed in more detail below.

» ***uThungula Biodiversity Sector Plan (BSP)***

The Biodiversity Sector Plan (BSP) for the uThungulu District Municipality (Elliott & Escott, 2013) was interrogated in terms of the location, extent and relevance of local conservation priorities identified for the project site and immediate surrounding areas. The BSP is "*intended to assist and guide land use planners and managers within the uThungulu District and its respective local municipalities, to account for biodiversity conservation priorities in all land use planning and management decisions, thereby promoting sustainable development and the protection of biodiversity, and in turn the protection of ecological infrastructure and associated ecosystem services"* (Elliott & Escott, 2013).

Local conservation priorities and Sites of Conservation Significance (SOCS) relevant to the project site and immediate surrounding areas are detailed below in Table 7 and shown spatially in Figure 7. Important local biodiversity conservation priorities are incorporated into the BSP for uThungulu either as aquatic CBAs (Critical Biodiversity Areas) or ESAs (Ecological Support Areas). CBAs and ESAs are shown mapped in Figure 8, below. CBAs represent natural or near-natural landscapes that are considered critical for meeting biodiversity targets and thresholds, and which safeguard areas thus ensuring the persistence of viable populations of species, and the functionality of ecosystems and ecological infrastructure. CBAs should be maintained in a natural state with limited to no biodiversity loss (Elliott & Escott, 2013). ESAs represent functional but not necessarily entirely natural landscapes that are largely required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the critical biodiversity areas. Ecosystem functionality needs to be maintained in these areas, allowing for some loss of biodiversity but without degrading Present Ecological State (PES) category (Elliott & Escott, 2013).

Table 7. Local biodiversity priorities identified in the uThungulu BSP relevant to the project site and surrounding areas.

LOCAL CONSERVATION PRIORITIES	DESCRIPTION/IMPORTANCE	INCORPORATION INTO BSP	SOURCE OF INFORMATION
Mhlatuze Wetlands (Intact)	Sections of intact wetland vegetation. Likely to be the most significant areas for biodiversity	Critical Biodiversity Area	

	conservation within this priority wetland system.		Macfarlane *et al.*, (2012): *Wetland health assessment of KZN priority wetlands.*
Mhlatuze Wetlands (Degraded)	Sections of degraded wetland vegetation. Areas remain important for ecosystem service provision.	Critical Biodiversity Area	

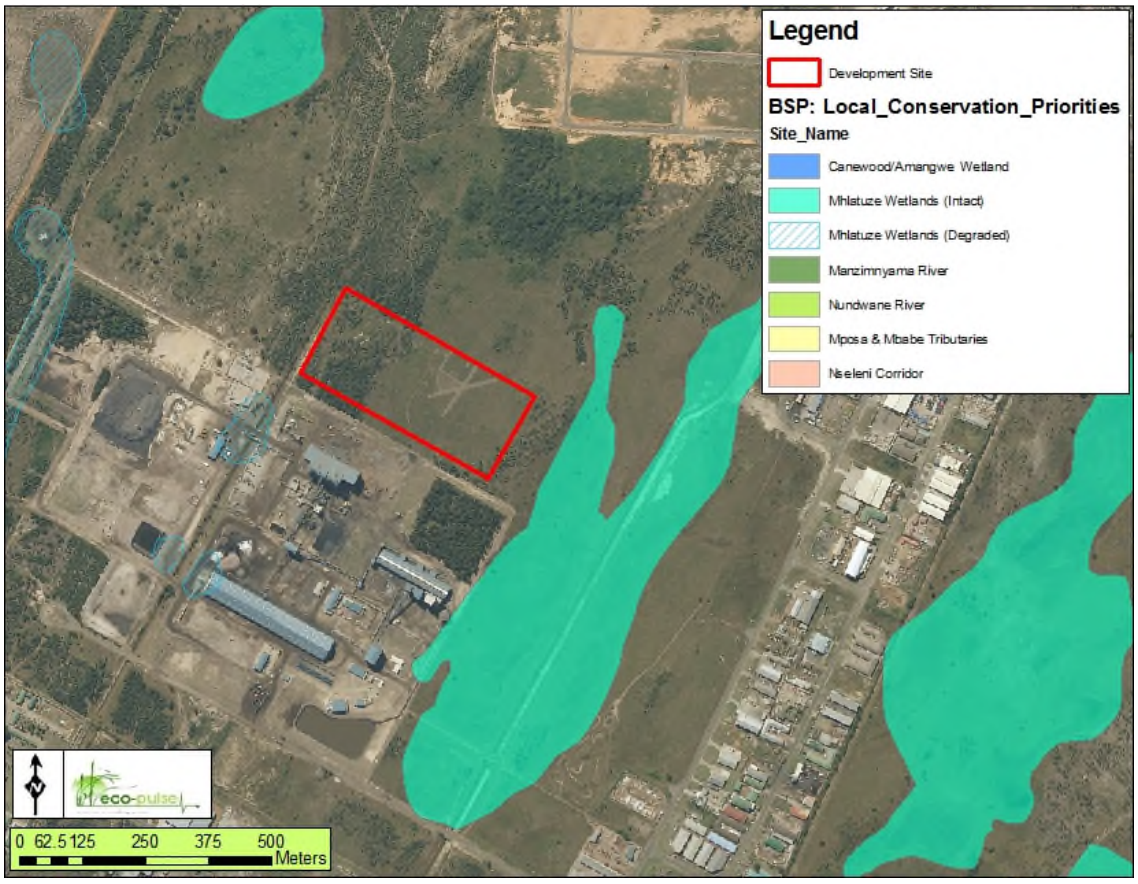

Figure 7 Map showing local conservation priorities highlighted in the uThungula BSP (EKZNW, 2013).

Figure 8 Map showing local conservation priorities classified as either CBAs or ESAs according to the uThungula BSP (EKZNW, 2013).

» ***Integrated Development Plan for the uMhlathuze Municipality (IDP)***

The Integrated Development Plant (IDP) for the uMhlathuze Local Municipality (ULM) (2015/2016) was informed by a number of planning and development principles, which includes among others, the desirability of 'compact urban form', the direction of new development to logical infill area, the principle of 'sustainable development, encouraging and promoting environmentally responsible behaviour in development planning and implementation and the protection and safe utilisation of prime and unique agricultural land, the environment and other protected lands. The IDP recognises Port Expansion and related infrastructure development as being "*the main economic attraction of the area, the port is the overarching priority for stimulating the local economy. It is also a provincial priority in that it is the growth engine for one of the primary provincial growth nodes. Port and related infrastructure is classified as Strategic Important Developments and such is important for the national economy*". Port expansion options are addressed in the Port Development Framework (2007) which has been integrated with the City's IDP and SDF and forms part of the City's Local Economic Development Strategy.

The IDP also sets the tone for development against the current backdrop of local biodiversity, water resources and important environmental assets that support high level of biodiversity and species endemism, recognised for the municipal area (includes

wetlands) The IDP recognizes the main environmental concerns and considerations identified in the SDF and ESMP (discussed further on in this section of the report) with key threats to ecosystem goods and services discussed and ultimately leading to the following key measures and priorities being integrated into the IDP in order to promote meeting environmental targets and objectives for the municipal area:

* To ensure legal compliance of environmental bylaws and legislative requirements by all;
* To ensure sufficient suite of local environmental bylaws and effective enforcement thereof;
* Regulation of land use and enforcement of usage of land in terms of the town planning scheme and land use management system;
* To minimize air pollution (prevention and reduction) through efficient monitoring;
* To reduce overall water pollution within the municipality as a result of land use practices through monitoring hotspots and imposing stringent requirements during EIA and planning processes;
* To ensure management of all water resources in a sustainable manner by adhering to lake management plans and water services bylaws;
* To ensure the management of soil and land resources in a sustainable manner through environmental and land use planning;
* To ensure the protection of habitats and natural resources that would contribute to conservation targets of the province;
* To preserve heritage resources by preventing damage and loss through development planning processes and through the tourism sector;
* Complying with the provisions of the National Environmental Management: Integrated Coastal Management Act;
* Maintaining the biological diversity and productivity of coastal ecosystems through implementation of coastal management programme and estuary management plans;
* To comply with the provisions of National Environmental Management: Waste Act by appointment of a waste management officer and compilation of a waste management plan;
* To improve energy efficiency of existing facilities and reducing demand in terms of the strategy set out in the energy sector plan, and facilitating renewable energy/co-generation initiatives and projects;
* To be prepared and anticipate disaster management;
* To ensure that the municipality maintains its environmental assets through environmental tools such as project specific EIA's, the EMF and the Environmental Framework of the SDF; and
* To increase the knowledge and understanding, and prepare for vulnerability to environmental changes within the municipality.

» ***Spatial Development Framework for the uMhlathuze Municipality (SDF)***

The Spatial Development Framework (SDF) for the uMhlathuze Municipality (2007), and in particular pertaining to the RBIDZ, is a sector plan of the IDP and essentially forms a forward planning document that reflects the current reality and future development options that should be used to guide decision-making within the municipal area by employing a 'balanced approach' to ensure sustainable development is achieved (i.e. seeking a balance between economic growth and development and environmental management and conservation, whilst acknowledging that there will be areas of trade-off between the two) . One of the guiding principles used to inform development of the SDF included: "*Sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure*". Environmental conservation considerations are highlighted in the SDF against the backdrop of proposed developments and opportunity areas, with some of the key development concepts and strategies included in the EMF being:

- Spatial planning should encourage sustainable, balanced growth and development within the carrying capacity of the area;
- Special development/management areas are to be identified to preserve areas of cultural, agricultural or environmental significance;
- The above is achieved through controlling urban sprawl and conservation of high potential agricultural and environmentally important land;
- Efficient land use management is critical to attain the above, by identifying areas at which certain types of land uses could be encouraged or should be discouraged;
- Indicating where the intensity of land development could be increased or should be reduced.
- Rural development and investment could create a degree of sustainability in such areas;
- Spatial planning needs to conserve limited natural resources;
- Identifying open space and natural resources that can be used; and
- Ensuring the ecological sustainability of the municipal area.

Environmental considerations that have been outlined in the uMhlathuze Strategic Catchment Assessment and Environmental Services Management Plan (ESMP) have also been identified and described in the SDF (*these are discussed in more detail below in terms of the ESMP for the municipal area outlined in section 3.2.3.5*).

» ***uMhlathuze Environmental Management Framework***

The KwaZulu-Natal Department of Agriculture, Environmental Affairs and Rural Development (DAERD) and the City of uMhlathuze have jointly developed an Environmental Management Framework (EMF) for the Richards Bay Port Expansion Area and Industrial Development Zone (IDZ), because of the inherent environmental sensitivity of the area and the fact that existing and future development needs associated with port

expansion and industrial development place severe pressures on the receiving environment. The purpose of the EMF is to *promote sustainability, secure environmental protection and promote cooperative environmental governance*. The expectation is that the information base presented in the EMF will be used cooperatively by the various role-players to support the decision-making process in respect of development activities that may potentially harm the environment. The EMF recognises that conservation, in the local context, goes beyond the protection of assets for its aesthetic value, as the remaining ecosystem types offer services that sustain the local economy in various ways (DAERD, 2011). The EMF gives emphasis to the landscape level management approach which takes the structure of the landscape into account as well as the spatial processes that interact with this structure. The approach further acknowledges the environmental asset system of the area that consists of a number of interlinked ecosystems that supply different services that are critical to the functioning of the life-support system that contributes directly and indirectly to human wellbeing, and they therefore have economic value. As such the assets in this system must be managed to retain its capacity, or its ability to provide goods and services to society over the long term.

The EMF was reviewed in order to inform the assessment and management of terrestrial habitats and biodiversity associated with the proposed project in Richards Bay. The uMhlatuze Municipality has been subdivided into specific "Management Zones", each with its own sustainability objectives and zone-specific environmental management guidelines designed to meet these objectives. The project development site falls within the **Richards Bay Industrial Development Zone (RBIDZ) Phase 1F** within the "**Zone 7: Coastal Plain Commercial-Industrial Zone**", strategically located near the Port of Richards Bay to leverage investment in export-orientated manufacturing industries and to promote the export of value-added manufactured products. This zone represents fairly flat land on the sandy coastal plain and is used primarily for light and heavy industrial purposes, business and commerce, and forms the economic hub of the municipality, within which land is already largely transformed. The IDZ objectives must be promoted in the phase but limited by prevailing environmental conditions and uncertainties, particularly in respect of water supply ad energy availability. The EMF objective for Zone 7 is *'to promote sustainable commercial and industrial development that is able to secure ecosystem productivity over the long-term'*. Conservation priorities and strategic environmental management guidelines for IDZ Phase 1F and Zone 7 include:

* Conservation and enhancement of critical ecological assets and linkages (grasslands and wetlands).
* Two main wetland systems occur on the site to the west and east, both are of conservation significance and are sensitive to development impacts and must be protected from development impact and integrated into development planning. *Note as an aside that a specialist wetland assessment has already been undertaken for the RBIDZ Phase 1F site (NEMAI Consulting, 2015), with the recommendations being that the wetland pan in the north-west of the Phase 1 F site ("Wetland A") must be zoned as conservation and omitted from all development planning, a*

buffer zone should be investigated for the remainder of "Wetland B" not to be in-filled and that an offset plan be developed for wetland areas to be in-filled for development ("Wetlands B and C") in line with the concept of 'no net loss of wetland' (NEMAI Consulting, 2015).

- There is some level of sensitivity associated with the remaining non-wetland vegetation but the overriding constraint remains hydrological in nature (i.e. associated with wetland ecosystems).
- Any development must take cognisance of air quality constraints, water demand and energy constraints that currently prevail in the area.
- There is still space to advance industrial development within Zone 1F but the prevailing environmental constraints may limit the extent to which this potential could be realised.
- Sustainable consumption and production patterns.
- Integrated water resource management.

The EMF further proposes a desired state of environment, which is reflected as a set of conditions that must be attained to ensure that the EMF achieves its purpose. To support implementation, the EMF defines sustainability criteria and environmental management guidelines that require attention in the decision-making process in order to promote the desired state of environment. Sustainability objectives for the **RBIDZ Phase 1F** within the "**Zone 7: Coastal Plain Commercial-Industrial Zone**" environmental management zone that have relevance with regards to ecological management are as follows:

- Discouraging encroachment of development into and/or near wetlands, delineating appropriate ecological buffers for wetlands, preventing illegal dumping of waste and reducing the risk of water contamination by industrial and related activities;
- Discouraging emission emitting activities, industries that demand huge quantities of water and activities with a high energy demand; and
- Wetlands and remaining ecological linkages must be protected, maintained and managed as a contribution to the management of water quality.

» ***Ecosystem Services Management Plan***

A Strategic Catchment Assessment and Environmental Services Management Plan or ESMP (Future Works, 2007) was undertaken and developed in 2007. The ESMP highlights the value of ecosystems such as wetlands in providing key environmental services in the area and focuses on the planning and management of the "natural" assets in the uMhlathuze Municipal Area. The ESMP forms part of the broader Environmental Policy of the Municipality which considers the supply side of environmental services management as well as the management of the demands placed on the environment by settlement and development. The assessment emphasised that the value of ecosystems providing such environmental services in the area is being eroded by unsustainable practices and that if the Municipality wants to ensure the continuation of free service delivery by the environment, it would have to put in place specific management actions to protect and enhance the supply of environmental services in the area. The ESMP was developed to:

- include provincial conservation targets into local biodiversity planning;
- resolve conflict between "conservation" and "development" parties;
- alleviate delays during EIA's as a result of biodiversity concerns;
- identify sensitive areas upfront in planning and to avoid impacts;
- define functional spatial management units for management to optimise the delivery of environmental services; and
- develop management plans to secure these services.

Instead of identifying and declaring conservation-worthy areas as "no-go", the ESMP stresses the need to manage natural assets to sustain the supply of ecosystem services through a process of identifying sensitive ecosystems that should be conserved, linkages between ecosystems, and areas that could be developed without impacting on the area's ability to provide environmental services (Future Works, 2007). The ESMP identifies specific "Management Zones" and specifies certain management actions that need to be implemented for these "Zones" in order to ensure not only the survival for key biodiversity assets, but also the sustainable use of biodiversity resources to benefit all residents of uMhlathuze. The proposed power plant development site within the RBIDZ Phase 1F site is located outside of management zones (see Table 8) identified in the ESMP (Figure 9, below).

Table 8. Summary of ESMP Management Zones applicable to the project area (taken from Future Works, 2007).

ZONE	DESCRIPTION	PURPOSE
Zone 2: Conservation Zone	Represents areas of high biodiversity/environmental significance, which although not viable for proclamation as Nature Reserves, still need or warrant some form of legal protection. In this zone are included unique areas, natural habitats such as wetlands, natural forests and areas within the 1:100m floodline.	Zone 1 and 2 areas are specifically designed and established to provide core areas with legislative protection. Core areas are critical for the supply of environmental services.
Zone 3: Open Space Linkage Zone	Includes natural buffers for Zone 1 (Nature Reserves) & Zone 2 (Conservation Zone), areas that provide a natural link between Zone 1 & 2 areas as well as areas that supply, or ensure the supply of, significant environmental services.	Zone 3 areas are specifically designed and established as buffers to protect core areas from being situated immediately adjacent to development and so reduce the level of impact that development can have on the core area. They are also established to provide important corridors that promote and enable the flow of energy, water, nutrients, genetic material and plants and animals between Core areas.
Zone 4: Development Zone	Includes all areas that are not included in Level 1, 2 and 3 zones. Areas in this zone are either already developed or transformed and contain land and natural assets that are not critical for environmental service supply. It is however recognised that the development of	The management of Level 4 areas (Development Zones) is critical to ensure the sustained supply of high quality environmental services from the Level 1, 2 and 3 areas, and as such broad guidelines are given for controlling and managing land use in these areas.

	these zones can impact on environmental services supply.	

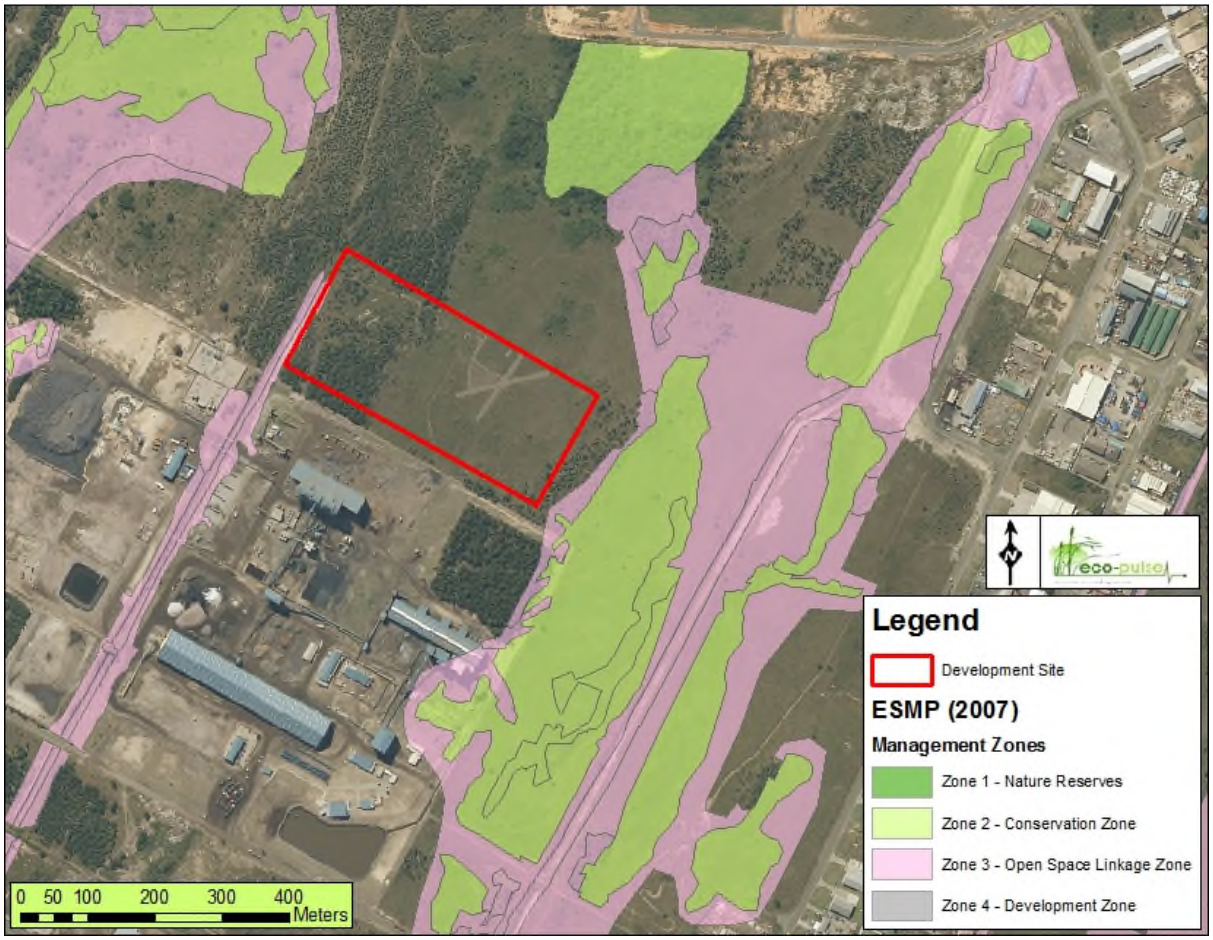

Figure 9 Map showing the location of the development site (outlined in 'red"), relative to areas highlighted for conservation/management in the ESMP (Future Works, 2007).

A number of environmental service assets have been identified and described in the ESMP and are relevant to the broader project area located within the 'City Catchment' unit which lies entirely within the Umhlathuze Municipal Area and is characterised primarily by industrial land uses and commercial activities in the Richards Bay CBD.. These are shown labelled in Figure 9 (above) and are described below. The key roles of ecological assets in terms of providing important ecosystem good & services as well as potential risks to these assets are summarised in Table 9 below.

City catchment unit:

This catchment unit lies entirely within the uMmhlathuze Municipal Area and is characterised primarily by industrial land uses and commercial activities in the Richards Bay CBD. Despite urbanization and industrial development, large, interconnected fragments of natural asset remain that generate important environmental goods and services. The City Catchment does not have an explicit surface water drainage system,

except for a system of artificial canals and drainage channels, and most of the water flows from this catchment via groundwater into the Lake Mzingazi and Harbour Catchments. Critically endangered KwaMbonambi Coastal Grasslands occur within the City Catchment.

The planned development site is located within the '***Northern wetlands and forest'*** sub-unit of the City Catchment unit and *f*orms the headwaters of the City Catchment and provides a sound cross-boundary environment linkage to the Nseleni and Lake Mzingazi Catchment Units. LEVEL 2 ZONES include grasslands, hygrophilous grasslands, marshes, wetlands, coastal forest patches and flood zones. LEVEL 3 ZONES include: shrubland, grassland, areas of alien trees that consolidate and create linkages between the Level 1 zones.

Table 9. Summary of the environmental service assets associated with the 'City Catchment' unit and 'Northern wetlands and forest' sub-unit (taken from the ESMP – Future Works, 2007).

Role of the Assets/Ecosystem Services
• Large, interconnected areas of natural asset remain. • The Catchment has a limited surface water drainage system, with most of the water flows from this catchment flowing via groundwater systems into the Lake Mzingazi and Harbour Catchments. • Most southerly remnants of KwaMbonambi grassland of which large, functional portions remain. • National and regionally significant biodiversity refuge and genetic resource. • Thulazihleka Pan is a regionally and & nationally important bird locality and feeding area. • Natural vegetation performs a critical air quality improvement and micro-climate management function. • Swamp forest and wetlands perform key flood attenuation and water quality improvement function. • Wetlands, marshes, forests, grasslands are locally important biodiversity refuges with existing and potential eco-tourism use potential. • Environment assets filter, dilute and assimilate polluted run-off and discharges from urban and industrial land uses, protecting water quality in the Harbour (estuary). Regulated freshwater flows into the harbour increase habitat value. This protects important fish nurseries and prawneries and creates a usable recreational environment. • Environment assets regulate sediment flows into the Harbour, protecting the integrity of this system and reducing dredging costs. Local sediment movement in the catchment is controlled, limiting damage to road and stormwater infrastructure. • Natural vegetation and waterbodies act as noise and heat sinks, regulating local temperatures and noise levels. Important as the City Catchment is used for urban and industrial land uses with high local heat and noise generation. • Environment assets create local landscape character, particularly as integrated into urban and industrial landscape. Important for tourism, quality of life and investment into the municipal area. • Wetlands, forests, grasslands and swamp forests in the catchment perform a local role in sequestering carbon and regulating atmospheric gases. A locally significant service given the concentration of urban land uses and industry with high carbon and other gaseous emissions – the service becomes most important if the city aims for carbon-neutral status.

Key ecological risks pertaining to the ecological assets and their role in the landscape (Table 9 above) have also been highlighted in the ESMP, and include the following:

- Risk of development encroachment (sections are within IDZ, also CBD edge);
- Alien plant encroachment;
- Agriculture encroachment (forestry);
- Uncontrolled natural resource harvesting'
- Poor / no fire management;
- Illegal dumping, illegal squatting (no access control);
- Soil erosion in agricultural areas posing sedimentation threat to asset; and
- Outfalls from air emissions (pollution, acid rain, nitrogen & sulphur deposition).

Specific recommended management actions for the City Catchment management zone are provided below, and while this has been largely integrated into the EMF process, guidelines are still useful and were used to inform the recommendations for management of the grassland ecosystems within the project area (where applicable and/or relevant):

- Land owners of Level 2 & 3 zones should keep illegal settlement off their land, close off access points used for illegal dumping on their properties, monitor & control access to their properties for natural resource harvesting;
- Alien plant management plan to be developed for the area and implemented by individual land owners; and
- Fire management programme to be implemented.

Coastal/KwaMbonambi Grasslands in Richards Bay:

During 1997, Ezemvelo KZN Wildlife (EKZNW) identified the Coastal / KwaMbonambi Grasslands in the broader Richards Bay area as a highly fragmented and critically endangered habitat, with the coverage of this habitat type believed to have decreased from 174,000ha previously to 1,531ha presently, or less than 1% of the original coverage (ESMP: Future Works, 2007). Most of the remaining KwaMbonambi Grasslands in fall within the proposed RBIDZ and an area surrounding Lake Nsezi, and are therefore under threat from development and land use change. In an effort to safeguard a reasonable proportion of the remaining areas of this habitat in the uMhlathuze Municipal Area, the Municipality and EKZNW met in 2006 to negotiate areas that should be protected and those that did not require protection, with the criteria used in this evaluation including the respective location of the grassland areas, size and quality of these areas (Future Works, 2007). The output and coverage showing areas requiring conservation is shown below in Figure 10, indicating that the development site is located outside of the proposed KwaMbonambi Grasslands conservation area.

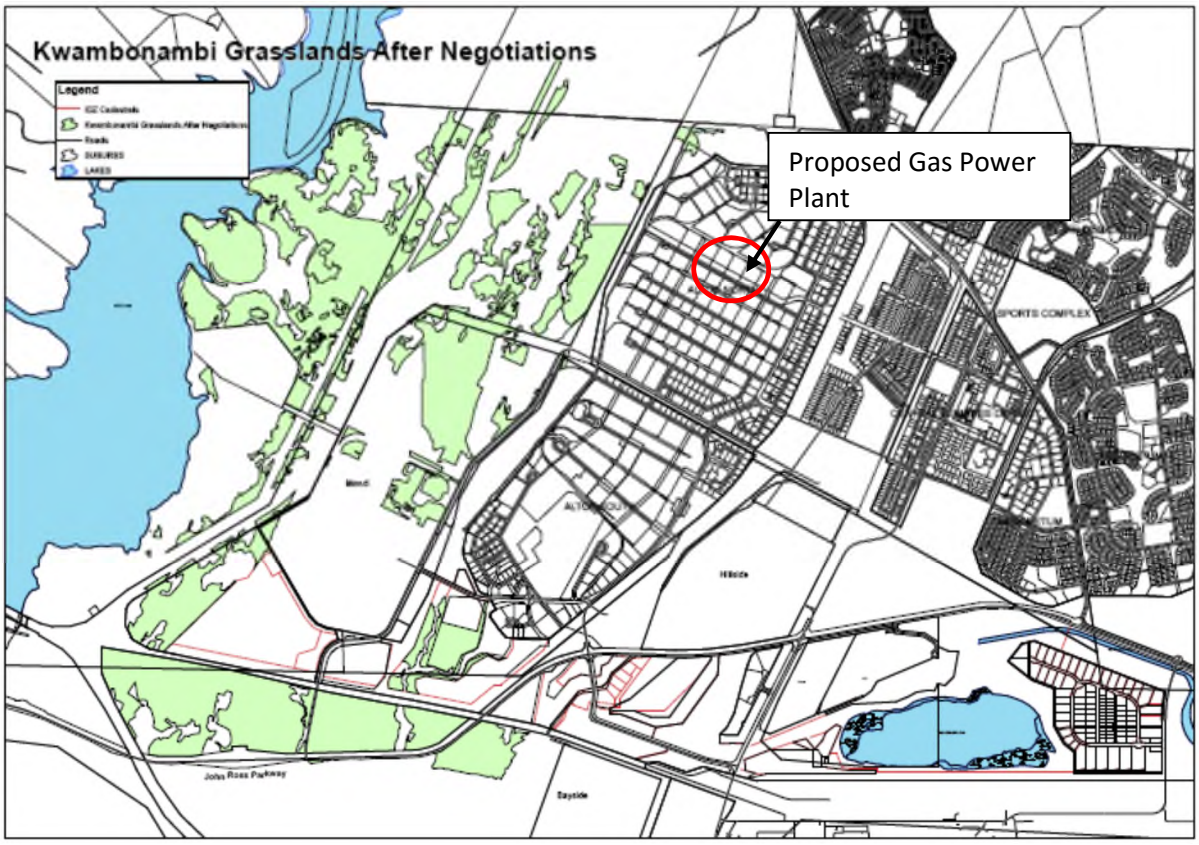

Figure 10 Map showing the location of the 'KwaMbonambi grasslands' requiring conservation (shown shaded in 'green') relative to the Gas Power Plant development site ('red' circle on the map) (source: ESMP by Future Works, 2007).

3.2.4 Regional and Local Connectivity and Implications for Biodiversity

Maintaining connectivity between natural areas is considered critical for the long term persistence of both ecosystems and species, in the face of human development and changes in global climatic conditions. Natural ecological corridors/linkages are therefore considered crucial for allowing species to migrate naturally and to accommodate shifts in species ranges in response to stressors such as climate change for example. Due to high levels of infrastructural development within the local area, natural connectivity has already been severely compromised with the natural asset becoming increasingly isolated, with only small, fragmented pockets of semi-natural coastal grassland and forest habitat remaining in many instances. Exotic vegetation has also replaced large areas of natural habitat. Natural ecological linkages are further severed by tarred roads.

3.3 Potential Occurrence (POC) of Species of Conservation Concern

3.3.1 Flora POC

Interrogation of SANBI website threatened species database and the outputs of the Provincial Terrestrial Systematic Conservation Plan (or CPLAN) indicated flora of conservation concern that could potentially occur in the project area. This was based primarily on a desktop assessment of associated species-specific habitat requirements and distributional ranges (with field verification to confirm the presence of these species during

the field survey). This information is summarized in Table 10, below. Based on the habitat requirements/preferences and distributional/altitudinal ranges for these key species, most plants are unlikely to occur within the secondary grassland habitat at the site. ***Field investigations did not confirm the presence of any of these species at the site.***

Table 10. Flora/flora of conservation significance potentially occurring in the project area (according to the SANBI's Plants of Southern Africa or POSA online database for the quarter degree 2832CA).

Species Name	Status	Habitat Requirements/ Preferences	Potential Occurrence at Site
Adenia gummifera Monkey Rope	**Declining**	Forested ravines, forest patches and forest margins, forest scrub, woodland, savanna, dune forest, on stony slopes, termitaria and littoral bush, altitude 0-1 800 m.	Highly unlikely
Aloe cooperi Inqimindolo	**Declining**	Occupies a wide variety of habitats in grasslands, from marshy areas to dry and well-drained, often wedges in shallow pockets among rocks, but also on hillsides in open grasslands, altitude 45-1700m.	Unlikely
Aloe linearifolia Inkuphuyana	**NT**	High rainfall mistbelt, Ngongoni and coastal grassland, occurs in short grasslands in hilly areas, often in rocky outcrops, altitude 75-1830m.	Unlikely
Asclepias gordon-grayae	**EN**	Tall, unburnt coastal grassland, in black peat soils in marshy areas, altitude 10-100 m.	Unlikely
Cineraria atriplicifolia	**VU**	Grassland, open dry thornveld, or sometimes at the edges of thicket or forest or below steep cliffs in river valleys, altitude 30-800 m.	**Possible**
Cyperus sensilis	**NT**	Coastal grasslands and dunes, associated with seasonal pans, forms a conspicuous zone around the water edge, altitude 5-50m.	Unlikely
Freesia laxa	**VU**	Grassy dunes or light shade along margins of coastal forests, , altitude 0 - 70 m.	Unlikely
Restio zuluensis	**VU**	Grows on the margins of wetlands in short coastal grassland. Restricted to a highly specialized habitat in northern KZN.	Highly unlikely
Thesium polygaloides	**VU**	Swamps, altitude 500-1000m.	Highly unlikely

Key to Species Threat Status:

EN – Endangered, **VU** – Vulnerable, **NT** – Near Threatened

3.3.2 Fauna POC

Fauna of conservation significance for the study area were highlighted by investigating at a desktop level:

(i) Biodiversity features for the study area highlighted in the Provincial Terrestrial Systematic Conservation Plan or CPLAN (EKZNW, 2010);
(ii) Species records found in the South African Bird Atlas Project (SABAP) database for the Richards Bay area;
(iii) Outputs of the uThungula Biodiversity Sector Plan (Elliot & Escott, 2013); and
(iv) Professional experience regarding rare/threatened amphibian species, reptiles and small mammals and their habitat requirements in KZN.

» **Mammals**

A diversity of mammal species could potentially occur within the study area, including a number of locally common small mammal species such as Duiker, Vervet Monkey, Tete Veld Rat, Natal Multimammate Mouse, Pygmy Mouse and the Wahlberg's Epauletted Fruit Bat (all listed as being of Least Concern). Species encountered at the broader RBIDZ Phase 1F site in the past (NEMAI Consulting, 2015) included Scrub hare, Common house mouse, House rat and Grey Duiker (all common species of Least Concern). The generally high level of disturbance and transformation in the area means that many of the larger species, which would have occurred in the area historically, have become locally extinct. The dominant small mammal species are therefore likely to be those with one or more of the following traits:

* Have generally small range requirements and broad habitat requirements;
* Tolerance for noise/light disturbance;
* Characterised by high reproductive and survival rates; and
* The ability to move easily between vegetation patches.

A number of small mammal species of conservation concern (including mice, shrews and moles) could occur within the grassland habitat at the site based on available distribution records and these are listed below in Table 11.

The likelihood of occurrence is reduced as a result of the proximity to human and industrial activities (such as the adjacent Tata Steel factory located immediately south site), proximity to the town of Richards Bay, livestock grazing and vehicle movement along the roads in the area. No small mammal trapping was conducted due to time and financial constraints. Fieldwork was augmented with previous surveys in similar habitats as well as published data. The area was initially traversed on foot to ascertain the presence of available refuges. Limited suitable refuges such as burrows, artificially created rock piles, stumps were observed.

No mammals were observed at the site during field investigations, with the only signs of wildlife being tracks left by livestock (cattle) and signs of grazing.

The majority of larger mammal species are likely to have been eradicated or have moved away from the area due to high levels of habitat transformation and degradation. This is mainly a result of historical disturbance (forestry) and increased development pressure and human disturbances in the area. Smaller mammal species are extremely vulnerable to human impacts such as poaching as well as the potential impact of predators such as dogs and feral cats in the area. It is therefore highly unlikely that the site constitutes significant habitat for any species of threatened mammal species as well as for mammal species in general.

Table 11. Summary of species of mammals of conservation concern potentially occurring on the site.

Species Name	Threat Status	Habitat Requirements/ Preferences (after Stuart & Stuart, 2007)	Distribution/ Range	Habitat requirements met at site?	Site within distribution/ range?	Potential Occurrence at Site
Reddish-grey Musk Shrew *Crodidura cyanea*	**DD**	Moist habitats but also found in very dry terrestrial habitats. Show a preference for dense, matted vegetation.	Widespread in RSA	Partial	Yes	Possible
Forest Shrew *Myosorex varius*	**DD**	Occur in a wide range of habitats, associated with well vegetated and generally moist areas.	Widespread in KZN	Partial	Yes	Possible
Sclater's Forest Shrew *Myosorex sclateri*	**Zululand endemic**	Occur in a wide range of habitats, associated with well vegetated and generally moist areas.	Widespread in KZN	Partial	Yes	Possible
Least Dwarf Shrew *Suncus infinitesimus*	**DD**	Range of habitats. Commonly found in association with termite mounds, which provide shelter and probably also food.	Coastal KZN	Partial	Yes	Possible
Rough-haired golden Mole *Chrysospalax villosus*	**CR**	Have very specific habitat requirements. Thought to be found mostly in grassland with a preference for drier soils bordering on vleis.	Western KZN (inland)	No	No	Unlikely
White-tailed mouse *Mystromys albicaudatus*	**EN**	Grassland and heath.	Northern coastal KZN and inland	Partial	Yes	Possible
Ongoye Red Squirrel *Paraxerus palliatus ornatus*	**CR**	Moist evergreen forest; Subtropical/Tropical Moist (Coastal Scarp forest).	Northern coastal KZN	No	Yes	Unlikely

Key to Species Threat Status: **VU** – Vulnerable, **NT** – Near Threatened, **DD** – Data Deficient

» Avifauna (birds)

The South African Bird Atlas Project (SABAP) aims to map the distribution and relative abundance of birds in southern Africa and relies heavily on data uploaded by "citizen scientists". Species records found in the SABAP database for the project area: Quarter Degree Grid Squares 2832CA (available online at http://sabap2.adu.org.za/) were interrogated. Whilst the majority of species recorded are considered locally common birds, there are a number of bird species that are considered to be of conservation concern based on their conservation/threat status. These are listed below in Table 12. The distributional ranges and habitat requirements/preferences for each bird species of conservation concern was reviewed (based on available literature) in an attempt to estimate the likelihood of

these species occurring within the terrestrial grassland habitat in the study area. Based on this assessment, only a few conservation significant avifauna (bird species) could potentially occur within terrestrial grassland habitats at the site, including:

* **Woolly-necked Stork**, *Ciconia episcopus*
* **Swamp Nightjar,** *Caprimulgus natalensis*
* **African marsh-harrier ,***Circus ranivorus*
* **Martial Eagle,** *Polemaetus bellicosus*

The only bird species observed at the site was a pair of Hamerkop (Least Concern), utilising the canal to the west. A previous ecological survey by NEMAI Consulting in 2015 recorded sixteen (16) locally common bird species of Least Concern (no species of conservation importance recorded) within the broader Phase 1F site.

Table 12. Summary of avifauna/bird species of conservation concern potentially occurring on the site based on South African Bird Atlas records for the study area (quarter degree grid squares: 2832CA).

Species Name	Status	Habitat Preference (after Chittenden, 2009)	Potential Occurrence
African Crowned Eagle *Stephanoaetus coronatus*	NT	Favours tall closed canopy forest, riparian forest, dense woodland and gorges. Also inhabits gum and pine forestry plantations. Normally chooses tallest canopy tree to build large stick platform nest.	Unlikely
Half-collared Kingfisher *Alcedo semitorquata*	NT	Mostly along clear, clean, well-vegetated, fast-flowing streams.	Highly unlikely
Lanner Falcon *Falco biarmicus*	NT	Favours open grassland or woodland near cliffs.	Unlikely
Woolly-necked Stork *Ciconia episcopus*	NT	Wetlands, river margins and adajcent cultivated lands, estuaries. From being rare about 30 years ago this bird has discovered the advantages of human association, and often breeds in suburbia (pers. comm. Dr. D. Johnson).	**Possible**
Yellow-billed Stork *Mycteria ibis*	NT	Shoreline of most inland freshwater bodies, also estuaries.	Highly unlikely
African Pygmy-Goose *Nettapus auritus*	NT	Prefers permanent waters with water-lilies.	Highly unlikely
Rudd's Apalis *Apalis ruddi*	NT	Confined to *Acacia* or mixed *Acacia* woodland.	Unlikely
Southern Ground-Hornbill *Bucorvus leadbeateri*	VU	Favours open woodland.	Highly unlikely
Collared Pratincole *Glareola pratincola*	NT	Floodplains and estuaries, always near large bodies of water.	Highly unlikely
Swamp Nightjar *Caprimulgus natalensis*	VU	Grassland adjoining swamps, rivers, lagoons.	**Possible**
Lesser Jacana *Microparra capensis*	NT	Permanent and seasonal shallow freshwater with floating vegetation.	Highly unlikely
African Finfoot *Podica senegalensis*	VU	Favours slow-flowing streams with overhanging branches.	Highly unlikely
African marsh-harrier *Circus ranivorus*	VU	Inland and coastal wetlands as well as adjacent moist grassland. Breeding demands a stretch of undisturbed long grass with	**Possible**

Species Name	Status	Habitat Preference (after Chittenden, 2009)	Potential Occurrence
		concealed clearings (pers. comm. Dr. D. Johnson).	
Southern Banded Snake-Eagle *Circaetus fasciolatus*	VU	Restricted to riparian forest and adjacent woodland.	Highly unlikely
Cape Gannet *Morus capensis*	VU	Coastal bird.	Highly unlikely
Pink-backed Pelican *Pelecanus rufescens*	VU	Wetlands & estuaries.	Highly unlikely
Great White Pelican *Pelecanus onocrotalus*	NT	Shallow lakes, large pans, estuaries, dams.	Highly unlikely
Black-throated Wattle-eye *Platystyeira peltata*	NT	Estuarine and riparian forest, seldom far from water.	Highly unlikely
Martial Eagle *Polemaetus bellicosus*	VU	Mostly open savanna and woodland on plains.	**Possible**

Key to Species Threat Status: **VU** – Vulnerable, **NT** – Near Threatened

» **Reptiles**

Twelve (12) reptile species of conservation importance have been recorded within the Richards Bay region and could potentially occur in the study area (Table 13, below). All reptile species are sensitive to major habitat alteration and fragmentation. As a result of human presence in the area as well as on the site; coupled with extensive habitat transformation (industrial area) and high levels of disturbance, alterations to the original reptilian fauna are expected to have already occurred to a great extent with the disappearance of reptile diversity in the area as a result. ***No reptile species were observed at the site during the field survey, however the numerous remaining dead tree stumps scattered across the site (post-forestry activities and harvesting of timber) could provide suitable but highly limited habitat for locally common species of snakes, lizards and skinks.*** A previous ecological survey by NEMAI Consulting in 2015 recorded only three common reptile species of Least Concern occurring in the broader RBIDZ Phase 1F area, including *Agama aculeata distanti* (Distant's Ground Agama), *Lygodactylus capensis capensis* (Common Dwarf Gecko) and *Acanthocercus atricollis atricollis* (Southern Tree Agama).

Table 13. Summary of reptile species of conservation significance occurring in KZN and potential occurrence in the study area.

Species Name	Threat Status	Habitat Requirements/ Preferences (after Marais, 2004)	Distribution/ Range	Habitat requirements met at site?	Site within distribution/ range?	Potential Occurrence at Site
Green Mamba *Dendroaspis anugusticeps*	**EN**	An arboreal (tree) species that seldom ventures to the ground except to bask or chase prey. Prefers evergreen lowland forest and moist savannah,	KZN coast	No	Yes	Unlikely

Species Name	Threat Status	Habitat Requirements/ Preferences (after Marais, 2004)	Distribution/ Range	Habitat requirements met at site?	Site within distribution/ range?	Potential Occurrence at Site
		usually found in dense coastal vegetation.				
Gaboon Adder *Bitis gabonica*	**NT**	Prefers moist, thickly wooded lowland areas in lowland forest and moist savannah. Avoids dense forest where food is limited.	KZN coast	No	Yes	Unlikely
Western Green Snake *Philothamnus angolensis*	**Endemic**	Lowland forest, moist savannah and margins of arid savannah regions. Usually associated with vegetation along wetlands and rivers.	KZN coast	No	Yes	Unlikely
Pygmy Wolf Snake *Lycophidion pygmaeum*	**KZN Endemic**	Lowland forest in northern Zululand. Strictly terrestrial. Commonly found beneath logs, pine plantations and in grass tussocks.	Northern Zululand coast	Yes	Partial	Possible
Transvaal Quillsnout Snake *Xenocalamus transvaalensis*	**DD (rare endemic)**	Alluvial sand in lowland forest and moist savanna.	Northern KZN coast	Partial	Yes	Possible
Eastern Long-tailed Seps *Tetradactylus africanus*	**Endemic**	Found in coastal grassland.	Coastal KZN	Yes	Yes	Possible
Large-scaled grass lizard *Chamaesaura macrolepis*	**NT**	Woodland and wooded grassland.	Northern KZN (Zululand)	Yes	Yes	Possible
Southern African Rock Python *Python natalensis*	**VU**	Fairly widespread, preferring rocky outcrops in arid and moist savanna as well as in lowland forest.	Widespread in KZN	Partial	Yes	Possible
Setaro's Dwarf Chameleon *Bradypodium setaroi*	**EN**	Coastal dune forest and thornveld.	Northern KZN (Zululand)	No	Yes	Unlikely
Natal Hinge-backed Tortoise *Kinixys natalensis*	**NT**	Usually favours bushveld, thornveld and savanna woodland	Restricted range in KZN	Partial	Yes	Possible

Species Name	Threat Status	Habitat Requirements/ Preferences (after Marais, 2004)	Distribution/ Range	Habitat requirements met at site?	Site within distribution/ range?	Potential Occurrence at Site
Southern Forest Thread Snake *Leptotyphlops sylvicolus*	**EN**	Forest inhabitant.	Coastal KZN	No	Yes	Unlikely
Nile Crocodile *Crocodylus niloticus*	**VU**	Requires freshwater in the form of large rivers, lakes and dams.	Broad range in RSA	No	Yes	Highly unlikely

Key to Species Threat Status: **CR** – Critically Endangered, **EN** – Endangered, **VU** – Vulnerable, **NT** – Near Threatened, **DD** – Data Deficient

» **Amphibians**

Rare, threatened and endangered Amphibian (frog) species potentially occurring within the grassland habitat in the study area were investigated at a desktop level by comparing the habitat requirements and distributional ranges of key species of conservation concern occurring in KZN (based on a review of available literature). The findings are summarised below in Table 14 and reveals that threatened/endangered frog species occurring in KZN are unlikely to occur in the study area due to their restricted ranges and species-specific habitat requirements/preferences that are unlikely to be satisfied at the site. ***No frog species were observed at the site during field investigations and are likely to be restricted to the adjacent canal to the west and the large wetland areas to the east and north-west of the site.*** During a previous ecological survey by NEMAI Consulting in 2015, only two species of locally common frog species of Least Concern were in the broader RBIDZ Phase 1F area, namely the common Guttural toad (*Amietophrynus gutturalis*) and Bubbling Kassina (*Kassina senegalensis*).

Table 14. Summary of amphibian species of conservation significance occurring in KZN and potential occurrence in the study area (after Passmore & Cattuthers, 1995).

Species Name	Threat Status	Habitat Requirements/ Preferences	Distribution/ Range	Habitat requirements met at site?	Site within distribution/range?	Potential Occurrence at Site
Plain stream frog *Strongylopus wageri*	**NT**	At lower altitudes, inhabits mistbelt forest, while at high altitudes up to 2000 m, it occurs in montane grassland. Adults may be found amongst vegetation or stones on the banks of clear streams and pools. Breeds in quiet pools in forested streams in the escarpment and foothills of the Drakensberg.	Inland (western) KZN Drakensberg foothills	No	No	Highly Unlikely

Species Name	Threat Status	Habitat Requirements/ Preferences	Distribution/ Range	Habitat requirements met at site?	Site within distribution/range?	Potential Occurrence at Site
Spotted shovel-nosed frog *Hemiscus guttatus*	**VU**	Inhabits grassland and savannah. It breeds in seasonal pans, swampy areas, and in pools near rivers where there are sandy soils/alluvial deposits. Spend most of their time underground in areas of flat, sandy soil that tend to flood during the rains. Breeds in burrows and is seldom encountered above ground.	Central and northern KZN	No	Yes	Unlikely
Pickersgill Reed frog *Hyperolius pickersgilli*	**CR**	The species is a habitat specialist occurring within perennial wetlands in Coastal Bushveld-Grassveld at low altitudes, comprised of very dense reed beds with typical vegetation including the Common Reed (*Phragmites australis*), Bulrushes (*Typha capensis*) and sedges such as *Cyperus dives*, *Cyperus latifoloius* and *Cyperus papyrus* and requiring an understudy of thick vegetation such as Snakeroot (*Persicaria attenuata*).	KZN endemic, narrow restricted range along the KZN coast	No	Yes	Highly Unlikely
Whistling rain frog *Breviceps sopranus*	**DD**	Found in forest and woodland in dense herbaceous undercover.	Restricted range in northern KZN	No	Yes	Highly Unlikely
Natal leaf-folding frog *Afrixalus spinifrons*	**NT**	Breeds in standing water, in dense sedge beds and inundated grassy wetlands with abundant surface vegetation.	KZN endemic, narrow restricted range along the central KZN coast extending inland	No	Yes	Highly Unlikely
Kloof frog *Natalobatrachus bonebergi*	**EN**	Very specific habitat requirements: always associated with rocky stream beds in densely forested ravines. Typically, the frogs inhabit streams with short, fast-flowing sections alternating with longer sections of slow-flowing water and pools of varying size and depth.	Restricted range in southern coastal KZN	No	No	Highly Unlikely

Species Name	Threat Status	Habitat Requirements/ Preferences	Distribution/ Range	Habitat requirements met at site?	Site within distribution/range?	Potential Occurrence at Site
Mist-belt chirping frog *Arthroleptella ngongoniensis*	**CR**	Confined to indigenous grassy slopes, above 1000m elevation, in the mist belt of the eastern escarpment. The breeding and non-breeding habitat is Short Mistbelt Grassland and Moist Upland Grassland. Preferred sites are above 1000 m elevation and consist of fairly steep slopes (30-40°) on either side of seepage channels, covered with a dense growth of indigenous grasses. Breeds in decaying vegetation at the base of grass tussocks.	Endemic to a small region of KwaZulu-Natal (KZN mistbelt)	No	No	Highly Unlikely
Giant bullfrog *Pyxicephalus adspersus*	**NT**	Found in drier savannas in large pans that fill with water during rains. Shallow margins of temporary rain-filled depressions.	Inland central KZN	No	No	Highly Unlikely

Key to Species Threat Status: **CR** – Critically Endangered, **EN** – Endangered, **VU** – Vulnerable, **NT** – Near Threatened, **DD** – Data Deficient

» **Invertebrates**

Invertebrate species of conservation significance that are highlighted in the Terrestrial Systematic Conservation Plan (CPLAN) for KZN (EKZNW, 2010) for areas adjacent to the study site include a variety of endemic invertebrates which are terrestrial grassland and forest specialists. These are highlighted in Table 15, below. ***No invertebrates of conservation importance were observed at the site during field investigations, with only a few locally common beetles (e.g. Net-winged beetle - Lycus sp.) and butterflies (Danus chrysippus, Junonia oenone) of 'Least Concern' observed.***

Table 15. Summary of Terrestrial CPLAN outputs for adjacent areas (EKZNW, 2010).

Feature Name	Type	Status	Habitat Preference	Potential Occurrence at Site
Centrobolus fulgidus Shining millipede	Millipede	Endemic to KZN	Woodland/forest	Unlikely
Centrobolus rugulosus Red millipede	Millipede	-	Woodland/forest	Unlikely
Doratogonus zuluensis Zululand black millipede	Millipede	Endangered	Coastal dune forest	Unlikely
Gulella aliciae Alice Burnup's hunter snail	Mollusc	Endemic to KZN	Freshwater	Unlikely
Gulella zuluensis	Mollusc	-	Freshwater	Unlikely
Orthoporoides corrugatus Red-legged millipede	Millipede	-	Woodland/forest	Unlikely

Feature Name	Type	Status	Habitat Preference	Potential Occurrence at Site
Orthoporoides laccatus Red-legged millipede	Millipede	Endemic to KZN	Woodland/forest	Unlikely
Teriomima zuluana Zulu Buff	Butterfly	Rare	Coastal lowlands forest	Unlikely
Whitea coniceps Cone-headed White's grasshopper	Grass hopper	Endemic to KZN	Grassland	**Possible**

3.4 Vegetation and Habitat Field Survey Findings

3.4.1 General description of the habitat and vegetation

A single terrestrial vegetation community was identified for the proposed development site, characterised based on floristic composition, vegetation structure and level of degradation/transformation. The site consisted of a coastal sandy wooded grassland community comprised of a range of different grasses, geoxylic suffrutices, dwarf shrubs, small trees and herbaceous flora reminiscent of the Maputaland Wooded Grassland type. Two principal sub-communities were identified within the broader wooded grassland community:

(i) ***Aristida junciformis subsp. junciformis – Helichcrysum kraussii*** wooded grassland; and

(ii) ***Themeda triandra - Parinari capensis subsp. incohata*** wooded grassland

The broader grassland community was found to be dominated by a number of indigenous grasses, including namely *Aristida junciformis subsp. junciformis, Themeda triandra, Perotis patens* and *Imperata cylindrica* with patches of *Melinis repens* and *Sporobolus africanus* among other subordinate grasses characteristic of disturbance, overgrazing and previous cultivation. The majority of grasses encountered are typical 'Increaser' grass species characteristic of disturbed/overgrazed veld. The KZN endemic sedge, *Cyperus natalensis*, was found in relatively high abundance amongst the other grass species. Short woody and herbaceous indigenous low shrubs dominated much of the grassland, with the main species being the short aromatic shrublet, *Helichcrysum kraussii,* and the dwarf woody shrublet *Parinari capensis subsp. incohata* (Sand mobola plum). Small indigenous trees (early growth stage) including mainly *Syzgium cordatum* (Waterberry, uMdoni tree) and *Dichrostachys cinerea* were subdominant and interspersed amongst *Strychnos spinosa* and *Brachylaena discolor*. Other woody species such as *Hyphaene coriacea* (lala palm), *Phoenix reclinata* and *Albizia adianthifolia* were present, albeit at very low abundance levels with only one or two specimens of each species observed. Small herbaceous and flowering plants were observed scattered within the broader grassland community and at generally low levels of abundance, with the main ones being *Hypoxis angustifolia, Justicia peteolaris, Lobelia coronopifolia, Commelina Africana, Tephrosia purpurea* and *Vernonia centauroides. A full list of 51 species of flora identified on the site is provided in* ***Annexure B*** *at the back of this report.*

Signs of past disturbance at the site were evident, with remnant stumps of *Eucalyptus sp.* trees scattered throughout the vegetation unit assessed, evidence of the past use of the site for commercial forestry plantation. Tarmac, old dilapidated brick buildings and fences within the eastern sections of the site are evidence of the small model airfield that once operated at the site. Other onsite disturbances include numerous vehicle, human and animal tracks and fill material deposited on the site as well as the maintained (mowed) firebreaks around the Tata steel factory perimeter to the south of the site. As a result of the disturbance created by forestry and other human activities (model airfield), a number of Invasive Alien Plants (IAPs) and exotic weeds characterise the site, with the most abundant woody alien plant being *Psidium guajava* (Guava), which has invaded areas of the grassland and was observed scattered amongst other species across the broader vegetation community as well as in dense patches just west of the old airfield buildings. Other species such as *Richardia brasiliensis*, *Cuscata campestris*, *Sesbania bispinosa* and *Acacia mearnsii* were observed at low levels and scattered throughout the unit. Livestock (cattle) grazing was evident throughout the vegetation community assessed, with cattle tracks/paths and heavily grazed grass tussocks identified.

Whilst most plant species identified at the site were species of 'Least Concern', there were two (2) species of plant identified which are 'specially protected plant species' in terms of the Natal Conservation Ordinance No. 15 of 1974. These are ***Crinum delagoense*** (Candy striped Crinum, 'Declining' threat status) and the SA Endemic ***Ledebouria ovatifolia*** (identification of this species was made difficult as it was not flowering at the time of the survey). Both species were observed occurring in patches amongst other grasses/herbs in the grassland community, with the location of these plant species shown in Figure 10. These are protected under Schedule 12 (Specially Protected Indigenous Plants) of the Natal Conservation Ordinance No. 15 of 1974. *A permit needs to be applied for with regards to relocating any of these species.*

A selection of digital photographs taken of the site and terrestrial vegetation community during the field survey in early April 2016 have been included below:

Photo 1. View of the *Aristida junciformis-Helichrysum kraussii* sandy coastal grassland.

Photo 2. View of the degraded grassland near the artificial canal in the west, with signs of previous forestry activitiers and vehicle tracks.

Photo 3. View of an over-grazed patch of grassland dominated by short secondary/pioneer grass species.

Photo 4. Densely vegetated wooded grassland within the eastern sections of the site.

Photo 5. *Digitaria eriantha* grass tussock that had been grazed by livestock frequenting the site.

Photo 6. Small *Syzygium cordatum (Water berry),*

Photo 7. *Cyperus natalensis*, a common sedge occurirng under mesic ecological conditions together with other grasses at the site and a KZN endemic species.

Photo 8. Old historic runway from the small aircraft airfield in the eastern section of the site assessed.

Photo 9. Old dilapidated building probably linked to the old airfield.

Photo 10. Remaining fence posts also probably linked to the old airfield.

Photo 11. View showing dense patch of the Invasive Alien Plant *Psidium guajava* (Guava) that has invaded a disturbed area of the grassland.

Photo 12. Heavily disturbed area adjacent to the artificial canal in the west.

Photo 13. Artificial (concrete lined) canal to the west of the site.

Photo 14. *Imperata cylindrica* grassland in the western site.

Photo 15. Sand mobolo plum, a dwarf shrublet characteristic of the maputaland coastal plain and the single most dominant woody species at the site.

Photo 16. Lala palm (*Hyphaene coriacea*), typical of wooded grassland habitat.

Photo 17. *Crinum delagoense* (Candy-striped Crinum), a 'specially protected plant species' in KZN.

Photo 18. *Ledebouria ovatifolia,* another 'specially protected plant species' in KZN and an SA Endemic.

3.4.2 Comparison with benchmark vegetation

The modified/secondary wooded grassland vegetation community sampled at the site was determined to be fairly similar to the benchmark vegetation unit, Maputaland Wooded Grassland (CB2). Major differences in species composition between the current modified/secondary wooded grassland community present at the site when compared with the reference/benchmark Maputaland Wooded Grassland vegetation type, and this is shown in Table 16, below. Species shaded in "blue" in Table 16 reflect similarities with the benchmark vegetation type species composition, suggesting quite major differences in composition. Whilst a number of typical woody tree and shrub species common to the benchmark vegetation type were identified within the community surveyed at the development site, the graminoid and herbaceous components were found to vary considerably and with a number of exotic, weedy and other undesirable plant species recorded at the site. Some species of grasses could possibly be present due to seeding of the grassland after forestry had been removed from the area in 2012.

Table 16. Comparison of modified/secondary grassland community with benchmark Maputaland Wooded Grassland type.

Parameter	Benchmark: Maputaland Wooded Grassland	Modified/Secondary wooded grassland
Geoxylic suffrutices	*Parinari curatellifolia* *Salacia krausii* *Anclobotrys petersiana* *Diospyros galpinii* *Eugenia capensis* *Syzigium cordatum*	*Parinari capensis subsp. incohata* *Syzygium cordatum*
Graminoids	*Diheteropogon amplectens* *Themeda triandra* *Aristida stipata subsp. graciflora* *Bewsia biflora* *Cyperus obtusiflorus* *C. tenax* *Digitaria natalensis* *Eustachya paspaloides* *Setaria sphacelata* *Sporobolus fimbriatus* *S. subulatus* *Urelytrum agropyroides*	*Aristrida junciformis subsp. junciformis* *Cynodon dactylon* *Cyperus natalensis* *Dactyloctenium aegyptium* *Digitaria eriantha* *Digitaria longiflora* *Eragrostis capensis* *Eustachys paspaloides* *Fimbrystylis sp.* *Heteropogon contortus* *Imperata cylindrica* *Kyllinga sp.* *Melinis nerviglumis* *Melinis repens* *Perotis patens* *Sporobolus africanus* *Themeda triandra* *Urochloa mosambicensis* *Trichloaena monachne*
Herbs	*Chamaechrista plumos* *Cyrtanthus galpinii*	*Chamaecrista plumosa* *Commelina africana* *Commelina erecta* *Cuscata campestris** *Hypoxis angustifolia* *Justicia peteolaris* *Lobelia coronopifolia* *Richardia brasiliensis** *Tephrosia purpurea* *Vernonia centauroides* *Vigna unguiculata* *Crinum delagoense* *Ledebouria ovatifolia*
Low shrubs	*Helichrysum kraussii* *Agathisanthemum bojeri* *Crotalaria monteiroi var. monteiroi*	*Chrysanthemoides monilifera* *Crotalaria monteiroi var. monteiroi* *Helichrysum kraussii* *Helichrysum ruderale* *Parinari capensis subsp. incohata*

Parameter	Benchmark: Maputaland Wooded Grassland	Modified/Secondary wooded grassland
Small trees/tall shrubs	*Acridocarpus natalitius var. linearifolius* *Dichrostachys cinerea subsp. nyassanam* *Diospyros lycoides subsp. sericea* *Hyphaene coriacea* *Syzigium cordatum* *Terminalia sericea*	*Acacia mearnsii** *Albizia adianthifolia* *Brachylaena discolor* *Dichrostachys cinerea subsp. nyassana* *Diospyros lycoides subsp. sericea* *Erythrina lysistemon* *Eucalyptus spp.* *Hyphaene coriacea* *Psidium guajava** *Sesbania bispinosa** *Strychnos spinosa* *Syzygium cordatum* *Phoenix reclinata*
Other important taxa	Known to host a number of Maputaland endemics, including *Ochna sp.*, *Syzigium cordatum*, *Aloe sp.* and *Brachystelma vahrmeijeri.*	*Cyperus natalensis* *Syzygium cordatum*

Key:

Asterisks*	Alien plant
Blue shade	Denotes similarities

3.4.3 Floristic habitat sensitivity assessment

The various grassland vegetation communities defined for the site and study area were assessed qualitatively in terms of their **ecological condition** (based on a combination of species composition; structural intactness and existing levels of anthropogenic disturbance) and **conservation importance** in order to estimate relative floristic sensitivity. This was based criteria described in Table 17.

Based on this assessment, the more intact (fair condition) sections of the wooded grassland community were considered to be of 'Moderate' Sensitivity. Within these areas, whilst composition has been modified in comparison to the reference Maputaland Wooded Grassland type, with an increase in pioneer and alien/weedy/undesirable species and structure appeared patchy with greatly reduced basal cover in places, sections of the grassland appeared more intact and harboured protected plants. The 'patches' of moderately high sensitivity grassland are shown shaded in "Orange" in Figure 11, below. The majority of the vegetation community was considered to be of 'Moderate' sensitivity due to the level of modification in terms of species composition and structure that has occurred across much of the site, with the absence of species of conservation significance in these areas (shown shaded in "Yellow" in Figure 11). Areas that have been highly disturbed and transformed and which are now dominated by weeds and alien plants as well as infrastructure are shown shaded in "Grey" in Figure 11 (below) and considered sites of 'Very Low' ecological sensitivity (areas in the vicinity of the old model airfield in

the central portion of the site. The western half of the site which was formally under plantation forestry and is now recovering/secondary grassland is regarded as being of relatively 'Low' ecological sensitivity.

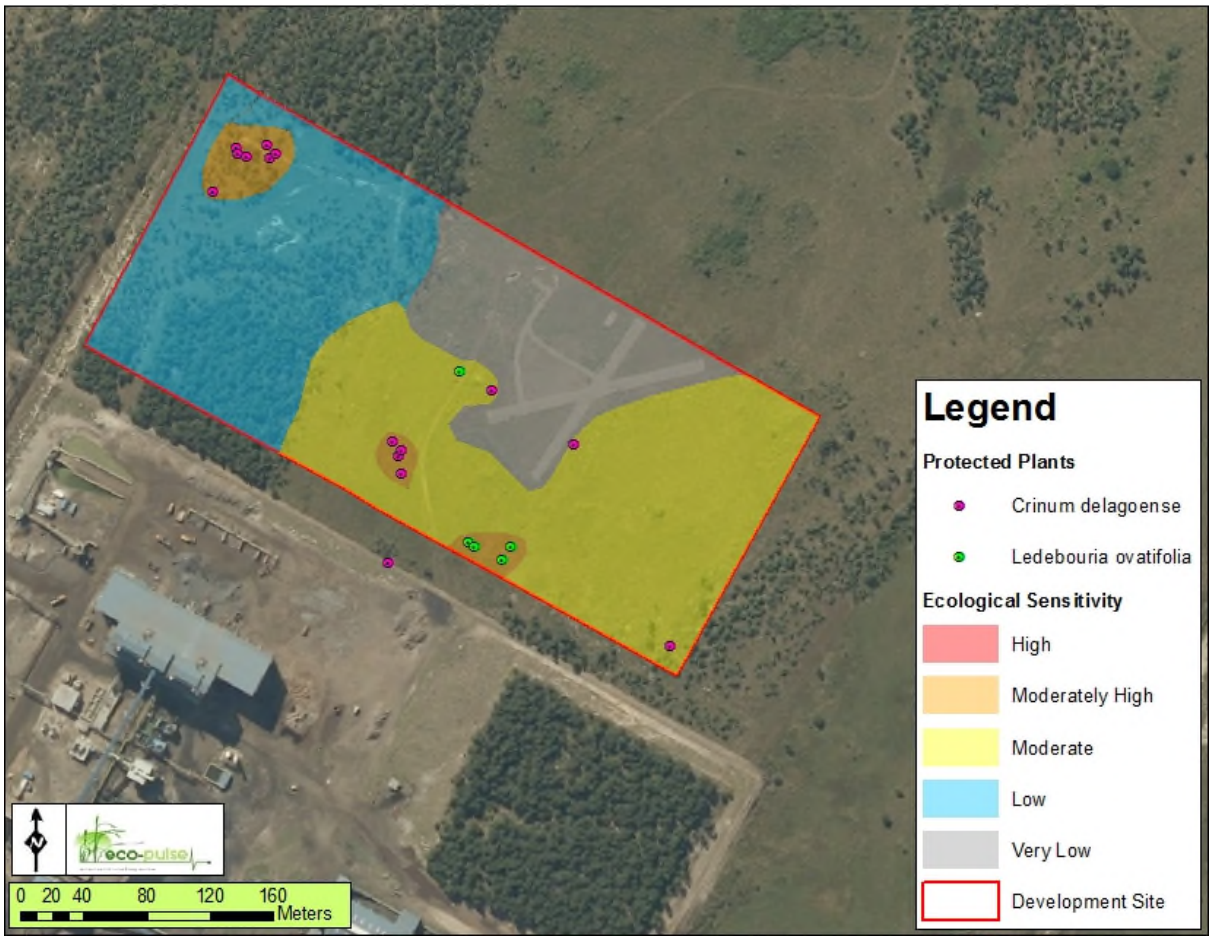

Figure 11 Map showing the extent of the site surveyed with the estimated location and extent of the grassland community with respect to the ecological sensitivity of the different components. The location of Protected Plants is indicated on the map by the coloured marker points.

Table 17. Floristic habitat sensitivity assessment criteria.

Ecological Sensitivity		Ecological Condition/Integrity			Conservation Importance
		Species Composition	Structural Intactness	Level of Disturbance	
High	Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered to be stable and important for the maintenance of ecosystem integrity and ecological processes.	Natural and representative of the reference vegetation type with low levels of weeds and undesirable species (good condition where >75% of expected species occur compared with an undisturbed site in a comparable vegetation type – EKZNW, 2009).	Contiguous with very few areas of patchy cover and representative of the reference vegetation type	Very low/ negligible	Ecosystems with high species richness and which provide suitable habitat for a number of threatened/protected species. Usually termed sensitive and 'no-go' areas and unsuitable for development, and should be protected.

Ecological Sensitivity		Ecological Condition/Integrity			Conservation Importance
		Species Composition	Structural Intactness	Level of Disturbance	
Moderate to High	Relatively important ecosystems at gradients of intermediate disturbances. Areas may also be considered important if directly adjacent to sensitive/pristine ecosystems.	Largely Natural to Moderately modified (some impact due to pioneer plants, weeds and less desirable species). Condition is regarded as fair/moderate where <75% of expected species occur compared with an undisturbed site in a comparable vegetation type – EKZNW, 2009).	Largely contiguous with some patches of reduced cover	Low to Moderate	Ecosystems with intermediate levels of species diversity, usually not containing threatened/Red data species. Low-density development may be allowed, provided the current species diversity is conserved.
Low to Very Low	Largely degraded and disturbed systems with little or no ecological function.	Largely modified (high proportion of pioneer species, invasive, exotic species, weeds and other undesirable plants). Condition is regarded as poor/degraded where <25% of expected species occur compared with an undisturbed site in a comparable vegetation type – EKZNW, 2009).	Patchy cover, bare ground and largely altered structure in comparison to the reference vegetation type	Moderate to High	Areas with little or no conservation potential and usually species poor (most species are usually exotic, locally common or weeds/undesirable species).

3.4.4 Summary of ecological assessment findings

A summary of the terrestrial ecological assessment findings is provided in Table 18.

Table 18. Summary of the main findings of the terrestrial ecological assessment.

Intrinsic/ecological value	Applicability to Study Site
Species level aspects of biodiversity	
Protected species of fauna/flora.	None observed but largely intact coastal forest habitat in the north may potentially harbour Red Data Listed (RDL) species of both flora and fauna.
Threatened species (Red Data List).	
Keystone species performing a key ecological role (e.g. key predator, primary producer).	None
Large or congregatory species populations.	None

Intrinsic/ecological value	Applicability to Study Site
Endemic species or species with restricted ranges.	Two South African Endemic plant species recorded: *Ledebouria ovatifloia* and *Hyphaene coriacea.*
Previously unknown species.	None
Community and ecosystem level aspects of biodiversity	
Distinct or diverse communities or ecosystems.	Maputaland wooded grassland (Endangered status)
Unique ecosystems.	
Locally adapted communities or assemblages.	
Species-rich or diverse ecosystems.	
Communities with a high proportion of endemic species or species with restricted ranges.	Maputaland wooded grassland
Communities with a high proportion of threatened and/or declining species.	*Crinum delagoense,* Declining threat status
The main uses and users of the area and its ecosystem goods and services: important ecosystem services (e.g. important water yield area, coastal buffer), valued ecosystem goods (e.g. harvestable goods important for lives and / or livelihoods), valued cultural areas.	Grazing for livestock the only use identified
Landscape level aspects of biodiversity	
Key ecological processes (e.g. seed dispersal, pollination, primary production, carbon sequestration).	Grassland ecosystems are associated with a number of key ecological processes and are known to provide a range of important ecosystem goods and services to society. They typically support a rich diversity of grasses, wild flowers, invertebrates, reptiles, birds and other animals. Other services provided by these ecosystems include their role in reducing runoff and attenuating downstream flooding, assisting with binding topsoil and controlling erosion as well as their role in storing carbon, especially in the topsoil.
Areas with large congregations or species and/or breeding grounds.	None
Migration routes/corridors.	The habitat has been quite largely fragmented by existing industrial developments
Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas.	
Importance and role in the landscape with regard to a range of 'spatial components of ecological processes', comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland gradients and macro-climatic gradients), as well as important	

Intrinsic/ecological value	Applicability to Study Site
movement or migration corridor for species.	

4. ASSESSMENT OF ECOLOGICAL IMPACTS AND IMPACT MITIGATION

Natural ecosystems are inherently vulnerable to human activities and these activities can often lead to irreversible damage or longer term, gradual/cumulative changes to ecosystems. Threats to terrestrial ecosystems and biodiversity include processes and activities which reduce system persistence, affect landscape structure and composition and alter community diversity and patterns, including reduced genetic diversity. One such threat to biological process could be the loss of important species due to loss or transformation of habitat. When making inferences on the potential impacts or risks that development activities place on ecosystems, it is important to understand that these impacts speak specifically to their effect on the ecological condition and/or functional importance/value of these ecosystems. Generally, impacts can be grouped into the following four (4) broad categories:

Direct impacts: are those impacts directly linked to the project (e.g. clearing of land, destruction of vegetation and habitat).

Indirect impacts: are those impacts resulting from the project that may occur beyond or downslope/downstream of the boundaries of the project site and/or after the project activity has ceased (e.g. migration of pollutants from development sites).

Induced impacts: are impacts that are not directly attributable to the project, but are anticipated to occur because of the presence of project (e.g. impacts of associated developments, establishment of residential settlements with increased pressure on biodiversity).

Cumulative impacts: are those impacts from the project combined with the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity or natural resources (e.g. a number of developments in the same catchment or ecosystem type collectively affecting or impacting the same ecosystem types or local endemic species).

There is normally a risk that human development can generally impact either directly (e.g. physical change to habitat) or indirectly (e.g. soils erosion and disturbance creating conditions for alien plants to invade natural areas). Figure 12 (below) shows conceptually how direct and indirect impacts to a terrestrial ecosystem habitat can have a number of possible ultimate negative ecological consequences and cumulative impacts as a result of certain impact pathways, ranging from the contribution to affecting ecosystem conservation targets to loss of sensitive species and even reduced ecosystem functioning and goods and services provision.

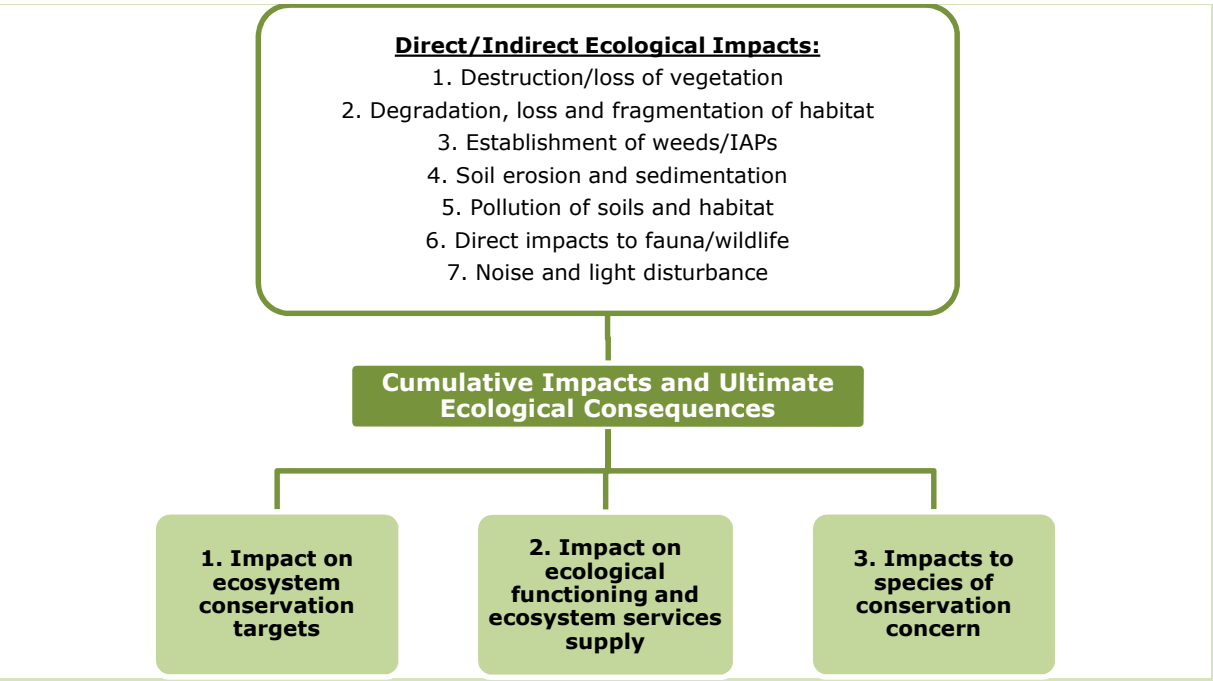

Figure 12 Conceptual diagram showing the range of typical negative ecological consequences for natural ecosystems as a result of typical direct and indirect anthropogenic impacts.

4.1 Direct and Indirect Impacts to Terrestrial Ecosystems and Biodiversity

Typical direct and indirect ecological impacts to terrestrial vegetation, habitat and biodiversity that are likely to be associated with the 'Gas Power Plant' development project are discussed in detail below. Impacts were identified and described based on an understanding of the receiving terrestrial environment and associated biodiversity, the location and extent of the proposed development activities and the identification of factors that could affect the receiving environment through the various project phases, including:

» Pre-construction/initial planning phase;
» Construction phase;
» Operation phase; and
» Decommissioning of the project in an estimated 25-40 years' time.

4.1.1 Pre-construction/Initial planning phase ecological impacts

Ecological impacts associated with this initial phase are likely to be associated with site walkabouts and pre-construction surveys for planning purposes, including the following:

* Geotechnical survey by geotechnical engineer;
* Site survey and confirmation of the substation footprint;
* Survey of substation site and power line servitude;
* Survey of internal access routes; and
* Environmental walk-through surveys.

Impacts during this initial phase have been described and assessed below:

» Pre-construction/Initial planning phase impact 1: **impact to indigenous vegetation**

Nature: *Destruction/damaging of indigenous vegetation during initial site walk-about and pre-construction planning surveys*

This impact relates to the potential destruction/disturbance of vegetation by machinery and employees accessing the site during pre-construction surveys for the various infrastructures planned. As a result of the largely disturbed/secondary nature of the grassland community on the site, combined with the fact that the site will be cleared almost entirely of vegetation during the construction phase, the magnitude of the impact on the general vegetation is likely to be medium. Importantly though, a number of protected plant species occur in the grassland community at the site and surrounds which could be impacted, increasing the magnitude of impact to a moderate level where unmitigated.

	Without Mitigation	With Mitigation
Extent	Local (2)	Site only (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (30)**	**Low (18)**
Status	Negative	Negative
Reversibility	Recoverable	Recoverable
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	This impact can be mitigated through onsite access control and management measures to limit impacts to protected plants in particular during site surveys.	

Mitigation:

Reducing the probability, magnitude and extent of disturbance to vegetation during pre-construction site surveys will be possible through onsite mitigation measures that can be implemented to minimise the magnitude and extent of disturbance. These include:

* Preconstruction walk-through of the development footprint for species of conservation concern that would be affected and that can be translocated.
* Demarcate areas identified as harbouring protected plants using suitable measures (such as fencing these areas or using perimeter stakes with high visibility/barrier tape for example).
* Undertake plant rescue and translocation prior to any clearing/disturbance of the site occurring, in line with the requirements and recommendations of the **Plant Rescue Translocation and Protection Plan** (*contained in Section 4.4.1).*
* Accessing the site during site initial planning/surveys walk-throughs by foot only (limiting vehicle access to the southern fence line and firebreak associated with

the adjacent Tata steel factory) and being careful not to disturb/damage protected plants by avoiding areas with high densities of protected plants.

* Contractor induction and staff/labour environmental awareness training needs are to be identified and implemented through staff/contractor environmental induction training. This should include basic environmental training based on the requirements of the EMPr. A copy of the EMPr is to be made available on site at all times.
* Temporary access routes should be designed to limit potential impact on the environment.
* No harvesting of plants for any purpose is to be permitted.

Residual:

Negligible: The impact of pre-construction surveys on the vegetation at the site is likely to be minimal and since the entire site will be subject to vegetation clearing during construction in any case, residual impacts are actually likely to be negligible. If mitigatory actions are properly and timeously employed, the extent of the impact can potentially be reduced to the development site footprint only (avoiding adjacent/surrounding habitats) and any potential impacts on protected plants can be avoided entirely.

» Pre-construction/Initial planning phase impact 2: **direct impacts to fauna**

Nature: *Direct impacts to fauna (wildlife) during initial pre-construction site surveys*

Pre-construction surveys of site can result in mortalities or damage to local wildlife (fauna/animals) as a result of vehicles/machinery accessing the area. There is a slight possibility that fauna of conservation importance such as Red Data and protected species may be killed, injured or damaged. Activities occurring within a close proximity to natural habitat have the potential to lead to increased pressure on natural resources through illegal hunting/poaching/trapping of wildlife for various uses such as food/medicinal purposes. This is particularly relevant to areas where protected/Red data species may occur and remote areas that have not been impacted to a high degree by local communities.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Short term (2)	Short term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Very improbable (2)
Significance	**Low (24)**	**Low (5)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely

Can impacts be mitigated?	This impact can be effectively mitigated at the site through appropriate management practices to limit and restrict disturbing activities where possible.

Mitigation:

Most wildlife that could utilise the site is likely to move into undisturbed surrounding areas as human presence increases at the site. If managed properly, the extent and probability of this impact occurring can also be reduced quite significantly. This impact can be best managed through practical on-site mitigation measures aimed at reducing the possibility of incidents occurring. These include:

* Education of workers/employees onsite on not to harm wildlife unnecessarily will assist in mitigating this impact. Contractor induction and staff/labour environmental awareness training needs are to be identified and implemented through staff/contractor environmental induction training. This should include basic environmental training based on the requirements of the EMPr, including training on avoiding and conserving local wildlife. A copy of the EMPr is to be made available on site at all times.
* No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way or removed from the site during initial site surveys. This includes animals perceived to be vermin (such as snakes, rats, mice, etc.). Workers are to be informed of this requirement.
* Any fauna/animal found on the site during initial clearing may not under any circumstance be hunted, snared, captured, injured, killed, and harmed in any way. Such animals must rather be moved to the closest point of natural or semi-natural vegetation outside the area to be stripped.
* The handling and relocation of any animal perceived to be dangerous/venomous/poisonous must be undertaken by a suitably trained individual.
* Accessing the site during site initial planning/surveys walk-throughs by foot only (limiting vehicle access to the southern fence line and firebreak associated with the adjacent Tata steel factory).
* All vehicles accessing the site should adhere to a low speed limit (30km/h is recommended) to avoid collisions with susceptible species such as reptiles (snakes and lizards).
* No litter, food or other foreign material should be disposed of on the ground or left around the site or within adjacent natural areas but should be retained and disposed of at proper waste receptacles off-site.

Residual:

Low: Without mitigation this impact is likely to be limited in terms of extent and intensity as a result of existing human activity in the area, associated with the adjacent industry and grazing livestock and the concomitant reduction in the faunal populations at the site which has already occurred. Where access to natural areas is supervised and onsite teams involved in surveys are properly managed, the probability of this impact occurring

and the extent of the impact can be reduced significantly and the risk of incurring residual impacts may be considered relatively low as a result.

» Pre-construction/Initial planning phase impact 3: **artificial noise disturbance**

Nature: *Artificial noise disturbance impact on local wildlife during initial pre-construction site surveys*

Local wildlife (fauna) generally respond to disturbances caused by human activities according to the magnitude, timing, and duration of the particular disturbance. Human activities can affect an animal's ability to feed, rest, and breed if it is unable to habituate to the disturbance caused (Rodgers & Schwikert, 2003). Anthropogenic activities occurring within a close proximity to natural habitats containing fauna (wildlife) during initial site surveys can lead to both the physical disturbance of habitats supporting animal life by machinery/labourers (already discussed above) as well as the disturbance of fauna due to noise pollution at the site caused by survey teams and vehicles accessing the site. Locally common species already occurring in the surrounding area are likely to be less sensitive to noise disturbance (due to the proximity of existing human development) and can probably become habituated at the site. Impacts are likely to be very short-lived during the pre-construction phase and affecting only a few areas of natural habitat where sensitive species may occur and will probably mainly affect local bird species that can quite easily migrate to other similar habitat in the area.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (15)**
Status	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Unlikely	Unlikely
Can impacts be mitigated?	Noise pollution and disturbance of local wildlife will be difficult to mitigate altogether, but the intensity and extent of the resultant disturbance can be managed to a degree.	

Mitigation:

If managed properly, the extent and probability of this impact occurring can be potentially reduced. The following mitigation measures apply:

- Ensure that survey teams accessing the site conduct themselves in an acceptable manner while on site.
- No activities should be permitted at the site after dark (between sunset and sunrise), except for security personnel guarding the development site.

Residual:
Low/negligible: Residual impacts to fauna are unlikely to persist as wildlife disturbed during initial site surveys are likely to readily migrate to other remaining habitat in the area outside of the development site.

4.1.2 Construction phase ecological impacts

Ecological impacts associated with the construction phase (expected duration of 14-16 months once Environmental Authorisation has been received) are likely to be associated with construction activities, heavy machinery and labour accessing the site and the range of equipment and the handling and disposal of potentially hazardous substances used during the construction process as well as waste products generated by construction activities. Construction activities will include the following:

» Establishment of access roads:
  * Establishment of internal access roads: up to 6 m wide permanent roadway within the site for use during construction and operation phase.

» Undertaking site preparation including:
  * Clearance of vegetation at the footprint for infrastructure.
  * Site establishment of offices/ admin/ workshops with ablution facilities, parking, area for placement of gas turbines, water and fuel tanks, substation and power line, etc.
  * Excavations for foundations.

» Civil Works / construction of structures:
  * Concrete works for structures such as foundation, the production unit (which comprises a complete turbine, generator and an auxiliary module), stacks, and air cooler condensers.
  * Ancillary infrastructure such as guard house, admin building, workshops and a warehouse will be established.
  * Mechanical work will then follow.

» Construct Substation and power line:
  * A 132 kV substation will be required to facilitate grid connection to the Indus Substation.
  * Substation components.
  * Security fencing around high-voltage (HV) Yard.

» Commissioning of the facility

» Undertake site rehabilitation:
  * Remove all construction equipment from the site.
  * Rehabilitation of temporarily disturbed areas where practical and reasonable.

Impacts likely to be associated with the construction phase have been described and assessed below:

» Construction phase impact 1: **impacts to indigenous vegetation**

Nature: *Destruction/damaging of indigenous vegetation during site clearing and construction of infrastructure*

With the change of land use from largely untransformed/undeveloped land (semi-natural grassland) to an artificial facility, indigenous vegetation will be lost through the stripping of vegetation and clearing of the land to make way for bulk earthworks and construction and other general disturbance within the development footprint. This impact relates to the complete removal or partial destruction/disturbance of vegetation by machinery and workers. Since the gross majority of the site (>95%) will be required for power plant infrastructure, it is anticipated that the loss of natural vegetation and species within the development footprint will be almost complete. The initial removal of vegetation during pre-construction site clearing may be exacerbated further during construction by machinery and workers operating outside of the construction footprint and disturbing indigenous vegetation outside of the site for the purposes of gaining access or through accidental incursions into natural areas adjacent to or beyond the development footprint.

Where the condition of the affected ecosystem is either good or fair/moderate, the impact significance should be dictated by the ecosystem threat status only and condition should not influence the rating (EKZNW, 2009). If development will have a residual impact on threatened ecosystems (i.e. Critically Endangered, Endangered, Vulnerable) that are not degraded/transformed (i.e. the affected area supports more than 25% of the species that would be expected to occur on an undisturbed site in a comparable vegetation type or ecosystem), the significance would be at least medium (EKZNW, 2009). As a result of the largely disturbed/secondary nature of the grassland community on the site, the magnitude of the impact on the general vegetation is likely to be relatively low with the implementation of mitigation measures. Furthermore, since adjacent areas beyond the site will also be cleared to make way for the various servitudes and road network required for the broader Phase 1F site, disturbance of areas beyond the site will also be of a low impact magnitude. Importantly though, a number of protected plant species occur in the grassland community at the site and surrounds which would be destroyed/lost during site clearing if not properly mitigated, thus impact magnitude is considered moderate in this context.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**High (65)**	**Medium (50)**

Status	Negative	Negative
Reversibility	Irreversible	Recoverable
Irreplaceable loss of resources?	Yes	Unlikely
Can impacts be mitigated?	This impact will be inherently difficult to mitigate based on the proposed development location on semi-natural grassland and the extent of hardened/artificial surfaces to be developed which will require >95% of the site to be stripped of vegetation. Loss of protected plant species can be readily mitigated.	

Mitigation:

Reducing the probability, magnitude and extent of this impact will not be practically possible or feasible given that >95% of the site will be cleared entirely of vegetation and transformed to hardened artificial surfaces. However, there are possible mitigation measures that can be implemented to minimise the magnitude and extent of disturbance. These include:

- Undertake pre-construction plant rescue and translocation prior to any clearing/disturbance of the site occurring, in line with the requirements and recommendations of the **Plant Rescue Translocation and Protection Plan** (*contained in Section 4.4.1). This is ideally dealt with during pre-construction*.
- Contractor induction and staff/labour environmental awareness training needs are to be identified and implemented through staff/contractor environmental induction training. This should include basic environmental training based on the requirements of the EMPr. A copy of the EMPr is to be made available on site at all times.
- Physically demarcate the construction zone using suitable measures (including pegs, fences, orange bonnox fencing, hazard tape, etc.) and include this on a master layout plan for the site. All demarcation work is to be signed off by the ECO.
- Limit construction activities, site camps and equipment lay-down areas to disturbed areas within the development footprint and alongside the existing Tata steel north perimeter fence firebreak to the south of the site. No construction camps, etc. to be located within natural grassland areas in areas adjacent to the development site. All site camps and lay-down area, etc. are to be signed off by the ECO.
- Restrict vegetation clearing to the development footprint only through appropriate project design and specifying and supervising access control and 'No-Go' areas (i.e. those areas outside of the demarcated development/construction site).
- Manage the extent of disturbance by supervising clearing activities during pre-construction to ensure these are limited to the designated development zone only. The ECO and/or Contractor's EO is to provide supervision and oversight of

vegetation clearing activities and other activities which may cause damage to the environment at the initiation of the project.

- Temporary access routes should be designed to limit potential impact on the environment.
- Where access is required to areas surrounding the development site, a 5m buffer may be used for access. Where possible, cut vegetation to ground-level rather than removing it completely, leaving root systems intact to ensure rapid re-colonization in areas that are not to be permanently hardened.
- Rehabilitation and re-vegetation of areas disturbed outside of the development footprint is to be undertaken as soon as practically possible, *as per the relevant rehabilitation guidelines contained in Section 4.4.4.*
- An appropriate fining system should be developed and implemented for any infringements to the EMPr.
- No harvesting of plants for firewood, medical purposes or other uses is to be permitted.
- No open fires to be permitted on the site and in surrounding areas.

Residual:

Moderate: Vegetation clearing is likely to be one of the greatest direct impacts on the terrestrial ecology in the study area. If mitigatory actions are properly and timeously employed, the extent of the impact can potentially be reduced to the development site footprint only (avoiding adjacent/surrounding habitats). Impact severity is likely to remain relatively high, however, and will be a permanent residual impact due to the loss of vegetation and transformation to hardened surfaces.

» Construction phase impact 2**: loss/degradation and fragmentation of habitat**

Nature: *Loss/degradation and fragmentation of habitat as a result of vegetation clearing and construction of infrastructure*

Vegetation clearing and disturbance of the semi-natural grassland vegetation at the development site will not only reduce the availability of habitat (refugia/breeding/nesting sites) and food for local wildlife but may also temporarily or even permanently restrict corridor movement between natural areas through associated fragmentation of natural habitat and the severing of natural ecological linkages/corridors. Excavations required during the construction phase would also have a direct impact on moles through loss of habitat, with the overall extent of impact related to the proportion of area developed. Loss of habitat will also have a deleterious impact on ants. The effect of fragmentation will generally be greater for fauna than for flora and is typically lower for grasslands when compared with wooded/forest communities and have a relatively minor impact on small mammals such as rodents and shrews because only a limited proportion of habitat with respect to the broader grassland community will be transformed, with sufficient adjacent habitat retained for the overall impact to be slight. Nocturnal species such as hares would generally avoid disturbance through their nocturnal habit requirements. Due to the broader plans to develop the entire RBIDZ Phase 1F site, loss of habitat connectivity and fragmentation of habitats will occur across the site, leaving little remaining connectivity in the form of wildlife corridors.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	This impact will be inherently difficult to mitigate based on the proposed development location on semi-natural grassland and the extent of hardened/artificial surfaces to be developed (>95% of the site).	

Mitigation:

Reducing the probability, magnitude and extent of this impact will not be practically possible or feasible given that >95% of the site will be cleared entirely of vegetation and transformed to hardened artificial surfaces. However, there are possible mitigation measures that can be implemented to minimise the magnitude and extent of disturbance. These include:

* Contractor induction and staff/labour environmental awareness training needs are to be identified and implemented through staff/contractor environmental induction training. This should include basic environmental training based on the requirements of the EMPr. A copy of the EMPr is to be made available on site at all times.

- Physically demarcate the construction zone using suitable measures (including pegs, fences, orange bonnox fencing, hazard tape, etc.) and include this on a master layout plan for the site. All demarcation work is to be signed off by the ECO.
- Limit construction activities, site camps and equipment lay-down areas to disturbed areas within the development footprint and alongside the existing Tata steel north perimeter fence firebreak to the south of the site. No construction camps, etc. to be located within natural grassland areas in areas adjacent to the development site. All site camps and lay-down area, etc. are to be signed off by the ECO.
- Restrict vegetation clearing to the development footprint only through appropriate project design and specifying and supervising access control and 'No-Go' areas (i.e. areas outside of the construction site).
- Manage the extent of disturbance by supervising activities during construction to ensure these are limited to the designated construction zone only. Natural areas outside of the development footprint are to be considered 'No-Go' areas. Access through and construction activities within the No-Go areas are strictly prohibited in these areas and needs to be controlled.
- Temporary access routes should be designed to limit potential impact on the environment.
- Where access is required to areas surrounding the development site, a 5m buffer may be used for access. Where possible, cut vegetation to ground-level rather than removing it completely, leaving root systems intact to ensure rapid re-colonization in areas that are not to be permanently hardened.
- Rehabilitation and re-vegetation of areas disturbed outside of the development footprint is to be undertaken as soon as practically possible, *as per the relevant rehabilitation guidelines contained in Section 4.4.4.*
- An appropriate fining system should be developed and implemented for any infringements to the EMPr.
- No open fires to be permitted on the site and in surrounding areas.

Residual:

Moderate: If mitigatory actions are properly and timeously employed, the extent of the impact can potentially be reduced to the development site only, however as this impact will be unavoidable at the site, residual impacts including the loss of habitat and fragmentation of habitat/reduced connectivity will remain.

» Construction phase impact 3: **soil erosion and sedimentation**

Nature: *Soil erosion and sedimentation caused by initial vegetation stripping and other construction activities*

Vegetation stripping/clearing will temporarily denude the vegetation on the site and expose the soils to erosive elements in the immediate to short-term. This could be exacerbated by water flowing down trenches and access roads, as well as from trench

de-watering activities. Soil erosion can result in the loss of valuable topsoil and formation of erosion gullies. This can cause localized habitat loss or alteration due to increased sediment deposition or erosion of natural areas adjacent to the construction site as well. Some of the key ecological effects related to the erosion/deposition of sediment may include:

* Habitat alteration due to increased sediment deposition or erosion of areas;
* Reductions in photosynthetic activity and primary production caused by sediments impeding light penetration;
* Reduced density and diversity of organisms as a result of habitat degradation, blanketing of sites and the establishment of more tolerant taxa or exotic species; and
* Exposure disturbed sites to invasion by weeds and other undesirable plants.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (32)**	**Low (21)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	Soil erosion and sedimentation linked to vegetation stripping/clearing and other construction activities can be mitigated through appropriate best-practice erosion control/management practices.	

Mitigation:

If managed properly, the probability, intensity and extent of this impact can be reduced quite significantly and would be best achieved through the onsite implementation of practical 'best practice environmental management' measures designed to control storm water runoff volumes/velocities, erosion and resultant sedimentation. These include:

* Schedule vegetation clearing such that this is completed immediately before construction, to avoid prolonged exposure of the soil to weather elements.
* Vegetation clearing and construction should ideally proceed mainly during the dry, winter months where possible in order to minimize the risk of soil erosion linked to high runoff rates.
* Vegetation/soil clearing and construction activities must only be undertaken during agreed working times (as agreed to between the contractor and project manager/ECO) and permitted weather conditions.
* If heavy rains are expected, construction activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
* Any disturbed surfaces outside of the area to be developed must be re-vegetated as soon as practically possible to prevent erosion of bare/exposed soils.

- Dewater any excavated trenches required for the development in a manner that does not cause erosion and does not result in silt-laden water flowing downslope. Water must be pumped out into a well-vegetated area to facilitate sediment trapping.
- Run-off generated from cleared and disturbed areas such as access roads must be controlled using suitable erosion control measures (e.g. sand bags, earthen berms, etc.). Sediment barriers (e.g. silt fences, sandbags, hay bales, earthen filter berms or retaining walls) must be established to counter erosion and sedimentation where necessary.
- Sediment barriers should be regularly maintained and cleared so as to ensure effective drainage.
- All temporary soil berms, sandbags and silt fences must only be removed once construction has been completed and vegetation cover has successfully re-colonised any disturbed areas outside of the construction zone.
- Erosion/sediment control measures such as silt fences, concrete blocks and/or sand bags must also be placed around soil/material stockpiles to limit sediment runoff from stockpiles. The slope and height of stockpiles must be limited to 2m to avoid collapse. If soil stockpiles are to be kept for more than 3 months they must be hydroseeded.
- Disturbed surfaces are to be paved or re-vegetated as soon as practically possible after construction has been completed to prevent erosion of bare/exposed soils. Rehabilitation and re-vegetation of areas disturbed outside of the development footprint is to be undertaken as soon as practically possible, *as per the relevant rehabilitation guidelines contained in Section 4.4.4.*

Residual:

Low: Without mitigation this impact can be considered somewhat significant due to the sandy/erodible nature soils at the site. Although impacts would be localized, erosion is likely to persist or worsen over time if not addressed properly and regularly through an appropriate monitoring and management programme for the site. Rapid and effective rehabilitation and re-vegetation of exposed soils outside of the development footprint will be important for reducing erosion risk linked with storm water runoff and thus reducing the overall potential for residual impacts (i.e. erosion and sedimentation in adjacent areas).

» Construction phase impact 4**: pollution of soils and habitat**

Nature: *Pollution of soils and habitat during construction of the power plant facility*

Waste products and pollutants, generated during the construction phase of the development may include fuels and oils from construction vehicles, cement and concrete products, paints and other hazardous substances; as well as solid waste in the form of building material and litter from labourers. These can potentially enter the surrounding natural grassland environments either directly through disposal/mismanagement of waste products/pollutants or more indirectly through surface runoff during rainfall

events. These contaminants have the capacity to negatively affect soil ecosystems including sensitive or intolerant species of flora and fauna. Where significant changes in soil quality occur, this will ultimately result in a shift in flora and soil microbes species composition, favouring more tolerant species and encouraging the invasion of early successional and alien invasive species and potentially resulting in the localised exclusion of any sensitive species.

	Without Mitigation	With Mitigation
Extent	Local (2)	Site only (1)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (16)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	Potentially hazardous pollutant/waste streams can be effectively managed onsite through best practice pollution control measures that will be able to effectively mitigate potential impacts to natural resources.	

Mitigation:

If managed properly, the probability and extent of this impact can be reduced quite significantly. This impact can be best managed through practical on-site mitigation measures aimed at reducing the possibility of incidents through waste and pollution control measures as well as developing contingency measures to deal with any significant pollution events should these arise. These include:

* All employees handling fuels and other hazardous materials are to be properly trained in their safe use, environmental restrictions and methods for proper disposal.
* Ensure that all workers on site are aware of the proper procedure in case of a fire occurring on site.
* Ensure adequate fire-fighting equipment is available and train workers on how to use it.
* The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, bitumen, paint, etc.) needs to be administered.
* Construction materials liable to spillage are to be stored in appropriate containment structures (e.g. drip-trays).
* No refuelling, servicing or chemical storage should occur outside the established construction camp. Hazardous storage and re-fuelling areas must be bunded prior to their use on site during the construction period. The bund wall should be high enough to contain at least 110% of any stored volume.
* Drip trays should be utilised at all fuel/chemical dispensing areas. Provide drip-trays beneath standing machinery/plant.

- Vehicle maintenance should not take place on site unless a specific lined and bunded area is constructed within the construction camp for such a purpose.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater.
- An emergency spill response procedure must be formulated and staff is to be trained in spill response. All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spillages of fuels, oils and other potentially harmful chemicals should be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and rehabilitated timeously and appropriately.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Sanitation – portable toilets (1 toilet per 10 users is the norm) to be provided where construction is occurring and away from watercourses such as rivers and wetlands. Workers need to be encouraged to use these facilities and not the natural environment.
- Provide adequate rubbish bins and waste disposal facilities on-site and educate/encourage workers not to litter or dispose of solid waste in the natural environment but to use available facilities for waste disposal.
- Clear and completely remove from site all general waste, constructional plant, equipment, surplus rock and other foreign materials once construction has been completed.
- No litter, refuse, wastes, rubbish, rubble, debris and builders waste must be placed, dumped or deposited on adjacent/surrounding properties during or after the construction period.
- Recycling/re-use of waste is to be encouraged.
- Ensure that no refuse/waste is burnt on the site or on surrounding premises.

Residual:

Low: Without mitigation this impact can be considered quite severe where activities are not managed properly at the site. Although impacts would be localized, pollution of soils and water by environmental contaminants such as wastes and hazardous products stored at the site can persist in the environment for some time and can be difficult to rectify. With proper mitigation, the risk of incurring residual impacts can be lowered significantly.

» Construction phase impact 5**: direct impacts to fauna**

Nature: *Direct impacts to fauna (wildlife) by construction machinery and workers*

Construction activities can result in mortalities or damage to local wildlife (fauna/animals) as a result of vehicles and machinery operating in the areas and involved with earthworks, site clearing, construction of infrastructure, etc. During initial vegetation clearing and earth works, fauna of conservation importance such as Red Data and protected species may be killed, injured or damaged. Construction activities occurring within a close proximity to natural habitat can lead to increased pressure on natural resources through illegal hunting/poaching/trapping of wildlife for various uses such as food/medicinal purposes. This is particularly relevant to areas where protected/Red data species may occur and remote areas that have not been impacted to a high degree by local communities.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Medium term (3)	Short term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (27)**	**Low (10)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	This impact can be effectively mitigated at the site through appropriate management practices to limit and restrict disturbing construction activities where possible.	

Mitigation:

Most wildlife that could utilise the site is likely to move into undisturbed surrounding areas as human presence increases at the site. If managed properly, the extent and probability of this impact occurring can also be reduced quite significantly. This impact can be best managed through practical on-site mitigation measures aimed at reducing the possibility of incidents occurring. These include:

* Education of workers/employees onsite on not to harm wildlife unnecessarily will assist in mitigating this impact. Contractor induction and construction staff/labour environmental awareness training needs are to be identified and implemented through staff/contractor environmental induction training. This should include basic environmental training based on the requirements of the EMPr, including training on avoiding and conserving local wildlife. A copy of the EMPr is to be made available on site at all times.
* Manage the extent of disturbance by supervising construction to ensure these are limited to the designated construction zone only.
* No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way or removed from the construction site or surrounding areas. This includes animals perceived to be vermin (such as snakes, rats, mice, etc.). Construction workers are to be informed of this requirement.

- Any fauna/animal found on the construction site may not under any circumstance be hunted, snared, captured, injured, killed, and harmed in any way. Such animals must rather be moved to the closest point of natural or semi-natural vegetation outside the construction zone.
- The handling and relocation of any animal perceived to be dangerous/venomous/poisonous must be undertaken by a suitably trained individual.
- Construct a temporary perimeter fence around the construction site and site camps (where practically possible) to restrict access of wildlife onto the construction site and likewise to restrict workers to the construction site and camp.
- All construction vehicles accessing the site should adhere to a low speed limit (30km/h is recommended) to avoid collisions with susceptible species such as reptiles (snakes and lizards).
- No litter, food or other foreign material should be disposed of on the ground or left around the site or within adjacent natural areas and should be placed in demarcated and fenced rubbish and litter areas that are animal proof.

Residual:

Low: Without mitigation this impact is likely to be limited in terms of extent and intensity as a result of existing human activity in the area, associated with the adjacent industry and grazing livestock and the concomitant reduction in the faunal populations at the site which has already occurred. Where access to natural areas is restricted and onsite staff/workers properly managed, the probability of this impact occurring and the extent of the impact can be reduced significantly and the risk of incurring residual impacts may be considered relatively low as a result.

» Construction phase impact 6: **artificial noise and light disturbance**

Nature: *Artificial noise and light disturbance impacts on local wildlife during construction*

Local wildlife (fauna) generally respond to disturbances caused by human activities according to the magnitude, timing, and duration of the particular disturbance. Human activities can affect an animal's ability to feed, rest, and breed if it is unable to habituate to the disturbance caused (Rodgers & Schwikert, 2003). Construction activities occurring within a close proximity to natural habitats containing fauna (wildlife) can lead to both the physical disturbance of habitats supporting animal life by construction machinery/labourers (already discussed above) as well as the disturbance of fauna due to noise and light pollution at the site during the construction process. Locally common species already occurring in the surrounding area are likely to be less sensitive to noise disturbance (due to the proximity of existing human development) and can probably become habituated at the site. Impacts are likely to be relatively short-lived over the course of the construction process and affecting only a few areas of natural habitat

<table>
<tr><td colspan="3">where sensitive species may occur and will probably mainly affect local bird species that can quite easily migrate to other similar habitat in the area.</td></tr>
<tr><td></td><td>Without Mitigation</td><td>With Mitigation</td></tr>
<tr><td>Extent</td><td>Local (2)</td><td>Local (2)</td></tr>
<tr><td>Duration</td><td>Short term (2)</td><td>Short term (2)</td></tr>
<tr><td>Magnitude</td><td>Low (4)</td><td>Minor (2)</td></tr>
<tr><td>Probability</td><td>Probable (3)</td><td>Probable (3)</td></tr>
<tr><td>Significance</td><td>Low (24)</td><td>Low (18)</td></tr>
<tr><td>Status</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Reversibility</td><td>Reversible</td><td>Reversible</td></tr>
<tr><td>Irreplaceable loss of resources?</td><td>Unlikely</td><td>Unlikely</td></tr>
<tr><td>Can impacts be mitigated?</td><td colspan="2">Noise pollution and disturbance of local wildlife will be inherently difficult to mitigate altogether, but the intensity and extent of the resultant disturbance can be managed to a degree.</td></tr>
<tr><td colspan="3">Mitigation:
If managed properly, the extent and probability of this impact occurring can be potentially reduced. The following mitigation measures apply:
* Manage the extent of disturbance by supervising vegetation clearing ad construction activities to ensure these are limited to the designated construction zone only.
* Ensure that construction workers accessing the site conduct themselves in an acceptable manner while on site, both during work hours and after hours.
* Temporary noise pollution from construction activities should be minimized by ensuring the proper maintenance of construction equipment and vehicles, and tuning of engines and mufflers as well as employing low noise equipment where possible.
* No activities should be permitted at the site after dark (between sunset and sunrise), except for security personnel guarding the construction site.</td></tr>
<tr><td colspan="3">Residual:
Low: Residual impacts are unlikely to persist to a large extent as wildlife disturbed during initial clearing and construction are likely to readily migrate to other remaining habitat in the area outside of the impacted zone.</td></tr>
</table>

4.1.3 Operation phase ecological impacts

Ecological impacts associated with the operation of the power plant are likely to be associated mainly with operation of the power plant (over an expected 25-40 year period). This includes vehicles and staff accessing the site during working times, the handling and storage of fuel for power plant operation, maintenance of turbines and substation

(involving oil and grease products), and disposal of any contaminants/waste generated at the site during operation and maintenance.

Impacts likely to be associated with the operational phase are described and assessed below:

» Operation phase impact 1: **Increased spread or introduction of declared weeds and Invasive Alien Plants**

Nature: *Increased spread or introduction of declared weeds and Invasive Alien Plants post-construction*

Although this impact is generally initiated during the construction phase, it is typically an operational issue as recovery of natural vegetation communities following disturbance can be a lengthy process. In many cases, the disturbance of soils and clearing of vegetation within natural areas (and adjacent habitats) prior to and during construction can create an ideal opportunity and optimal conditions for weeds and Invasive Alien Plants (IAPs) to invade disturbed areas. IAPs can have far reaching detrimental effects on native biota and has been widely accepted as being a leading cause of biodiversity loss. They typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil chemistry and stability, promote erosion, change litter accumulation, reduce food supply for fauna and soil properties and promote of suppress fire. Failure to manage stripping of vegetation, topsoil and rehabilitation can lead to serious IAP infestation which compromises the quality of habitat provided by the naturally occurring vegetation community. Clearing and disturbance can also result in an increase in 'edge habitat' immediately adjacent to disturbed areas. Edge habitat is characterized by a predominance of generalist and alien species that are usually highly competitive species which can invade areas of established vegetation, resulting in a loss of sedentary species of mature habitats which are normally considered sensitive. Edge habitat effects will be typically lower for grasslands when compared with wooded communities such as forests and woodland. The spread of existing alien plants within natural areas can be exacerbated if not properly managed, and new alien plant species may be introduced to natural areas as a result of human disturbance.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Medium term (3)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (3)
Significance	**Medium (30)**	**Low (18)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely

Can impacts be mitigated?	The impacts of alien plant within disturbed adjacent areas can be effectively mitigated through the implementation of appropriate alien plant management programme with proper follow-up treatment/control operations.

Mitigation:

Mitigation would be best achieved through the development and implementation of an Invasive Alien Plant (IAP) Control and Eradication Programme for the site. This will need to be implemented as per the ***Invasive Alien Plant Eradication and Control Programme*** in Section 4.4.3 for areas adjacent to or surrounding the development that may be disturbed during construction and where invasive alien plants (IAPs) and other undesirable plant species (weeds for example) colonise these sites. IAP control is likely to be required for the duration of the operation of the project until the site has been decommissioned and adequately rehabilitated.

Residual:

Negligible: If not monitored and properly controlled on a regular basis, the scale and magnitude of infestation of invasive alien plants and weeds is likely to increase rapidly and may persist for the entire lifecycle of the project. Areas likely to be affected will be minimal due to plans to develop the broader IDZ Phase 1F site, hence residual impacts are likely to be negligible in the long-term.

» Operation phase impact 2: **soil erosion and sedimentation**

Nature: *Soil erosion and sedimentation linked to storm water runoff from the operating power plant facility*

During operation, poorly managed storm water runoff from the developed site (runoff from impermeable surfaces created such as roads, buildings, rooftops, etc.) could cause erosion, with the loss of topsoil and sedimentation of adjacent areas being the most critical negative ecological consequences. The negative ecological effects of erosion and sedimentation are discussed above under pre-construction impacts.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Long term (4)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (14)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	Soil erosion and sedimentation linked to storm water runoff from the site can be mitigated through appropriate	

	best-practice storm water and erosion control/management practices.

Mitigation:

If managed properly, the probability, intensity and extent of this impact can be reduced quite significantly and would be best achieved through the onsite implementation of an Operational Storm Water Management Plan designed to attenuate and control the volume and velocity of storm water runoff generated from hardened surfaces associated with the operational power plant facility. The following should be considered when developing this plan:

* Manage surface runoff from hardened surfaces without causing increased peak discharge, soil saturation in non-wetland areas and erosion and sedimentation.
* The site should be well graded to permit water to readily drain away and to prevent ponding of water anywhere on the surface of the ground.
* Overland flow routes and erosion and sediment trapping control measures should cater for large rainfall events given the high summer rainfall in this region.
* An appropriate SUDS (Sustainable Urban Drainage System) should be implemented, characterized by a combination of open, grass-lined channels/swales and stone-filled infiltration ditches that will encourage infiltration across the site, provide for the filtration and removal of pollutants and provide for some degree of flow attenuation by reducing the energy and velocity of storm water flows.
* It is suggested that semi-pervious materials be used for roads that allow for some infiltration rather than using totally impermeable tarred road surfaces, as this will assist with reducing storm water runoff.
* The provision of swales/mini ponds adjacent to roads is recommended to provide additional attenuation capacity where necessary.
* All storm water detention and attenuation structures must be located within the development footprint.
* A "first flush" treatment system should be considered in the storm water design to ensure that the initial flux of polluted surface runoff is contained, tested and treated before being discharged to the environment.
* Storm water outlets should be designed in the form of multiple smaller storm water outlets rather than a few large outlets in order spread out surface flow and avoid flow concentration as far as possible.
* Development design can also promote the conservation and efficient utilisation of water, implement rainwater harvesting measures, the recycling / re-use through grey water systems and using water efficient fittings. Rainwater harvesting and storage should be promoted on-site by installing appropriate systems to collect rainwater from roofs/gutters, etc. in closed-top tanks or landscaped features for irrigation and non-potable purposes.
* Storm water management systems should be designed with longevity in mind and should require little maintenance by catering for silting.

Residual:

Low: Without mitigation this impact can be considered quite severe due to the sandy/erodible nature soils at the site. Although impacts would be localized, erosion is likely to persist or worsen over time if not addressed properly and regularly through an appropriate monitoring protocol for the site. Rapid and effective rehabilitation and re-vegetation of exposed soils will be important for reducing erosion risk in adjacent areas linked with storm water runoff from the developed site.

» Operation phase impact 3: **pollution of soils and habitat**

Nature: *Pollution of soils and habitat during operation of the power plant facility*

Fuels and oils/grease stored and handled at the proposed gas powered power plant during operation and maintenance, including any liquid and solid waste produced, could enter adjacent environments if not managed adequately and could lead to pollution of the adjacent habitat, flora and fauna. The same applies to any flammable and/or hazardous substances such as fuels that will be stored and used at the site for the necessary operation of the facility. *Potential negative ecological consequences of hazardous substances on ecosystems and biodiversity have been discussed under construction phase impacts.*

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (22)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	Potentially hazardous pollutant/waste streams can be effectively managed onsite through best practice pollution control measures that will be able to effectively mitigate potential impacts to natural resources.	

Mitigation:

If managed properly, the probability and extent of this impact can be reduced quite significantly. This impact can be best managed through practical on-site mitigation measures aimed at reducing the possibility of incidents through waste and pollution control measures as well as developing contingency measures to deal with any significant pollution events should these arise. These include:

* All employees handling fuels and other hazardous materials at the operational facility are to be properly trained in their safe use, environmental restrictions and methods for proper disposal.

- Ensure that all workers on site are aware of the proper procedure in case of a fire occurring on site.
- Ensure adequate fire-fighting equipment is available and train staff/workers on how to use it.
- The proper storage and handling of hazardous substances (e.g. fuel, oil, grease, etc.) needs to be administered.
- Any materials liable to spillage are to be stored in appropriate containment structures such as bunded areas capable of containing at least 110% of any stored volume.
- Drip trays should be utilised at any necessary fuel dispensing areas.
- An emergency spill response procedure must be formulated and staff is to be trained in spill response. All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spillages of fuels, oils and other potentially harmful chemicals should be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and rehabilitated timeously and appropriately.
- Contaminated water containing fuel, oil, grease or other hazardous substances must never be released into the adjacent environment. It must be disposed of at a registered hazardous landfill site.
- Provide adequate rubbish bins and waste disposal facilities on-site and educate/encourage staff not to litter or dispose of solid waste in the adjacent natural environment but to use available facilities for waste disposal.
- No litter, refuse, waste products, rubbish, rubble, debris, etc. must be placed, dumped or deposited on adjacent/surrounding properties.
- Recycling/re-use of waste is to be encouraged at the site where possible.
- No refuse/waste is burnt or buried on the site or on surrounding premises.

Residual:

Low: Without mitigation this impact can be considered quite severe where operational activities and waste generated are not managed properly at the site. Although impacts would probably be highly localized, pollution of soils and water by environmental contaminants such as wastes and hazardous products stored/handled at the site can persist in the environment for some time and the residual impact of environmental pollution can be difficult to rectify. With proper mitigation, the risk of incurring residual impacts can be lowered significantly.

» Operation phase impact 4**: direct impacts to fauna**

Nature: *Direct impacts to fauna (wildlife) by staff accessing the operational power plant facility*

Wherever there are human activities occurring within a close proximity to natural habitat, this can lead to increased pressure on natural resources through illegal

hunting/poaching/trapping of wildlife by staff/workers accessing the power plant facility. This is likely to remain a risk as long as humans occupy the site but is likely to be less significant due to the existing close proximity of industrial activities and livestock grazing which has likely depleted the faunal communities occurring in the surrounding areas.

	Without Mitigation	With Mitigation
Extent	Local (2)	Site only (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (30)**	**Low (14)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	This impact can be effectively mitigated at the site through appropriate management practices to limit and restrict disturbing construction activities where possible.	

Mitigation:

Wildlife are probably unlikely to utilise the site (apart from vermin) and would be contained within adjacent natural areas. If managed properly, the extent and probability of this impact occurring can also reduced significantly. This impact can be best managed through practical on-site mitigation measures aimed at reducing the possibility of incidents occurring. These include:

* Education of staff/employees accessing and working on the property on not to harm wildlife unnecessarily will assist in mitigating this impact.
* Any fauna/animal found on the power plant site may not under any circumstance be hunted, snared, captured, injured, killed, and harmed in any way. This includes animals perceived to be vermin (such as snakes, rats, mice, etc.). Such animals must rather be moved to the closest point of natural or semi-natural vegetation outside the facility. Employees/workers are to be informed of this requirement.
* The handling and relocation of any animal perceived to be dangerous/venomous/poisonous must be undertaken by a suitably trained individual.
* Construct a suitable perimeter fence around the power plant facility to restrict access of wildlife onto the site and likewise to restrict/control access of staff to adjacent natural areas.
* No open fires to be permitted on the site and in surrounding areas.

Residual:

Low: Without mitigation this impact can be potentially high but is likely to be limited in terms of extent and intensity as a result of existing human activity in the area, associated with the adjacent industry and grazing livestock and the concomitant reduction in the faunal populations at the site which has already occurred. Where access

to adjacent natural areas is restricted and onsite staff/workers properly managed, the probability of this impact occurring and the extent of the impact can be reduced significantly and the risk of incurring residual impacts may be considered relatively low as a result.

» Operation phase impact 5: **artificial noise and light disturbance**

Nature: *Artificial noise and light disturbance impacts on local wildlife during site operation*

Longer term noise and light pollution impacts are likely to persist during the operational life-span of the power plant facility but is unlikely to create significant ecological impacts due to the proximity of existing human disturbance/industrial activity in the area. *Potential negative ecological consequences on ecosystems and biodiversity linked to noise and light pollution have been discussed under construction phase impacts*.

	Without Mitigation	With Mitigation
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (24)**
Status	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Unlikely	Unlikely
Can impacts be mitigated?	Noise pollution and disturbance of local wildlife will be inherently difficult to mitigate altogether, but the intensity and extent of the resultant disturbance can be managed to a degree.	

Mitigation:

During operation, noise reduction could be implemented but may be difficult given the nature of the operational activities associated with the proposed power plant development.

* Due to the low potential significance of this impact, where noise and light reduction measures can be implemented, this should be done but is not considered critical. Explore the possibility of using low-intensity noise and lighting where possible (this is however unlikely to assist with reducing this impact due to the future large-scale development of the broader Phase IDZ 1F site).
* Education of employees/workers accessing the site on how to conduct themselves in an acceptable manner while on site, both during work hours and after hours.

Residual:

Negligible: Whilst operational activities will continue to create noise and artificial light disturbance throughout the life-span of the project (until closure and rehabilitation of the site has been successfully completed), residual impacts are unlikely to persist to a large extent as wildlife disturbed are likely to readily migrate to other remaining habitat in the area outside of the impacted zone.

4.1.4 Decommissioning phase ecological impacts

It is anticipated that the power plant project and facility will have a life-span of 25-40 years. Under the Department of Energy (DoE) IPP Programme, projects are provided with a 20-25 year Power Purchase Agreement (PPA). There are currently no guidelines provided by the DoE as to whether these contracts will be renewed after this term in the future. During the initial term of the PPA with the DoE, the technology selected will remain in place for the duration of the initial contract period. Technology continually advances in both efficiency and reduction in emissions from energy producing facilities, however, and if an extension to the initial contract is provided by the DoE, then the developer will undertake an assessment of the plant facilities and the latest technology available at such a point in time, and this contract period may be extended subject to the DoE requirements at the time and the findings of the assessment. This may mean that the facility will need to be decommissioned to provide for new energy producing technology or an alternative land-use may be decided for the site once the initial contract is lapsed and the life-span of the plant has been expended. Ecological impacts during decommissioning of the power plant are likely to be associated with disassembly of production units and associated infrastructure and demolishing of buildings and stacks. This is likely to involve heavy machinery and labour accessing the site and the range of equipment and the handling and disposal of potentially hazardous substances used during the decommissioning process as well as any waste products generated. Further impacts to vegetation and wildlife are unlikely given that the plans for the broader IDZ Phase 1F area will be to develop the site completely in the future, with no remaining natural grassland habitat to remain within areas surrounding the power plant site.

Preliminary impacts likely to be associated with the project decommissioning phase (when and if this occurs in the future) have been described and assessed below. *Note that the potential for rehabilitation of the site back to its former state is regarded as non-feasible at this time (given the large-scale loss of vegetation and habitat envisaged for the broader IDZ Phase 1F site), but this is not to say that rehabilitation back to grassland will not present itself as a future opportunity at the site. This will however need to be assessed in terms of viability/feasibility given the constraints and opportunities operating at the site in the future at such a time when decommissioning is considered.*

» Decommissioning phase impact1: **soil erosion and sedimentation**

Nature: *Soil erosion and sedimentation*

Where any bare/exposed soils are left unvegetated once the project has been decommissioned, these are inherently vulnerable to erosion and can result in excessive removal/loss of topsoil and the resultant sedimentation of downslope/adjacent habitats.

	Without Mitigation	With Mitigation
Extent	Local (2)	Site only (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Low (24)**	**Low (14)**
Status	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Unlikely	Unlikely
Can impacts be mitigated?	Soil erosion and sedimentation linked to decommissioning activities can be mitigated through appropriate best-practice erosion control/management practices.	

Mitigation:

If managed properly, the probability, intensity and extent of this impact can be reduced quite significantly and would be best achieved through the onsite implementation of practical 'best practice environmental management' measures designed to control storm water runoff volumes/velocities, erosion and resultant sedimentation during decommissioning activities. These include:

* If heavy rains are expected, decommissioning activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
* Dewater any trenches/excavations in a manner that does not cause erosion and does not result in silt-laden water flowing downslope. Water must be pumped out into a well-vegetated area to facilitate sediment trapping.
* Run-off generated from hardened surfaces must be controlled using suitable erosion control measures (e.g. sand bags, earthen berms, etc.) whilst the facility is being decommissioned. Sediment barriers (e.g. silt fences, sandbags, hay bales, earthen filter berms or retaining walls) must be established to counter erosion and sedimentation where necessary.
* Sediment barriers should be regularly maintained and cleared so as to ensure effective drainage.
* All temporary soil berms, sandbags and silt fences must only be removed once the site has been closed and rehabilitated successfully.
* Disturbed surfaces are to be re-vegetated as soon as practically possible to prevent erosion of bare/exposed soils. Rehabilitation and re-vegetation of natural areas disturbed outside of the development area is to be undertaken as soon as practically possible, *as per the relevant rehabilitation guidelines contained in Section 4.4.4.*

Residual:

Low/negligible: Without mitigation this impact can be considered relatively significant due to the sandy/erodible nature soils at the site. Although impacts would be highly localized, erosion is likely to persist or worsen over time if not addressed properly and regularly through an appropriate monitoring protocol for the site. Rapid and effective rehabilitation and re-vegetation of exposed soils will be important for reducing erosion risk and can essentially eliminate residual impacts related to erosion/sedimentation.

» Decommissioning phase impact 2**: pollution of soils and habitat**

Nature: *Pollution of soils and habitat during decommissioning of the power plant facility*

During decommissioning, residual waste products generated or materials/substances involved in decommissioning could enter the adjacent environment, leading to pollution of habitats, soils and vegetation. Any products illegally disposed of into the environment will also likely cause harm to the natural environment and its components.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (14)**
Status	Negative	Negative
Reversibility	Recoverable	Reversible
Irreplaceable loss of resources?	Possible	Unlikely
Can impacts be mitigated?	Potentially hazardous pollutant/waste streams can be effectively managed onsite through best practice pollution control measures that will be able to effectively mitigate potential impacts to natural resources.	

Mitigation:

If managed properly, the probability and extent of this impact can be reduced quite significantly. This impact can be best managed through practical on-site mitigation measures aimed at reducing the possibility of incidents through waste and pollution control measures as well as developing contingency measures to deal with any significant pollution events should these arise. These include:

* All employees handling fuels and any other hazardous materials are to be properly trained in their safe use, environmental restrictions and methods for proper disposal.
* Ensure that all workers on site are aware of the proper procedure in case of a fire occurring on site.
* Ensure adequate fire-fighting equipment is available and train workers on how to use it.

* Materials/liquids liable to spillage are to be stored in appropriate containment structures (e.g. drip-trays).
* An emergency spill response procedure must be formulated and staff is to be trained in spill response. All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spillages of fuels, oils and other potentially harmful chemicals should be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and rehabilitated timeously and appropriately.
* Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
* Sanitation – portable toilets (1 toilet per 10 users is the norm) to be provided where construction is occurring and away from watercourses such as rivers and wetlands. Workers need to be encouraged to use these facilities and not the natural environment.
* Provide adequate rubbish bins and waste disposal facilities on-site and educate/encourage workers not to litter or dispose of solid waste in the natural environment but to use available facilities for waste disposal.
* Clear and completely remove from site all general waste, plant, equipment, surplus rock and other foreign materials.
* No litter, refuse, wastes, rubbish, rubble, debris and builders waste must be placed, dumped or deposited on adjacent/surrounding properties during or after the construction period.
* Recycling/re-use of waste is to be encouraged.
* Ensure that no refuse/waste is burnt or buried on the site or on surrounding premises.

Residual:

Low: Without mitigation this impact can be considered significant where activities are not managed properly at the site. Although impacts would be localized, pollution of soils and water by environmental contaminants such as wastes and hazardous products can persist in the environment for some time and can be difficult to rectify. With proper mitigation, the risk of incurring residual impacts can be lowered significantly.

4.2 Cumulative Impacts to Terrestrial Ecosystems and Biodiversity

Concerns are often raised in the environmental impact assessment process regarding long term environmental changes, not only as result of a single action, activity or development project, but the combined effects of many actions over time. 'Cumulative impacts' or 'Cumulative effects' are commonly understood as the impacts operating over different temporal and spatial scales which combine from different projects or activities which result in significant change, which often exceeds the simple sum of all the individual impacts (DEAT, 2004). Cumulative effects generally occur under three typical scenarios:

1. When impacts on the environment take place so frequently that the effects of individual impacts cannot be assimilated by the environment;
2. When impacts occur so densely spatially that the effects of individual impacts cannot be assimilated by the environment; and
3. When the impacts of one activity/project combine synergistically with those of another.

Each individual development, when assessed in isolation, may produce impacts that are socially acceptable or insignificant, however, when the effects of the numerous single developments are considered in combination, these impacts may become 'cumulatively significant'. In recent years there has been a growing realisation that the process of evaluating the negative environmental impacts of individual developments, which may be unobjectionable in themselves, do not adequately take into account the cumulative nature of individual impacts. The complicating factor is that the projects then need to be considered from the perspective of past, present and reasonably foreseeable future development. Put another way then, cumulative effects are "*…changes to the environment that are caused by an action in combination with other past, present and future human actions*" (DEAT, 2004). The assessment of cumulative impacts therefore requires a holistic view, interpretation and analysis of the biophysical, social and economic systems and is limited and constrained by the current methods used for identifying and analysing cumulative effects.

The following principles were used in describing and assessing cumulative impacts of the proposed development (after DEAT, 2004):

» *Cumulative effects/impacts are caused by the aggregate of past, present, and reasonably foreseeable future actions;*
» *Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who has taken the action;*
» *It is not practical to analyse the cumulative effects of an action on every environmental receptor, the list of environmental effects must focus on those that are truly meaningful;*
» *Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries;*
» *Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects (repeated actions may cause effects to build up);*
» *Cumulative effects may last for years beyond the life of the action that caused the effects;*
» *Cumulative impacts can be characterised according to impact pathways (one pathway could be the persistent additions from one process and yet another pathway could be the compounding effect from one or more processes);*
» *Cumulative impacts can also occur when thresholds are passed or when interaction is antagonistic; and*

» *Each affected resource, ecosystem, and human community must be analysed in terms of its capacity to accommodate additional effects, based on its own time and space parameters.*

In assessing cumulative impacts of the development, past, present and future development scenarios and impact pathways need to be accounted for or anticipated and the interaction between these assessed where possible. An attempt has been made to account for past, present and future impacts and pressures on the terrestrial ecosystems and biodiversity occurring at the site and immediate surrounding intact habitats as follows:

» **Past ecological impacts and effects**

According to the Biodiversity Study of Alton North Richards Bay undertaken in 2005 by O'Connor and Associates, the site has experienced past environmental perturbations that are judged to have had 'an enormous influence on its biodiversity and ecological functioning'.

- » The first is associated with the planting of historic *Pinus and Eucalyptus sp*. tree plantations (Google Earth™ imagery shows the area under plantation forestry between 2004–2012). In addition to the direct loss of indigenous vegetation through land transformation, the introduction of evergreen species into seasonal vegetation results in a concomitant increase in transpirational losses and leaves the area susceptible to alien and weed invasion.
- » A second impact has been the canalisation of water flow in the area, with a consequent effect being the lowering of the water table within the pre-existing dryland component of the environment.
- » Based on the history of ecological disturbance at the site (O'Connor and Associates, 2005) remaining open grassland habitat is largely degraded and secondary in nature, with signs of earthworks, vehicle/human tracks, tarred roads (former airfield) and general soil disturbance associated with historic plantation forestry.

» **Present ecological impacts and pressures**

The proposed development site is currently located in the Alton North Area, south of the North Central Arterial and bordering on the Tata Steel factory to the south, with the eastern edge being industry linked with Alumina Alley. The site is comprised of vacant municipal owned land bordered by mixed-use of industrial developments as well as residential areas and open space areas. The broader area is characterised by intense past land-use modifications from agriculture, mining, tourism, residential, recreational and industrial development activities. Impacts associated with current land use and activities at the site and surrounds include:

- » grassland habitat degradation through over-grazing by livestock;
- » habitat fragmentation as a result of industrial development (i.e. Tata steel factory and other industrial activities and warehousing);

- the effect of the artificial canal in the west on the local water table level (draw-down effects);
- noise and visual disturbance due to industrial activities and the effect of this on local wildlife; and
- alien invasive plant and weed proliferation and increased source of regenerative/seed material for undesirable plant species as a consequence of disturbance.

» **Future ecological impacts/development pressures**

Future ecological impacts beyond the individual impacts likely to be associated with the proposed Gas Power Plant Development will be centred around the large-scale and complete development of the RBIDZ Phase 1F project area for various industrial developments. This is shown spatially in Figure 13 (below) which shows the RBIDZ Phase 1F area and planned industrial development (factories, warehouses and access road infrastructure) in relation to the existing factories and warehouses to the south and east. Impacts associated with these development/activities will probably be similar to those of the Power Plant development, involving:

- The destruction of natural habitat (grasslands, woodland and wetlands);
- Loss of habitat and species of flora/fauna (including protected/threatened species);
- Habitat fragmentation;
- Proliferation of alien plants post-disturbance for areas to be conserved/retained;
- Soil erosion related to increased runoff from hardened surfaces;
- Increase in noise and light pollution; and
- Potential for soil, water and vegetation pollution.

Only very minimal areas will be set aside to be conserved (shaded 'dark green' in Figure 13, below) to the north-west and south-east of Tata steel.

Figure 13 Map showing RBIDZ Phase 1F land allocation for industrial development (Source: Savannah Environmental, 2016).

Cumulative impacts identified for the development project have been described and assessed in terms of cumulative impact significance (with and without the proposed Power Plant development project) below:

» Cumulative Impact 1: ***Cumulative impact on ecosystem conservation targets***

Nature: *Cumulative impact on ecosystem conservation targets*

Maputaland Wooded Grassland (CB2) is provincially listed as ***Endangered*** in terms of its threat status and is currently moderately protected. A 25% conservation target has been set for this vegetation type that is not currently met by existing statutory protected areas in the Province (17% protected) and with statistics suggesting that only 36% of this vegetation type remains in KZN (based on KZN Vegetation Targets & Statistics December 2014, obtained from Ezemvelo KZN Wildlife/EKZNW). This suggests that further loss of this grassland type could contribute in a reduction in the ability to meet conservation targets set provincially for this vegetation type.

Given the small extent of the development site (<8ha) and the degraded/secondary nature of much of the grassland vegetation community within the proposed development footprint, with only small portions of fairly intact and moderately sensitive/importance natural grassland, the site in itself is unlikely to contribute

significantly to meeting ecosystem conservation targets for the region. However, given that plans for the broader IDZ Phase 1F area include the large-scale and almost complete development of the broader project area for various industrial developments (see development plan in Figure 13), the cumulative impact in terms of total vegetation/habitat loss is therefore likely to contribute to the loss of vegetation/habitat required to meet conservation targets for the Maputaland Wooded Grassland vegetation type, and it is recommended that the need and desirability for a biodiversity offset be considered for the broader RBIDZ Phase 1F as a means of mitigating against this impact. This would require identifying, securing and rehabilitating where necessary, a similar vegetation/habitat type in the region for the purposes of compensating for the irreplaceable loss of vegetation and habitat at the IDZ Phase 1F site (*refer to Section 5.4.5 for further details on offsets).*

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Site only (1)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**Medium(55)**	**High (65)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Loss of resources?	Yes	Yes
Can impacts be mitigated?	The impact of irreplaceable loss of an Endangered vegetation type and associated habitat will be difficult to mitigate onsite and the need and desirability for a biodiversity offset to compensate for the loss of vegetation/habitat should be investigated further.	

Confidence in findings:
Moderate.

Mitigation:
Mitigating the cumulative impact involving the loss of an endangered grassland vegetation type will be inherently difficult to achieve. It is recommended that the need and desirability for a biodiversity offset be investigated further as a means of compensating for the cumulative and irreplaceable loss of Maputaland Wooded Grassland vegetation and habitat associated with the broader RBIDZ Phase 1F development. *This is discussed further under Section 5.4.5.*

» Cumulative Impact 2: ***Cumulative impact on ecological functioning and ecosystem services supply***

Nature: *Cumulative impact on ecological functioning and ecosystem services supply*

Grassland ecosystems provide a range of important ecosystem goods and services to society. They typically support a rich diversity of grasses, wild flowers, invertebrates, reptiles, birds and other animals. Other services provided by these ecosystems include their role in reducing runoff and attenuating downstream flooding, assisting with binding topsoil and controlling erosion as well as their role in storing carbon, especially in the topsoil. Benefits to local communities may include medicinal plants, grazing material for livestock and thatching grass.

Disturbance can affect processes and structure within an ecosystem or the outside forcing functions driving the ecosystem. Whether a disturbance causes a loss of ecosystem function depends on the degree of redundancy in the ecosystem to buffer ecosystem function from disturbance (US EPA, 1992). Potential loss of ecological goods and services currently supplied by the grassland (in terms of habitat, harvestable goods and grazing land mainly) are likely to be limited due to the degraded/secondary nature of much of the site and the degree of habitat fragmentation. The functioning and services supplied by the broader wooded grassland community on the RBIDZ Phase 1F site will be permanently lost as a result of the broader industrial development at the site, of which the proposed has powered power plant will make a somewhat meaningful contribution when considered cumulatively. Whilst some remaining area on the site will be set aside for conservation (see Figure 13), these areas are likely to be small and insignificant in terms of their potential functioning within a to-be highly developed and fragmented landscape (isolated patches that are unlikely to function well ecologically). The overall net loss of ecosystem goods and services is likely to be somewhat significant and will only be able to be mitigated through a compensatory mechanism such as a biodiversity offset (*refer to Section 5.4.5 for further details on offsets).*

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Loss of resources?	Highly likely	Highly likely
Can impacts be mitigated?	The impact of irreplaceable loss of vegetation and associated habitat and the ecosystem goods and services provided will be difficult to mitigate onsite and the need and desirability for a biodiversity offset to compensate for the loss of ecosystem functioning should be investigated in this respect.	
Confidence in findings:		

Moderate.
Mitigation: Mitigating the cumulative impact involving the loss of an endangered grassland habitat and associated ecosystem functioning and services will be inherently difficult to achieve. It is recommended that the need and desirability for a biodiversity offset be investigated further as a means of compensating for the cumulative loss of grassland habitat, ecosystem functioning and goods/services provision associated with the broader RBIDZ Phase 1F development. *This is discussed further under Section 5.4.5.*

» Cumulative Impact 3: ***Cumulative impact to species of conservation concern***

Nature: *Cumulative impact to species of conservation concern*

Activities involving the clearing/harvesting of natural vegetation could result in the destruction or loss of plants and animal species of conservation significance. This of course depends on whether these species are present at a site or not and on the threat status of individual species. If a subpopulation of a species of conservation concern is found to occur on a proposed development site, it would be one indicator that development activities are likely to result in the loss of biodiversity, bearing in mind that loss of subpopulations of these species will either increase their extinction risk or may in fact contribute to their extinction risk.

The presence of numerous individual *Crinum delagoense* plants within the grassland ecosystem at the development site is likely to negatively affect the local population of this provincially-protected species which is classified as "Declining". Despite the widespread distribution of this species, some population decline is likely due to harvesting of plants for medicinal purposes and loss of available grassland habitat (SANBI). However, it can still be seen in a number of localities, and current levels of decline are unlikely to exceed 10% of the population (SANBI). Other KZN specially protected plants include *Ledebouria ovatifolia,* a South African Endemic which occurs within the grasslands at the site. Within the broader RBIDZ Phase 1F area, there are likely to be these and potentially other threatened/protected /endemic species that could be lost to development. Additional protected plants species/plants of conservation concern that have been previously recorded at the IDZ Phase 1F site (NEMAI Consulting, 2015a) include: *Boophone disticha, Hypoxis hemerocallidea* and *Eulophia speciosa* (all three plants listed by SANBI as 'Declining' in terms of threat status).

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Site only (1)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (56)**	**High (64)**
Status	Negative	Negative
Reversibility	Reversible	Reversible
Loss of resources?	Likely	Likely
Can impacts be mitigated?	Loss of protected/threatened plant species can be mitigated by translocating these plants to suitable adjacent grassland habitat, reducing the impact on the local population of this species to a low significance level.	
Confidence in findings: Moderate.		
Mitigation:		

Mitigating this impact will be possible and if managed properly, the extent and probability of this impact occurring can be reduced. This impact can be best mitigated by translocating these plants to suitable adjacent grassland habitat outside of development zones, reducing the impact on the local population of this species to a low significance level. Through education of workers/employees onsite on not to disturb/harvest plant species (apart from rescue and relocation activities), the likelihood of this impact occurring could also be reduced.

4.3 Impact Assessment Summary

Table 19 (below) provides a brief summary of the impact significance assessment undertaken for each project phase. Notably, most direct and indirect (negative) ecological impacts associated with the various development project phases can be reduced from Moderate to acceptably Low impact significance levels through the implementation of practical onsite impact mitigation measures, with the exception of the transformation of wooded grassland vegetation and habitat at the site during vegetation clearing/stripping and construction, which will be a permanent and irreversible impact that will be difficult to mitigate. The magnitude of the impact of vegetation removal/clearing at the site can be mitigated by translocating sensitive/protected plant species prior to clearing, effectively reducing impact significance from a High to a Moderate level for this particular impact.

Cumulative impacts of the project, in terms of the combined effect of the IDZ Phase 1F development area (all future land use changes and industrial developments considered), are likely to be relatively high, and remaining Moderately-High to High even when considering cumulative impact without the planned gas power plant development. Whilst the cumulative loss of threatened/protected species can be effectively managed by relocating species to suitable conservation sites outside of the developable area, the permanent and irreversible loss of vegetation and habitat will be difficult to mitigate, and the consequences in terms of meeting targets set for Maputaland Wooded Grassland (Endangered vegetation type) as well as the resultant loss of ecosystem functioning, goods and services will be unavoidable. In order to compensate for the loss of habitat and ecosystem functioning/services supply, an investigation into the need and desirability for biodiversity offsets are recommended for the broader IDZ Phase 1F development project (*refer to Section 4.4.5 for further details on offsets*).

Table 19. Summary of ecological impact significance assessment.

1 Pre-Construction/Initial Planning Phase Ecological Impacts		
Impact	**Impact Significance Without Mitigation**	**Impact Significance With Mitigation**
Impact 1: Destruction/damaging of indigenous vegetation	Medium (30)	Low (18)
Impact 2: Direct impacts to fauna (wildlife)	Low (24)	Low (5)
Impact 3: Artificial noise disturbance	Low (24)	Low (15)

2 Construction Phase Ecological Impacts		
Impact	**Impact Significance Without Mitigation**	**Impact Significance With Mitigation**
Impact 1: Destruction/damaging of indigenous vegetation	High (65)	Medium (50)
Impact 2: Loss/degradation and fragmentation of habitat	Medium (50)	Medium (36)
Impact 3: Soil erosion and sedimentation	Medium (32)	Low (21)
Impact 4: Pollution of soils and habitat	Medium (36)	Low (16)
Impact 5: Direct impacts to fauna (wildlife)	Low (27)	Low (10)
Impact 6: Artificial noise and light disturbance	Low (24)	Low (18)

3 Operation Phase Ecological Impacts		
Impact	**Impact Significance Without Mitigation**	**Impact Significance With Mitigation**
Impact 1: Increased spread or introduction of declared weeds and Invasive Alien Plants	Medium (30)	Low (18)
Impact 2: Soil erosion and sedimentation	Medium (40)	Low (14)
Impact 3: Pollution of soils and habitat	Medium (36)	Low (22)
Impact 4: Direct impacts to fauna (wildlife)	Medium (30)	Low (14)
Impact 5: Artificial noise and light disturbance	Low (24)	Low (24)

4 Decommissioning Phase Ecological Impacts		
Impact	**Impact Significance Without Mitigation**	**Impact Significance With Mitigation**
Impact 1: Soil erosion and sedimentation	Low (24)	Low (14)
Impact 2: Pollution of soils and habitat	Medium (36)	Low (14)

5 Cumulative Ecological Impacts		
Cumulative Impact	**Impact Significance With Project**	**Impact Significance Without Project**
1. Cumulative impact on ecosystem conservation targets	Medium (55)	High (65)
2. Cumulative impact on ecological functioning and ecosystem services supply	Medium (48)	Medium (48)
3. Cumulative impact to species of conservation concern	Medium (56)	High (64)

4.4 Impact Mitigation and Management

'Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on biodiversity is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area/environment standing to be affected. The Guideline for Biodiversity Impact Assessment (Ezemvelo KZN Wildlife, 2013) was used to inform the identification of suitable mitigation measures. According to the document, the guiding principle with regards to biodiversity conservation and sustainable development adopted by KZN Wildlife is one of "*no net loss of biodiversity and ecosystem processes".* To achieve this principle, a proactive approach to planning and biodiversity conservation must be adopted to ensure:

» The early identification and evaluation of potential biodiversity impacts that may constitute 'fatal flaws', or significant biodiversity related/management issues;

» The early identification and evaluation of conceptual alternatives which could prevent, avoid or reduce significant impacts on biodiversity, or enhance or secure opportunities for biodiversity conservation; and

» The appropriate design of mitigation through the mitigation hierarchy which should strive first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining residual negative impacts on biodiversity.

The protection of ecosystems and biodiversity generally begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces in situ impacts. Management of impacts should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging (e.g. as a result of sedimentation and pollution). Mitigation requires proactive planning that is enabled by following the '**mitigation hierarchy'** (see Figure 14, below).

The application of the mitigation hierarchy is intended firstly, to strive to avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts. The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology and phasing until the proposed development can best be accommodated without incurring significant negative impacts to the receiving environment. In cases where the receiving environment cannot support the development or where the project will destroy the natural resources on which local communities are wholly dependent for their livelihoods or eradicate unique biodiversity; the development may not be feasible and the developer knows of these risks, and can plan to avoid them, the better. In the case of particularly sensitive ecosystems, where biodiversity impacts can be severe, the guiding principle should generally be "*anticipate and prevent*" rather than "*assess and repair*".

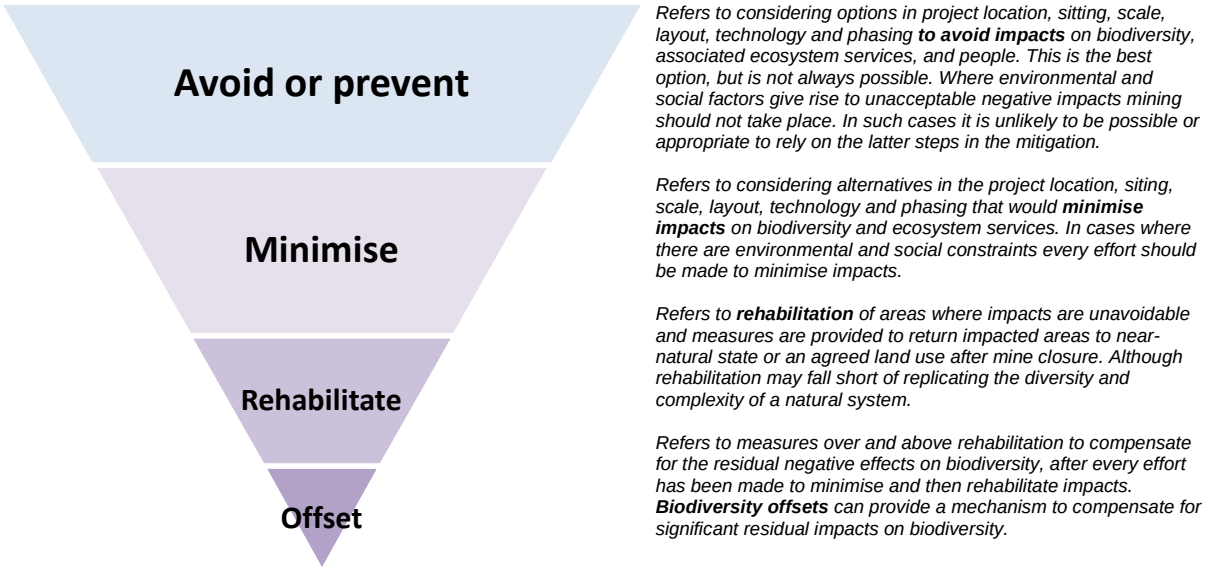

Figure 14 Diagram illustrating the 'mitigation hierarchy' (after DEA et al., 2013).

4.4.1 Impact Management and EMPr

In terms of Section 2 and Section 28 of NEMA (National Environmental Management Act, 1998), the land owner is responsible for any environmental damage, pollution or ecological degradation caused by their activities "inside and outside the boundaries of the area to which such right, permit or permission relates". In dealing with the range of potential ecological impacts to natural ecosystems and biodiversity highlighted in this report, this would be best achieved through **the incorporation of the management and mitigation measures (recommended below) into an Environmental Management Programme (EMPr)** for the development project. The EMPr should be separated for construction and operational phases of the proposed development and should define the responsibilities, budgets and necessary training required for implementing the recommendations made in this report. This will need to include appropriate monitoring as well as impact management and the provision for regular auditing to verify environmental compliance. The EMPr should be enforced and monitored for compliance by a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EO's (Environmental Officers) having the required competency skills and experience to ensure that environmental mitigation measures are being implemented and appropriate action is taken where potentially adverse environmental impacts are highlighted through monitoring and surveillance. The ECO will need to be responsible for conducting regular site-inspections of the construction process and activities and reporting back to the relevant environmental authorities with findings of these investigations. The ECO will also need to be responsible for preparing a monitoring programme to evaluate construction compliance with the conditions of the EMPr.

Specialist ecological impact mitigation measures for inclusion in the EMPr have been included per project phase and impact category (as per Sections 4.1 and 4.2). A plant

rescue/translocation plan, IAP control/eradication plan, rehabilitation guidelines and biodiversity offset recommendations are included below in Sections 4.4.2 - 4.4.5.

Project phase and impact specific EMPr tables have also been included as **Appendix A** of this specialist ecological report.

4.4.2 Plant Rescue, Translocation and Protection Plan

The purpose of the plant rescue, translocation and protection plan is to provide guidelines for the implementation of plant rescue, translocation and protection as a means of mitigating development impacts of the proposed power plant development on protected plants of conservation importance occurring on the site.

Schedule 12 of the (KZN) Nature Conservation Ordinance (No. 15 of 1974) lists Specially Protected Plants that are regulated in terms of activities that can take place with respect to harvesting, selling, importing, trading and handling of these plant species. On application by a landowner wishing to develop his land in such a manner that such development may cause damage or destruction to specially protected indigenous plants, a permit for the relocation of such plants may be granted.

The following species found to occur on the site have been identified as being Specially Protected Plants which will require a permit for removal/relocation should their disturbance be unavoidable:

» ***Crinum delagoense***

» ***Ledebouria ovatifolia***


A plant rescue and translocation operation for these protected plants will need to be undertaken prior to site clearing/construction taking place, according to the following guidelines:

- A suitably qualified botanist or other specialist with extensive experience in terrestrial plant rescue and translocation within the Zululand coastal zone must be appointed prior to any construction/land clearing activities taking place, to undertake plant rescue and relocation for the protected plants listed for the site.
- Prior to plant translocation, a suitable patch of similar natural sandy terrestrial coastal grassland (preferably 1ha or larger) will need to be identified outside of the construction/developed footprint (also bearing in mind future development within the RBIFZ Phase 1F area – these areas are to be excluded from potential relocation sites). Intact habitat is a prerequisite, with limited ecological disruptions to prevent further disturbance of translocated plant populations. In situ conservation is preferable to ex situ conservation. Removing a population from its natural habitat and placing it under artificial conditions results in the erosion of the inherent genetic diversity and characteristics of that species. Sites nearest to the donor grassland site (i.e. the development site) are ideal, as too great a distance could impair genetic variation and potential exchange. Suitable habitat should meet the candidate species' total biotic and abiotic needs through space and time and for all life stages (IUCN, 2012).
- A list of protected plants together with their coordinates is included below (Table 20) for use in relocating individual plants in the field. Refer also to the map showing the location of protected plants in Figure 15, below.
- A plant permit must be obtained from the relevant environmental/conservation authority prior to plant rescue and translocation. In the case of Specially Protected Plants (Schedule 12 of the Natal Conservation Ordinance), the permits office at Ezemvelo KZN Wildlife (EKZNW, formerly the Natal Parks Board) will need to be approached in this regard.
- The appointed specialist must identify, demarcate and translocate protected plants. Each individual plant rescued must be photographed prior to removal, tagged with a unique number of code and the geographical coordinates (latitude/longitude) recorded using a hand-held GPS device.
- The specialist and team appointed to carry out plant rescue and relocation must carefully remove each plant from the loose sandy substrate, including its

underground storage organ (bulb/corn) and/or rooting structure (root ball) by hand or using a small shovel/trowel) and carefully transport plants without causing unnecessary damage/trauma to the rescued plants.

* Rescued plants are likely to be sensitive to removal and transplanting and are therefore to be handled with care and not to be stored outside of their soil/habitat for more than a few hours (remove and transplant plants on the same day). Alternatively, plants can be planted into suitable containers and housed within a temporary nursery.
* Plants removed are to be stored safely and treated according to their specific requirements (to be advised by the botanist/plant translocation specialist appointed to undertake rescue and relocation of plants).
* Relocate/transplant the rescued plants at the target grassland area identified.
* The timing of plant rescue operations and transplanting will be essential and should be planned for the onset of the growing season. The optimal timeframe for removal and replanting is to perform the search, rescue and relocation in spring or early summer (September to November), once the spring rains have fallen, in order to facilitate plant establishment.
* The plants should be planted in patches within the grassland (similar to how they occur spatially/naturally at the site).
* Transplants should be placed within a small hole (large enough to contain the bulb/route structure), with soil to be placed and gently compacted around the base of the plant (gently firm down the soil, compaction not to be too great).
* Re-planting into the wild must occur sensitively, causing as little damage/disturbance to natural vegetation as possible.
* Immediately after being transplanted, species should be adequately watered.
* Plant mortality can be high when individuals are relocated to a new environment and it is therefore recommended that relocated plants be monitored for a period of at least a month post-translocation to identify any additional plant requirements.
* Step are to be taken to protect rescued and translocated plants from further disturbance in order to aid/facilitate their re-establishment at the new site (may require fencing off, signage, monitoring, etc.). The position (coordinates) of rescued plants that have been re-planted should be recorded using a GPS device to inform future monitoring of the success of the plant rescue, translocation and protection efforts undertaken. Success entails not only survival of the translocated individuals but also establishment of a self-sustaining, viable population able to reproduce and adapt to changing environmental conditions.
* Any deviations from the plan that may be required should first be checked by the ECO and the appointed botanist/specialist responsible for plant rescue and translocation.

Other species that should be relocated from the development site should include the following Endemic species:

Hyphaene coriacea (Lala palm) – 1 plant observed along the eastern boundary of the development site

Table 20. Coordinates of protected plant species for rescue and relocation.

SPECIES NAME	LATITUDE (S)	LONGITUDE (E)
Crinum delagoense **Number of plants observed: ~15-20**	-28.74049868450	32.02706985460
	-28.74080255870	32.02760902580
	-28.74195530290	32.02824085870
	-28.74098102040	32.02648415000
	-28.74088023210	32.02647111530
	-28.74084823810	32.02648887670
	-28.74080091030	32.02642816700
	-28.74149136930	32.02640479250
	-28.73938148700	32.02525153960
	-28.73912809220	32.02539781970
	-28.73916201100	32.02540612800
	-28.73917916290	32.02546213520
	-28.73918146780	32.02562169990
	-28.73916130690	32.02565341140
	-28.73911016570	32.02559840170
Ledebouria ovatifolia **Number of plants observed: ~5-8**	-28.74039231160	32.02686107380
	-28.74136947300	32.02693225920
	-28.74139884280	32.02696616260
	-28.74146660610	32.02714611170
	-28.74139207500	32.02720701230

Figure 15 Map showing the location of protected plant species occurring at the development site.

4.4.3 Invasive Alien Plant Eradication and Control Programme

It is the responsibility of the developer/applicant/land owner to eradicate and control categorised Invasive Alien Plants (IAPs) and any other undesirable species (such as weeds) that invade any areas on the property and surrounds as a result of any disturbance caused during the construction and operation phases of the project. As such the ecologists from Eco-Pulse Consulting recommend the implementation of a bi-annual IAP monitoring and clearing exercise for the first year post-rehabilitation. Thereafter, IAPs clearing can be undertaken annually. In terms of Section 75 of NEMBA, the following applies to the control & eradication of IAPs:

» The control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs;
» Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment; and
» The methods employed to control and eradicate a listed invasive species must also be directed at the new growth, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

There are various means of controlling invasive alien plants in South Africa including chemical, biological, mechanical and integrated control methods. The suitability of control methods depends on a number of factors, including practical constraints, economic constraints and applicability of methods for particular species of alien plants. It is generally advised that a form of integrated control be implemented, based on a combination of two or more of the control measures outlined below (depending of course on the species present at the site). Selection of the appropriate methods of control should be based on the following criteria:

- **Species to be controlled:** herbicides are registered for specific species. Selection should be based on "*A Guide to the use of Herbicides*" issued by the Directorate: Agricultural Production Inputs and labels and information brochures provides by herbicide suppliers.
- **Size/age of target plants:**
  - For **seedlings:** hand-pulling or hoeing and foliar applications of herbicides for dense stands.
  - For **saplings:** hand-pulling or hoeing, foliar applications of herbicides for dense stands, basal stem treatments and cut stump treatments recommended.
  - For **mature trees**: ring barking, frilling, basal stem treatments and cut stump treatments recommended.
- **Density of stands:** Overall applications of herbicide can be made to dense stands of seedlings or saplings. Where dense stands of large trees are present, treatment of standing trees may be appropriate to obviate the problem of disposing felled trees.
- **Accessibility of terrain:** In inaccessible areas, methods that rely on the minimum amount of transportation of equipment and chemicals should be given preference.
- **Environmental considerations:** Riparian/wetland areas require a careful approach to treatment/control. Only herbicides approved for use in wetland/riparian areas are to be considered because washed-away herbicides often end up in aquatic systems.
- **Desirable vegetation:** Control methods that will cause the least damage to desirable vegetation must be considered. Selective herbicides or mixes that will not damage other desirable vegetation should be applied where relevant.
- **Disposal of dead vegetation:** Where possible, utilizable wood should be removed after tree felling. This is also the case for trees that could cause the blockage of water courses. Brushwood should be spread rather than stacked to limit soil damage in instances where burning is planned.
- **Cost of application:** the cost of application and re-treatment should be taken into consideration when selecting methods/herbicides, etc.

A **Method Statement for IAP clearing and control** has been compiled and details the requirements and strategy for IAP eradication & control within disturbed terrestrial areas of the site. The method statement is presented below.

Method Statement 1. *IAP Eradication & Control for terrestrial areas*

1 Planning for IAP Control:

Proper planning and preparations are fundamental to achieving cost-effective and successful IAP control. The following steps must be followed during planning:

i. The contractor must visit the site and assess the extent of IAP infestation and topographic challenges he will have work in.
ii. Identify and gather field equipment and personal protective equipment (PPE) required.
iii. Gather all chemicals required to control IAPs. Only herbicides registered for use on the target species may be used (*note that the application of herbicides on different types of alien invasive plant species is limited in South Africa. It is therefore necessary to assess the herbicide's activity such as its residual effect in the soil; it ability to work under wet conditions etc.).*
iv. Train project workers and supervisors on target IAPs and identified clearing methods. This may include: environmental protection with emphasis on aquatic resources, IAP identification; safety training for use of specialised equipment such as chainsaws; specialised training for working in difficult or sensitive terrain and under difficult climatic conditions.

2 Strategy for IAP eradication/control:

The strategy for the removal of IAPs and weeds on the site shall be in accordance with the following practice measures and guidelines for control/eradication of IAPs:

i. Identify, locate and demarcate Protected indigenous plants that should be conserved within areas to be cleared.
ii. Keep the team working in a line, with the daily tasks pegged out where possible.
iii. Target dense infestations of woody and herbaceous alien plants, focusing on the removal of Invasive Alien Plants (IAPs).
iv. Recommended methods of IAP control and their application are summarised in Box 2, below. For the IAPs identified at the site (mainly *Psidium gaujava, Eucalyptus spp. and Sesbania bisponosa)* a form of integrated control is recommended with mechanical removal (hand-pulling and uprooting) of smaller plants and cut-stump treatment for larger woody plants that will be difficult to remove manually). There is a possibility that other IAP species may colonise the site in the future and the most relevant method of control will need to be selected as these plants appear at the site during the operational phase.
v. For large specimens that cannot be easily removed entirely, cut plants as low to ground as possible and apply herbicide to all cut surfaces and exposed roots. The "cut-stump" application method is the safest method of applying herbicides.
vi. All IAPs must be removed carefully and exposed soil should be covered with cut vegetation or leaf litter that is free of weed seeds to ensure that re-growth of alien flora will not occur.
vii. Press any loosened soil down carefully but firmly and mulch with plant material where possible.
viii. All alien seeds, fruit bulbs, tubers and stems must be stacked and burnt onsite or removed for disposal at a registered land fill for example.
ix. Stack/move the slashed brush off the stumps to aid herbicide application and re-establishment of indigenous plant species.
x. Stack the brush into hips for collection and disposal at a landfill site.

3 Follow-up control:

Follow-up inspections are necessary to ensure the success of the control phase. It is preferable to follow up on an area and remove all seedlings or treat re-sprouting plants, rather than treat a new area. Follow-up operations must be carried out if inspections establish that initial removal efforts have failed or have had a limited impact.

4 Maintenance:

Maintenance control entails conducting regular control of invasive alien plants. This helps to sustain low alien plant numbers and keep the alien plants in check. Inspections of the site must be carried out every six (6) months.

5 Monitoring requirements:

The site should be monitored through visual inspections at regular intervals to determine whether IAP control has been successful and if further follow-up treatment is required.

Notes on the use of herbicides in IAP control:

Note that herbicide application will need to be carried out strictly in accordance with the manufacturer's specifications and according to current legislation. The following pollution and safety measures must be also adhered to regarding the handling, use and storage of herbicides:

i. All herbicides, concentrated and diluted, must be stored in a secure and covered area, or off-site under lock and key.
ii. All containers into which the herbicide or mixers are decanted must be clearly marked and a copy of the original label secured to the container.
iii. Herbicides must at all times be applied according to the recommendations on the labels.
iv. All MSDS sheets are to be made available on site along with a fully kitted Medical Aid Kit.
v. Herbicide equipment must under no circumstances be washed in a local stream, river or wetland.
vi. Suitable protective clothing like gloves, aprons, overalls and eye protection must be worn by herbicide applicators at all times.
vii. The correct protective clothing is to be used in line with manufacturer's instructions and/or the Occupational Health & Safety Act, Act 85 of 1993 (and amendments).
viii. Avoid contact of herbicide with skin and eyes.
ix. After contact, all applicators must wash their hands with soap and water or as recommended on the herbicide label.

Box 2. Alien Plant Control Methods

The control methods detailed below have been adapted from the ARC-PPRI (Agricultural Research Commission: Plant Protection Research Institute) Weed Research Programme (online at www.arc.agric.za/arc-ppri/), the DWA Working for Water Programme ((http://www.dwaf.gov.za/wfw/Control/) and eThekwini Municipality's *Practical tips on the management and eradication of invasive alien plants* (EcoFiles Sheet 4. Local Action for Biodiversity).

1 Mechanical control

Mechanical control entails physically damaging or removing the target alien plant. Mechanical control is generally labour intensive and therefore expensive, and can also result in severe soil disturbance and erosion. Different techniques can be applied and include uprooting/hand-pulling, felling, slashing, mowing, ring-barking or bark stripping. This control option is only really feasible in sparse infestations or on a small scale, and for controlling species that do not coppice after cutting. Species that tend to coppice (e.g. *Eucalyptus spp., Melia azedarach)* need to have the cut stumps or coppice growth treated with herbicides following mechanical treatment.

- **Hand pulling/uprooting:** The hand-pulling should be reserved for small plants and shrubs with shallow root systems (not recommended for trees with a stem diameter of more than 10cm). Grip the young plant low down and pull out by hand (using gloves). Uprooting is similar but is undertaken on slightly older individuals with the major drawback being that a relatively large area can be disturbed with the soils being altered and opening the area up to re-infestation.
- **Chopping/ cutting/ slashing:** This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/trunks. An effective method for non re-sprouters or in the case of re-sprouts (coppicing), it must be done in conjunction with chemical treatment of the cut stumps. Cut/slash the stem of the plant as near as possible to ground level. Paint re-sprouting plants with an appropriate herbicide immediately after they have been cut.
- **Strip bark:** Using a bush knife, strip bark away from tree from waist height down to soil. Cambium is stripped with the bark. No herbicide used.
- **Felling:** Large trees can be cut-down in their entirety, however, this is often not recommended unless absolutely necessary as large trees can play a pivot role in soil protection and biodiversity maintenance.
- **Girdling:** Girdling involves cutting a groove or notch into the trunk of a tree to interrupt the flow of sap between the roots and crown of the tree. The groove must completely encircle the trunk and should penetrate into the wood to a depth of at least 1.5 centimetres on small trees, and 2.5 to 4 centimetres on larger trees. The effectiveness of girdling can be increased by using herbicides.

2 Chemical control

Chemical control involves the use of registered herbicides to kill the target weed. The use of herbicide is often essential to the success of an eradication/control programme as it greatly reduces the re-growth potential of alien plants. Unfortunately, if the wrong herbicide is chosen, one can potentially cause more harm than good to the environment. When choosing the most appropriate herbicide, one needs to consider the following:

- **Relative toxicity to humans/animals**
- **Selective vs non-selective herbicides**: There are advantages and disadvantages to using each type. When dealing with light to moderate infestations in grass-dominated veld types, a broad-leaf selective herbicide is recommended so as to reduce the danger that spray drift could kill natural grass. In areas of heavy infestation, a non-selective herbicide is recommended.
- **Residual effect**: Some active ingredients in herbicides will remain in the environment for months, even years, before denaturing. Others start to denature as soon as they enter the soil. If a persistent herbicide is used, ensure that it is not used near any watercourse or area with a high water table (such as wetlands & riparian areas).
- **Is the herbicide registered for the target species:** A list of registered herbicides can be obtained from the Department of Water Affairs: Working for Water Programme – Policy on the Use of Herbicides for the Control of Alien Vegetation (January 2002). Also see http://www.arc.agric.za/arc-ppri/Pages/Weeds%20Research/Specific-IAP-Species-and-their-control-according-to-botanical-names.aspx

Some additional recommendations regarding herbicide use include:

- Herbicides should be applied during the active growing season.
- Always observe all safety precautions printed on the labels and manufacturer's instructions when mixing and applying herbicide.
- Herbicides can be applied in various ways. They can be sprayed onto dense infestations or painted onto the main stem of the plant or cut stump.
- Spraying herbicide on small infestations is not recommended, rather cut and apply herbicide to the stumps either with a brush.
- Spraying should be restricted to windless days when there is less risk of droplets drifting onto non-target species.
- Pressure or flow regulators should be fitted to sprayers for overall application. Spraying should be restricted to plants waist height or lower, but also ensuring there is sufficient foliage to carry the applied herbicide to the root system of the target plant.
- For water-based applications, Actipron Super Wetter should be added where recommended on the herbicide label, at a rate of 1.75/ha for dense-closed stands of alien vegetation.
- For all water-based treatments, a suitable brightly coloured dye should be added to the mix to ensure that all target plants are treated. For diesel-based applications, Sudan Red Dye should be added.
- Chemical control of IAPs is not recommended in aquatic systems due to the risk of water pollution, but may be used in conjunction with cutting or slashing of plants.
- Chemicals should only be applied by qualified personnel.
- Only herbicide registered for use on target species may be used.
- Follow the manufacturer's instructions carefully.
- Appropriate protective clothing must be worn.
- Only designated spray bottles to be used for applying chemicals.
- The number of herbicides for safe use under wet conditions is very limited.

3 Biological control

Biological weed control involves the releasing of natural biological enemies to reduce the vigour or reproductive potential of an invasive alien plant. Research into the biological control of invasive alien plants is the main activity of the Weeds Research Programme of ARC-PPRI and a list of biocontrol agents released against invasive alien plants in South Africa can be downloaded from their website. To obtain biocontrol agents, provincial representatives of the Working for Water Programme or the Directorate: Land Use and Soil Management (LUSM), Department of Agriculture, Forestry and Fisheries (DAFF).

4 Mycoherbicides

A mycoherbicide is a formulation of fungal spores in a carrier, which can be applied to weeds in a similar way as a conventional chemical herbicide (using herbicide application equipment). The spores germinate on the plant, penetrating plant tissues and causing a disease which can eventually kill the plant. Mycoherbicides are indigenous to the country of use and therefore are already naturally present in the environment and do not pose a risk to non-target plants. Under natural conditions they do not cause enough damage to the weed to have a damaging impact and are therefore mass produced and applied in an inundative inoculation, which leads to an epidemic of the disease knocking the weed population down. Mycoherbicides need to be re-applied at regular intervals.

5 Integrated control

It is frequently advisable to use a combination of two or more of the control method mentioned above, which is referred to as *integrated control*. Killing plants without cutting down causes the least disturbance to the soil and is the ideal.

The following integrated control options are available:

- **Basal bark and stem application**: apply recommended herbicide mixed in diesel carrier to the base of the stem of trees (<25cm stem height) and saplings. This method is appropriate for plants with thin bark or stems up to 25cm in diameter. Do not cut the bark. Apply herbicide mix with paintbrushes or using a coarse droplet spray from a narrow angle solid cone nozzle at low pressure. For multi-stemmed plants, each stem must be treated separately.
- **Ring barking**: Invasive trees growing away from any structures or roads can be ring-barked, poisoned and left standing rather than felled. They will slowly collapse over time and can establish habitat for birds, etc. Strip all bark and cambium from a height of 75cm to 100cm down to just below soil level. Cut a ring at the top and pull strips. All bark must be removed to below ground level for good results. Where clean de-barking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatments should be carried out. Bush knives or hatchets should be used for debarking.
- **Frilling:** Using an axe or bush knife, make angled cuts downward into the cambium layer through the bark in a ring. Ensure to effect the cuts around the entire stem and apply herbicide into the cuts.
- **Cut stump treatment**: This is a highly effective and appropriate control method for larger woody vegetation that has already been cut off close to the ground. The appropriate herbicide should be applied to the stump using a paintbrush within 30 min of being cut. Apply recommended herbicide mixture to the cut surface with hand sprayers, a paintbrush or knapsack sprayer at low pressure. Apply only to the cambium or outer layer of large stumps and the entire cut surface of small stumps. Ensure the stumps are cut as low to the ground as practically possible (about 10 – 15 cm or as stipulated on specific herbicide label). Herbicides are applied in diesel or water as recommended for the herbicide. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.
- **Scrape and paint**: This method is suitable for large vines and scrambling plants i.e. creepers. Starting from the base of the stem, scrape 20-100cm of the stem to expose the sapwood just below the bark. Within 20 seconds apply the herbicide to the scraped section. Do not scrape around the stem. Stems over 1cm in diameter can be scraped in 2 sides. Leave the vines to die in place to prevent damaging any indigenous plants they may be growing over.
- **Foliar spray:** This is not an advocated method of application by unqualified applicators due to the danger of spraying indigenous species. Should be restricted to droplet application made directly on the leaves on plants that are no higher than knee height. Use a solid cone nozzle that ensures an even coverage on all leaves and stems to the point of runoff. Do not spray just before rain (a rainfall-free period of 6 hours is recommended) or before dew falls. Avoid spraying in windy weather as the spray may come into contact with non-target plants. Spraying dormant or drought stressed plants is not effective as they do not absorb enough of the herbicide.

6 Disposal of alien plant material

Treated/removed alien plant material will need to be removed from the site and disposed of at a proper/registered receiving area such as a local registered land fill site.

4.4.4 Rehabilitation Guidelines: Terrestrial Vegetation and Habitat

During construction there is bound to be disturbance of terrestrial vegetation outside the actual development footprint (for access by vehicles/workers, site camps, storage of equipment/material, etc.). Such disturbance is likely to be inevitable and will likely require rehabilitation post-construction where the vegetation and/or soil surface has been damaged or disturbed. *The following guidelines provide a clear and practical means of implementing such rehabilitation once construction activities have ceased.*

» **Land/soil preparation measures:**

The following are general land preparation requirements for all terrestrial areas potentially requiring rehabilitation:

- All rubble, litter, foreign materials and waste products needs to be removed from the construction area and disposed of at proper local waste disposal/landfill facilities. Minimise additional disturbance by limiting the use of heavy vehicles and personnel during clean-up operations
- Any topsoil stockpiles/material must be spread evenly on the ground to match the natural slope of the grassland. The final prepared surface shall not be smooth but furrowed to follow the natural contours of the land pre-disturbance.
- All Invasive Alien Plants (IAPs) and weeds must be removed from target sites, preferably by uprooting (refer to the detail contained in ***Section 5.4.3: Invasive Alien Plant Eradication and Control Programme****).*
- Any erosion features within the construction site must be stabilised. Compacted soil infill, rock plugs, gabions, excavation and reshaping or any other suitable measures can be used for this purpose.
- Where significant soil compaction has occurred, the soil may need to be ripped or scarified with a mechanical ripper or by hand to a depth >25cm, in order to reduce its bulk density thus improving the chances of such that vegetation can become established at the site. Rip and / or scarify all disturbed and compacted areas outside of the development footprint. The ECO with the assistance of the engineer/contractor will specify whether ripping and / or scarifying is necessary, based on the site conditions.
- Immediately after ripping and scarifying disturbed areas, about 300mm of topsoil must be applied on top. The thickness of the topsoil maybe reduced at the instruction of the engineer only if the recommended 300mm of topsoil compromises the integrity of the works.
- Topsoil must be placed in the same area from where it was originally stripped. If there is insufficient topsoil available from a particular soil zone to produce the minimum specified depth, topsoil of similar quality may be brought from other areas. Where topsoil is lost during construction as a result of erosion, topsoil will need to be imported to the site and re-established. Such topsoil must be sourced commercially and legally.

- The topsoil must be compacted to similar compaction levels as natural soils in the area. The engineer will provide detailed advice on this.
- For seeding, the soil needs to be prepared to optimise germination. This is typically undertaken by hand hoeing to loosen the soil in the seedbed but should be firm enough to facilitate good contact between the seeds and the soil.
- Other relevant land preparation methods are illustrated in Figure 16, below.

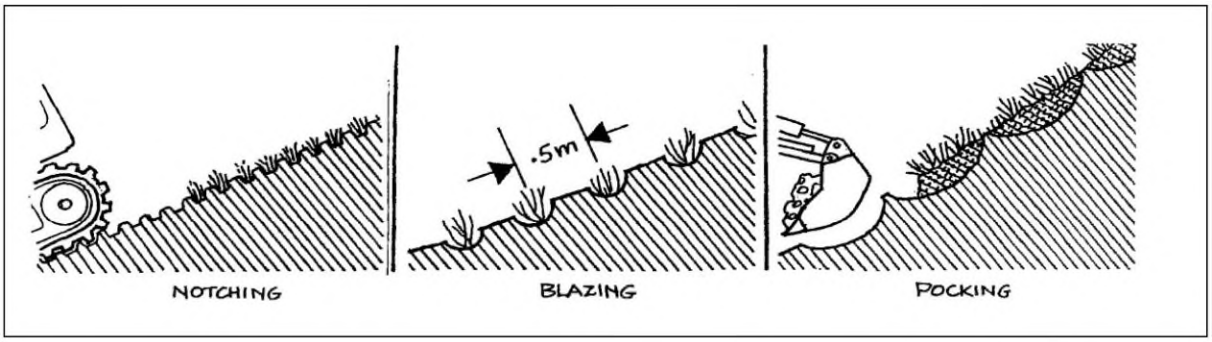

Figure 16 Methods of preparing the land for planting (Source: EThekwini Municipality, 2002).

» **Re-vegetation of disturbed terrestrial areas:**

For disturbed terrestrial sites outside of the development footprint where rehabilitation and re-vegetation will be necessary, the end state of the vegetation should be decided upon (should be similar to that which occurred at the site pre-disturbance associated with the development) and a list of species to be established for each specific site must be generated. Immediately after preparing the soil at a site to be rehabilitated, re-vegetation must commence in order to help bind the soil and prevent soil erosion and to inhibit IAP/weed establishment which will compete with the natural vegetation for space, light, nutrients and water. In this regard, the following mitigation measures must be implemented for disturbed terrestrial habitats/vegetation:

Method 1: Sodding/transplanting

- Transplants of grasses, herbs and woody shrubs/small trees removed during vegetation clearing at the site can and should be used to revegetate within disturbed areas where possible.
- A temporary on-site plant nursery will need to be established for the holding of rescued plant material and the propagation of appropriate species for re-vegetation.
- Stored plants will need to be kept moist and weed free and shall be protected from vermin, pests, pathogens, excessive sun and wind.
- Runner grass sods composed of indigenous species found naturally at the site must be laid out on all road batters and secured in place using wooded pegs. Use of grass sods is the most preferred revegetation method because it offers instant protection of vulnerable areas. It is best to install the sod as soon as it is delivered.
- Prior to installing sods, rake or harrow to achieve a smooth, final grade.

- Lay the grass sods then peg each on to the ground using wooden pegs/stakes.
- When sodding is carried out in alternating strips, or other patterns the areas between the sods should be seeded immediately after the sodding.
- Immediately after revegetation, the grass sods must be watered thoroughly. Watering must be undertaken on a daily basis until such time as the sod becomes well rooted within the soil. Thereafter, less frequent watering should be sufficient until such time as the vegetation is established to the satisfaction of the rehabilitation implementer and ECO/resident engineer.
- **No exotic/alien plants are to be used in sodding.**
- Soil or other propagation media, where used, shall be weed- and pathogen free.

Method 2: Hydroseeding

- Hydroseeding is the second preferred option to re-vegetating slopes. The advantages of hydroseeding include faster germination, increased plant survival, and the ability to cover large, often inaccessible areas rapidly.
- The slurry (basic materials) for hydroseeding must consist of water, seed, fertiliser, anti-erosion compounds (soil binders) and organic supplements to enhance grass growth.
- Prior to hydroseeding water must be sprayed over target area to provide added moisture.
- The target groundcover of re-vegetated areas shall be no less than 80% of specified vegetation and there must be no bare patches of more than 500 x 500mm in maximum dimension.
- Ideal species for hydroseeding include runner and short tufted species, such as *Cynodon dactylon* or suitable alternative indigenous grasses species adapted to the local environmental conditions (preferably grasses endemic to the region).
- A stabilising grass *mix should be selected* that should consist of a mix of quick covering grasses (pioneer species) and mat-forming grasses (e.g. *Digitaria eriantha, Cynodon dactylon, Chloris gayana*) to ensure prompt and adequate coverage of the exposed soil while ensuring that long-term stability of the grass sward is also achieved. The seed mix should consist of pioneer grass species of the area, which will also depend on what species are commercially available during the season required. Tufted grasses (e.g. *Eragrostis curvula, Themeda triandra*) are recommended.
- The natural seed bank in the topsoil will supplement the seed mix applied.
- **No exotic/alien plants are to be used in hydroseeding** (e.g. Kikuyu grass, *Pennisetum clandestinem,* is not recommended).
- Sowing rates for seeds should be obtained from the relevant supplier and in accordance with the existing environment. The quantity of seed used will depend on the slope, with a steeper slope generally requiring a heavier application of seed. For slopes<15º: 15-25 kg/ha.

- The areas which have been seeded must be regularly watered directly after seeding until the grass cover becomes established. Watering is to be done in a manner that ensures that no erosion of the topsoil and seed mix takes place.
- In the absence of sufficient follow-up rains after seeds start germinating, watering of the new vegetation cover will become necessary until it is established in order to avoid loss of this vegetative cover and the associated seedbank.
- From sites that will be cleared, 100% of all seeds from indigenous grasses/shrubs/trees available may be collected and broadcast across disturbed areas requiring re-vegetation (note that seed harvested may not contain materials of any alien invasive species). Where nursery facilities onsite can only cater for rescued plants, a suitable local nursery nearby should be identified that will be willing to receive seeds collected and propagate the necessary species for later revegetation.

» **Monitoring of re-vegetated areas:**

- Re-vegetated areas should be monitored on a monthly basis by the ECO during construction, and then every 2-3 months for the first 12 months post-construction or until such time as 80% of the desired plant species cover has been achieved, with annual inspections thereafter until the rehabilitation/re-vegetation of the plant community has been deemed successful and self-sustaining.
- Re-vegetated areas showing inadequate surface coverage (less than 30% within 9 months after re-vegetation) should be prepared and re-vegetated/reseeded from scratch. Where necessary, another dressing of topsoil may need to be applied prior to re-seeding the area.
- Damage/disturbance to any re-vegetated areas should be repaired.
- Exotic weeds and invaders that establish on re-vegetated areas should be controlled to allow the native species to properly establish (refer to the detail contained in ***Section 5.4.3: Invasive Alien Plant Eradication and Control Programme***).

4.4.5 Biodiversity Offset Recommendations

» **Introduction to offsets**

The guiding principle adopted by Ezemvelo KZN Wildlife with regards to biodiversity conservation and sustainable development is one of "*no net loss of biodiversity and ecosystem processes".* To achieve this principle, a proactive approach to planning and biodiversity conservation must be adopted, with the appropriate design of mitigation through the mitigation hierarchy which should strive first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining residual negative impacts on biodiversity (EKZNW, 2012).

The term 'Biodiversity Offset' refers to "*the measurable conservation outcome resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken*" (EKZNW, 2009). The concept of biodiversity offsets is still relatively new, with no standard method set to determine the right biodiversity offset. The goal of biodiversity offsets is to achieve **no net loss** (and potential net gain) with respect to species composition, habitat structure, ecosystem function and societal use and cultural values associated with biodiversity.

» **When should offsets be considered?**

Biodiversity offsets are normally only considered as the last resort option in the 'mitigation hierarchy'. The trigger for offsets is linked to the significance of residual negative impacts of development on biodiversity: where residual impacts are of medium to high significance, offsets to compensate for biodiversity loss should be explored (EKZNW, 2009). A number of factors generally dictate whether residual impacts on biodiversity can be considered significant enough to trigger a biodiversity offset and these are associated mainly with the characteristics of the receiving environment to be impacted. General guidelines and considerations stipulated in the document ***Norms and Standards for Biodiversity Offsets in KZN*** (EKZNW, 2009) for informing the evaluation of significance of biodiversity impacts and associated ecosystem services and criteria triggering the need for offsets are as follows:

- If development were to have a residual impact on a Critical Biodiversity Area (CBA), Protected area or other priority area identified by national/provincial conservation agencies, the impact would be considered to be of very high significance and their loss cannot be offset as these area are required in order to meet conservation targets.
- The values attached to biodiversity, ecosystems and/or ecosystem services to affected parties and society as a whole. Where values/use is considered high, impacts are likely to be significant.
- Irreplaceability or uniqueness of biodiversity that will be impacted. Where ecosystems or species are threatened or constitute Critical Biodiversity Areas (CBAs), options for conserving that biodiversity will be limited. Notably, seemingly inconsequential impacts at a site level on endangered biodiversity in KZN could have national or even global significance.
- Vulnerability or the risk of imminent loss due to on-going cumulative impacts, fragmentation of habitat, background trends or rates of biodiversity loss or degradation and/or the anticipated effects of climate change. This includes the consideration of past, on-going or predictable future impacts.
- Where the condition of the affected ecosystem is either good or fair/moderate, the significance should be dictated by the ecosystem threat status only and condition should not influence the rating. If development will have a residual impact on

threatened ecosystems (i.e. Critically Endangered, Endangered, Vulnerable) that are not degraded/transformed (i.e. the affected area supports more than 25% of the species that would be expected to occur on an undisturbed site in a comparable vegetation type or ecosystem), the significance would be at least medium and would likely trigger the need for a biodiversity offset in this context. *See also Table 21, below.*

* If development will have a residual impact on threatened ecosystems that are largely transformed/degraded (i.e. the affected area supports less than 25% of the species that would be expected to occur on an undisturbed site in a comparable vegetation type or ecosystem), the significance may be regarded as low and would likely not trigger the need for a biodiversity offset in this context.
* Residual impacts on endangered ecosystems/vegetation types are generally considered Medium to Very High significance, depending on the area to be residually impacted (extent), the condition of the impacted habitat and its connectivity in the landscape.
* Residual impacts on threatened species or their known habitat would be of medium to very high significance, depending on the conservation status of individual species. Impacts on species that are Near Threatened would be of relatively low significance (i.e. not triggering requirement for biodiversity offset).
* Residual impacts on fixed ecosystem services and/or biodiversity processes may be considered of medium to very high significance, depending on the value attached to the process or service by society.
* Whether the development footprint of an activity will result in the destruction of 3ha or 20ha of an Endangered ecosystem in moderate to good condition, the fact that there would be erosion of a threatened ecosystem would be the predominant informant of significance and in this context, the significance of residual impact could at most be reduced from a high to medium significance.

Table 21. Impact significance for residual impacts to biodiversity and triggers for biodiversity offsets in KZN (after EKZNW, 2009).

Impact Significance for residual impacts to biodiversity	Implications and Offset Requirements
Very High	Represent a fatal flaw for development and in all likelihood irreversible impacts or irreplaceable loss of resources will result. Impacts cannot be compensated for through offsets.
Medium to High	Would trigger an investigation into biodiversity offsets.
Low	Would not require any offsets.

In terms of the contribution of the Gas Power Plant development site to the loss of Maputaland Wooded Grassland vegetation/habitat type within the context of the broader IDZ Phase 1F project area, this accounts for 7.4ha or less than 5% of the broader

development area zoned industrial (see Table 22 and Figure 17, below). In terms of the contribution of the development site for meeting conservation targets (7 873.4 ha required), this amounts to only 0.09%, which is considered very minor.

Table 22. Summary of RBIDZ Phase 1F Land Use.

RBIDZ Phase 1F Land Use (current)	Reference Vegetation Type	Extent/Area (ha)	Contribution to Grassland Loss (ha)	Contribution to Grassland Loss (%)
Development site	**Maputaland Wooded Grassland**	**7.5ha**	**7.4ha**	**4.6%**
Remaining grassland to be developed	Maputaland Wooded Grassland	97.9ha	97.9ha	61%
Wetlands	Hygrophilous grassland	31.5ha	-	-
Plantation forestry	Maputaland Wooded Grassland	5.4ha	5.4ha	3.4%
Tata steel factory	Maputaland Wooded Grassland	49.7ha	49.7ha	31%
Coastal Forest	Coastal Forest	8.1ha	-	-
	Totals	*200.1ha*	*160.4ha*	*100%*

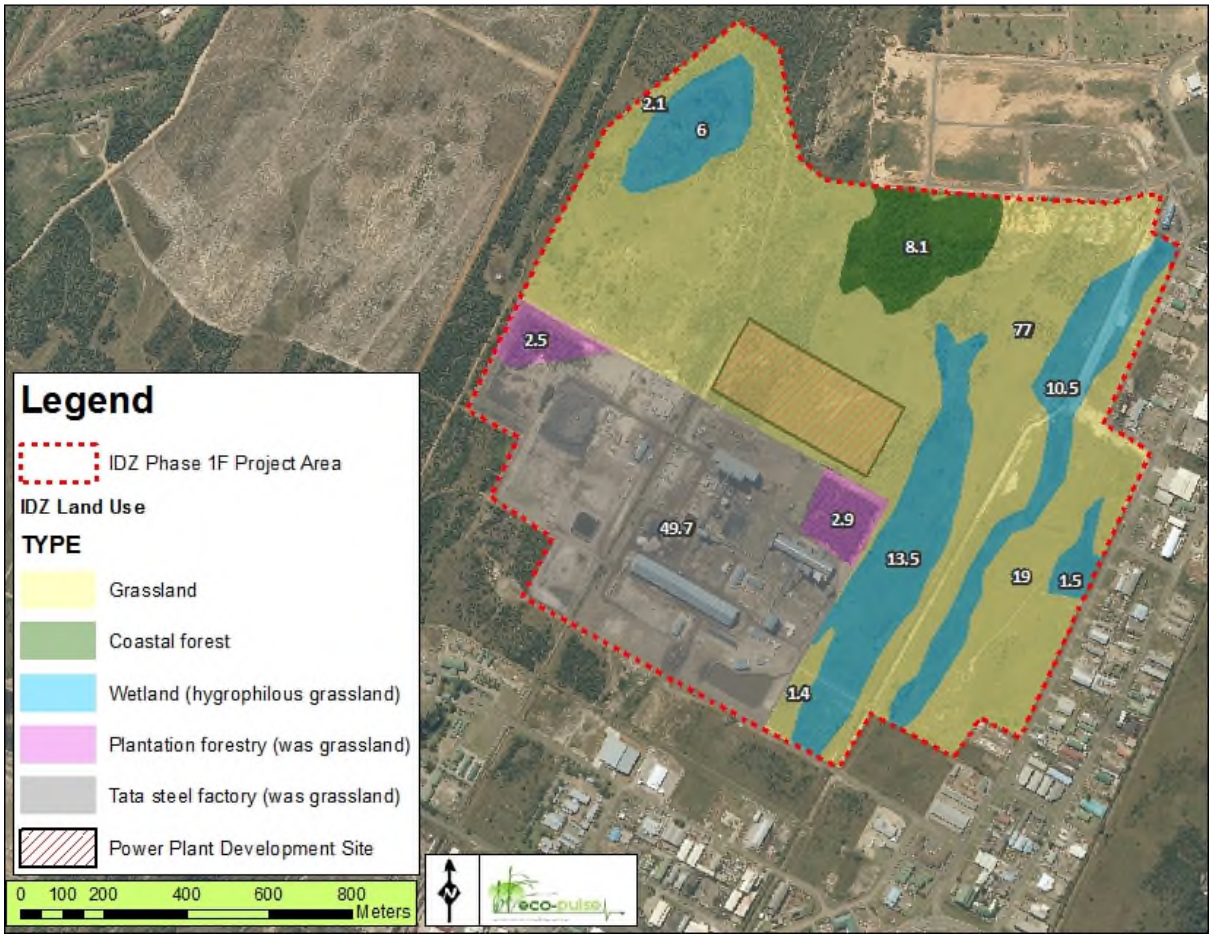

Figure 17 Map showing RBIDZ Phase 1F project area, with estimated (current) land use mapped.

Importantly, the cumulative impact in terms of habitat/vegetation loss due to the various development projects aimed within the Phase 1F zone (including areas already lost to development – i.e. Tata steel) amounts to roughly 160.4ha, which can be considered significant given that there is an estimated 36.3% (39 173ha) of this vegetation type remaining in KZN. In terms of the contribution of the broader RBIDZ Phase 1F project area for meeting conservation targets (7 873.4 ha required or 7.3%), this amounts to roughly 2% which can be seen as significant in light of the 36% of remaining habitat for meeting this target (see Table 23 and Figure 18, below).

Table 23. Summary of RBIDZ Phase 1F contribution to meeting conservation targets for the Maputaland Wooded Grassland vegetation type.

	Extent	
Provincial area (Maputaland Wooded Grassland)	107925 ha	100%
Remaining untransformed natural habitat in KZN (2011)	39173 ha	36.3%
Conservation target (KZN)	26981 ha	25%
Formally protected in KZN	19107.56 ha	17.7%
Needed to meet conservation target for KZN	7873.44 ha	7.3%
Development site (power plant): *wooded grassland transformation*	7.4 ha	0.09%
Broader RBIDZ Phase 1F development: *wooded grassland transformation*	160.4 ha	2.04%

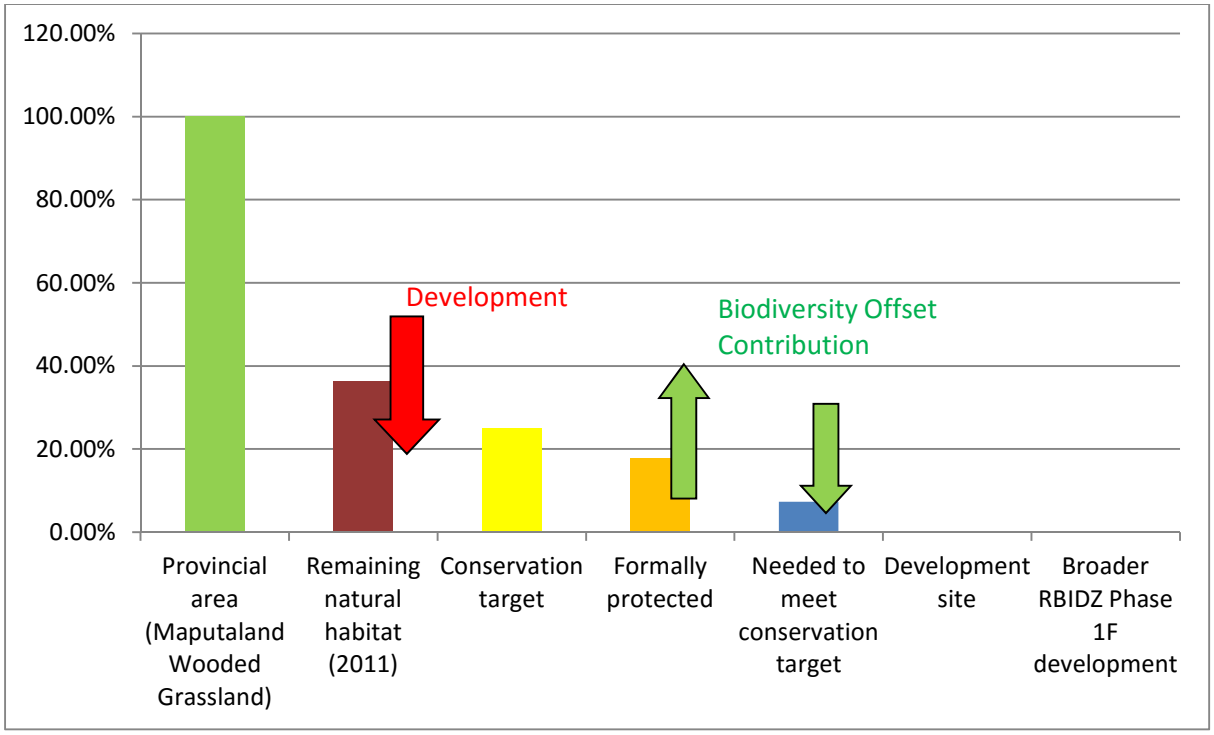

Figure 18 Diagram illustrating the contribution of the broader RBIDZ Phase 1F site for meeting provincial targets set for the 'Endangered' Maputaland Wooded Grassland vegetation type.

It is therefore recommended that the need and desirability for a biodiversity offset be investigated further as a means to compensate for the cumulative residual loss of Maputaland Wooded Grassland vegetation and habitat associated with the broader RBIDZ Phase 1F development site based on the following rationale:

* The potential contribution (~2%) of the Phase 1F grassland areas in meeting provincial conservation targets set for the Maputaland Wooded Grassland type is considered relatively high (given that only ~36% of this type remains in KZN).
* Review of an existing Ecological Study undertaken for the broader Phase 1F study area in 2015 (NEMAI Consulting, 2015b) identified the findings around grassland condition and sensitivity to be broad and relatively vague. The condition of the remaining wooded grassland habitat within the broader Phase 1F area was also not assessed in detail by Eco-Pulse in 2016 (beyond the scope of this assessment which focused on the proposed power plant site). Therefore, in the face of scientific uncertainty, a risk averse and cautious approach should be taken in line with the precautionary principle of NEMA. Understanding the condition of remaining grassland vegetation communities at the site in detail will be critical in motivating for why an offset will be triggered/required or not for the broader Phase 1F development project. This would need to identify whether the condition of the affected ecosystem is poor or fair/medium (residual impacts on endangered ecosystems/vegetation types are generally considered Medium to Very High significance, depending on the area to be residually impacted, the condition of the impacted habitat and its connectivity in the landscape). According to the ***Norms and Standards for Biodiversity Offsets in KZN*** (EKZNW, 2009), if development will have a residual impact on an Endangered vegetation type/ecosystem that is not degraded/transformed (i.e. the affected area supports more than 25% of the species that would be expected to occur on an undisturbed site in a comparable vegetation type or ecosystem), the significance would be at least medium and would likely trigger the need for a biodiversity offset in this context. Essentially, this is what needs to be determined for the remaining untransformed grassland areas at the site.

Interestingly, upon review of the existing EIA Report for the RBIDZ Phase 1F site services infrastructure (NEMAI Consulting, 2015a), no comments appear to have been raised by Ezemvelo KZN Wildlife pertaining to the need for a biodiversity offset for the development site, as the provincial conservation authority responsible for conservation planning in KZN. Either this was not an issue or the conservation authority did not provide comment or in time. It is therefore recommended that the Richards Bay Industrial Development Zone Company engage further with EKZNW around the need and desirability for a biodiversity offset for the cumulative loss of grassland habitat to be realised at the Phase 1F site (this was beyond the scope of this assessment, which merely highlighted the possible trigger and need for a biodiversity offset to account for cumulative impacts at the site).

Of the possible range of typical offset activities, the securing of priority areas for biodiversity conservation in perpetuity is generally the focus of offsets in KZN (EKZNW, 2009). Biodiversity offsets are 'area-based' and should comprise the same biodiversity as that affected by development i.e. 'like for like' compensation (EKZNW, 2009). Ezemvelo KZN Wildlife will need to be engaged with in order to discuss and confirm viable offset sites and to determine the 'offset ratio' to be applied, based on ecosystem threat status (ratios of 3:1 to 25:1 are generally applied to Endangered ecosystems - EKZNW, 2009).

5. CONCLUSION

The specialist terrestrial ecological survey and impact assessment was undertaken to inform the Environmental Impact Assessment being conducted for the proposed proposed 'Gas powered Power Plant' to be established and operated by Independent Power Producer 'Richards Bay Gas Power 2 (Pty) Ltd'. The development is to be located on three erven within the Richards Bay Industrial Development Zone (RBIDZ) Phase 1F site, which is zoned general industrial, in the vicinity of the Tata Steel factory in Alton, Richards Bay, KZN. The approximate extent of the proposed development site is to be 7.5 hectares and will be located on terrestrial (untransformed) grassland.

The proposed facility is to be located within a within a fragmented and previously transformed Maputaland Wooded Grassland community (Endangered threat status, moderately protected in KZN) which was found to be dominated by two indigenous plant communities, namely (i) ***Aristida junciformis subsp. junciformis – Helichcrysum kraussii*** wooded grassland and (ii) ***Themeda triandra - Parinari capensis subsp. incohata*** wooded grassland. Most species of plants identified (including grasses/graminoids, small herbs and woody shrubs/small trees) were identified as locally common species of Least Concern with two (2) plant species of conservation significance were recorded occurring in patches within the broader grassland community ***Crinum delagoense*** (*'Declining' threat status, specially protected in KZN*) and ***Ledebouria ovatifolia*** (SA Endemic species*, specially protected in KZN*), with approximately 20 to 30 individual plants estimated for the site. The broader modified/secondary wooded grassland vegetation community sampled at the site was determined to be fairly similar to the benchmark vegetation unit, Maputaland Wooded Grassland when comparing the species composition with the benchmark/reference type. Whilst composition has been modified in comparison to the reference grassland type, with an increase in pioneer and alien/weedy/undesirable species and structure appeared patchy with greatly reduced basal cover in places, sections of the grassland appeared more intact and harboured protected plant species. Ecological sensitivity arranged from very low/low within the more degraded areas associated with the old airfield and forestry activities to moderate, with patches containing high densities of protected plants considered moderately high in terms of ecological sensitivity.

The site was notably depauperate in terms of wildlife/fauna, with only locally common species invertebrates and birds noted. Reptiles, mammals and amphibians of conservation importance could potentially occur but alterations to the original fauna are expected to have already occurred to a great extent with the disappearance of faunal diversity in the area as a result of human presence in the area as well as on the site; coupled with extensive habitat transformation (industrial area) and high levels of disturbance.

The significance of potential construction-related ecological impacts are estimated to range from Low to Moderate ecological significance, with the direct disturbance/degradation and loss of vegetation/habitat during vegetation clearing and construction being the most

significant. Cumulative impacts on ecosystem conservation targets, loss of ecological functioning and ecosystem services supply, and impacts to species of conservation concern ranged from Medium to High significance in light of the threat status and irreplaceability value of the Maputaland Wooded Grassland vegetation type and the presence of protected/threatened plant species at the site. Cumulative impacts are likely to remain Moderately-High to High even when considering these impacts without the planned gas power plant development (due to the extensive industrial development planned for the Phase 1F area).

With adequate mitigation and impact management, most direct and indirect impacts can be effectively managed and reduced to estimated low significance levels. It is therefore recommended that Section 5.4 of this report which deals with 'Impact Mitigation/Management' be referenced in the Environmental Authorisation (EA) for this project as a specific condition of the EA. The cumulative, permanent and irreversible loss of vegetation and habitat will be difficult to mitigate, and the consequences in terms of meeting targets set for Maputaland Wooded Grassland (Endangered vegetation type) as well as the resultant loss of ecosystem functioning, goods and services will be unavoidable. In order to compensate for the loss of habitat and ecosystem functioning/services supply, an investigation into the need and desirability for biodiversity offsets is recommended for the broader IDZ Phase 1F development project and the Richards Bay Industrial Development Zone Company should consult further with Ezemvelo KZN Wildlife in this regard.

Should you have any queries regarding the findings and recommendations in this Specialist Terrestrial Ecological Assessment Report, please contact Eco-Pulse Environmental Consulting Services directly.

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7. ANNEXURES

Annexure A: Relevant Environmental Legislation.

» ***National Environmental Management Act No.107 of 1998 (NEMA)***

NEMA is South Africa's overarching environmental legislation and has, as its primary objective to provide for co-operative governance by establishing principles for decision making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state and to provide for matters connected therewith (Government Gazette, 1998). The Act provides for the right to an environment that is not harmful to the health and well-being of South African citizens; the equitable distribution of natural resources, sustainable development, environmental protection and the formulation of environmental management frameworks. In addition there is recognition that development must be socially, environmentally and economically sustainable and that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied (Government Gazette, 1998). Specific principles of NEMA that are of particular relevance to the management and protection of biodiversity are indicated in the table below. Any developments with a potential impact to biodiversity and natural ecosystems therefore typically need to be assessed to ensure that impacts are adequately minimized. Authorizations may also be required before planned activities can commence. A summary of NEMA principles applicable to the management of biodiversity is included below:

Section	Principle
2(4) (a) (i)	The disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
2(4) (a) (ii)	Pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
2(4) (a) (vi)	The development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised.
2(4) (a) (vii)	A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions.
2(4) (e)	Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.
2(4) (o)	The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.
2(4) (p)	The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.
2(4) (r)	Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal habitats including dunes, beaches and estuaries, reefs, wetlands, and similar ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

» ***National Environmental Management: Biodiversity Act No. 10 of 2004 (NEM:BA)***

The NEM:Biodiversity Act provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act (NEMA). The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed alien invasive species. The South African National Biodiversity Institute (SANBI) is established by this Act and is responsible for coordinating and implementing programs.

» ***NEM:BA - Invasive Species Regulations***

Legislative requirements in terms of Invasive Alien Plants (IAPs) occurring on the property are informed by the Alien and Invasive Species Regulations, 2014 in terms of section 97(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA). Plants are categorized according to the NEM:BA Alien and Invasive Species List 1: National list of Invasive Terrestrial and Fresh-water Plant Species, contained within Government Notice 599 (Government Gazette No. 37886, 1 August 2014) in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). NEM:BA classifies three categories of invasive alien plants according to Government Notice R. 598 National Environmental Management: Biodiversity Act (No. 10 of 2004): Alien and Invasive Species Regulations, 2014, as contained within Government Gazette No. 37885 (Vol. 590), 1 August 2014. These categories and relevant management requirements are summarized in the table below.

Table 24. Summary of NEM:BA invasive alien plant categories and management requirements.

NEM:BA Category	NEM:BA Management Requirements
1a	Category 1a invasive species are those species listed as such by notice in terms of section 70(1)(a) of the NEM:BA as species which must be combated or eradicated immediately. By law, any specimens of these plants require compulsory eradication from the environment (to be removed and destroyed so they can no longer persist in the environment). No permits will be issued for Category 1a species. If an Invasive Species Management Programme has been developed in terms of section 75(4) of the NEMBA, a person must combat or eradicate the listed invasive species in accordance with such programme.
1b	Category 1b invasive species are those species listed as such by notice in terms of section 70(1)(a) of the NEM:BA as species which must be controlled. By law, any specimens of these plants require compulsory control as part of an invasive species control programme.
2	Category 2 invasive species are regulated by area. These species require a permit to carry out a restricted activity specified in the permit (e.g. import, possess, grow, breed, move, sell, buy or accept as a gift) or an area specified in the permit. No permits will be issued for Category 2 plants to exist in riparian zones. Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit. A landowner on whose land a Category 2 Listed Invasive Species occurs or person in possession of a permit, must ensure that the specimens of the species do not spread outside of the land or the area specified in the permit or over which they have control. Any species listed as a Category 2 species that occurs outside the specified/permitted area is to be considered a Category 1 b Listed Invasive Species and must be managed accordingly.

NEM:BA Category	NEM:BA Management Requirements
3	Category 3 invasive species are regulated by activity and are as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of NEM:BA. No permits will be issued for Category 3 plants to exist in riparian zones and any plant species identified as a Category 3 Listed Invasive Species that occurs in riparian areas will be considered to be a Category 1b Listed Invasive Species and must be controlled in accordance with an invasive plant control programme.

» ***Threatened or Protected Species (TOPS) in terms of NEMBA***

Threatened or Protected Species (TOPS) are regulated in terms of the National Environmental Management: Biodiversity Act No. 10 of 2004 (NEMBA). TOPS are listed in the NEMBA: PUBLICATION OF LISTS OF CRITICALLY ENDANGERED, ENDANGERED, VULNERABLE AND PROTECTED SPECIES (GOVERNMENT GAZETTE, 23 FEBRUARY 2007). The TOPS regulations apply only to those species that are listed as threatened or protected in terms of the Biodiversity Act. *Provincial legislation still applies to all species not listed as threatened or protected.* A person may not carry out ANY restricted activity involving a TOPS specimen, without a TOPS permit. There are NO exemptions from any of the provisions of the TOPS regulations, to any person, organization or organ of state. Restricted activity involving a TOPS specimen means:

(i) hunting, catching, capturing or killing by any means, method or device whatsoever, including searching, pursuing, driving, lying in wait, luring, alluring, discharging a missile or injuring with intent to hunt, catch, capture or kill any such specimen;
(ii) gathering, collecting or plucking;
(iii) picking parts of, or cutting, chopping off, uprooting, damaging or destroying;
(iv) importing into the Republic, including introducing from the sea;
(v) exporting from the Republic, including re-exporting from the Republic;
(vi) having in possession or exercising physical control over;
(vii) growing, breeding or in any other way propagating, or causing it to multiply;
(viii) conveying, moving or otherwise translocating;
(ix) selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any way acquiring or disposing of; or
(x) any other prescribed activity which involves a TOPS specimen without the relevant TOPS permits.

» ***Nature Conservation Ordinance No. 15 of 1974***

This piece of legislation makes extensive provision for protected areas (including private nature reserves) and protection of flora and fauna (including marine and freshwater fish). The administration of the whole of this Ordinance has under Proclamation 107 of 1994, published in Government Gazette 15813 of 17 June 1994, been assigned to the Province of KwaZulu-Natal with effect from 17 June 1994. Schedule 12 of the Ordinance lists Specially Protected Plants that are regulated in terms of activities that can take place with respect to harvesting, selling, importing, trading and handling of these plant species. On application by a landowner wishing to develop his land in such a manner that such development may cause damage or destruction to specially protected indigenous plants, a permit for the relocation of such plants may be granted.

Annexure B: Species List for Flora identified for the Site.

*Exotic species shown in **red** text

No.	Botanical Name	Common Name	Type	Status	Threat Status	Description	Habitat	Abundance
1	*Aristrida junciformis subsp. junciformis*	Ngongoni	Graminoids	Increaser 3	LC	Densely tufted grass	Open grassland in areas with high rainfall.	Very High
2	*Cynodon dactylon*	Couch grass	Graminoids	Increaser 2	LC	Short mat-forming grass	Disturbed places, especially sandy soils.	Low
3	*Cyperus natalensis*		Graminoids	SA Endemic (KZN)	LC	Medium to tall perennial sedge	Permanent freshwater but also mesic ecological conditions with grasses.	High
4	*Dactyloctenium aegyptium*	Common crowfoot grass	Graminoids	Increaser 2	LC	Annual tufted grass	Disturbed places, especially sandy soils.	Low
5	*Digitaria eriantha*	Common finger grass	Graminoids	Decreaser	LC	Perennial tufted grass	Mainly grows in undisturbed veld.	High
6	*Digitaria longiflora*	False couch grass	Graminoids	Pioneer	LC	Mat-forming creeping grass	Pioneer of disturbed places, particularly sandy soils.	Very Low
7	*Eragrostis capensis*	Heart-seed love grass	Graminoids	Increaser 2	LC	Perennial tufted grass	Disturbed places and moist sites.	Very Low
8	*Eustachys paspaloides*	Brown Rhodes Grass	Graminoids	Decreaser	LC	Perennial tufted grass	Undisturbed open grassland or mixed bushveld, sandy or stony soil.	Low
9	*Fimbrystylis sp.*		Graminoids		LC	Perennial grass-like plant	Mesic ecological conditions with grasses.	Low
10	*Heteropogon contortus*	Spear grass	Graminoids	Increaser 2	LC	Grass	Gravelly and other well drained soils in disturbed places.	Low
11	*Imperata cylindrica*	Cottonwool grass	Graminoids	Increaser 1	LC	Water-loving creeping grass	Poorly drained damp soils and other habitats in high rainfall areas.	Moderate
12	*Kyllinga sp.*	Kyllinga	Graminoids		LC	Perennial grass-like plant	Wet areas	Very Low
13	*Melinis nerviglumis*	Bristle-leaved red top	Graminoids	Increaser 1	LC	Densely tufted grass	Undisturbed veld.	Low
14	*Melinis repens*	Natal red top	Graminoids	Increaser 2	LC	Weak perennial tufted grass	Disturbed places.	Low
15	*Perotis patens*	Cat's tail	Graminoids	Increaser 2	LC	Sparse tufted grass	Disturbed places, poor sandy and compacted soils.	Moderate
16	*Sporobolus africanus*	Rat's tail dropseed	Graminoids	Increaser 3	LC	Perennial tufted grass	Disturbed places, also near streams and other damp sites.	Low
17	*Themeda triandra*	Red grass	Graminoids	Decreaser	LC	Perennial tufted grass	Undisturbed open grassland and bushveld.	Low
18	*Trichloaena monachne*	Blue seed grass	Graminoids	Increaser2	LC	Sparse tufted grass	Mostly disturbed places, sandy soil.	Low
19	*Urochloa mosambicensis*	Bushveld signal grass	Graminoids	Increaser 2	LC	Perennial tufted grass	Disturbed places, overgrazed and trampled veld.	Low
20	*Chamaecrista plumosa*		Herbs		LC	Herb	Grassland.	Low
21	*Commelina africana*	Yellow commelina	Herbs		LC	Perennial herb	Widespread.	Low

No.	Botanical Name	Common Name	Type	Status	Threat Status	Description	Habitat	Abundance
22	*Commelina erecta*	Blue commelina	Herbs		LC	Perennial herb	Sandy coastal areas.	Low
23	*Crinum delagoense*	Candy-striped crinum	Herbs	**Specially Protected Plant**	Declining	Deciduous bulbous flowering plant	Scattered in low altitude grassland and bushveld on sandy soils.	Low
24	*Cuscata campestris*	Dodder	Herbs	Exotic (1/1b)	LC	Herbaceous climber	Parasitic invader	Low
25	*Hypoxis angustifolia*	Molinyana	Herbs		LC	Herb, flowering plant	Scattered in grassland.	Low
26	*Justicia peteolaris*	Blue justicia	Herbs		LC	Perennial herb	Woodland and forest.	Very Low
27	*Ledebouria ovatifolia*	Icubudwana	Herbs	**Specially Protected Plant & Endemic**	LC	Bulbous herb	Grassland/woodland in shaded places mainly.	Low
28	*Lobelia coronopifolia*	Wild lobelia	Herbs		LC	Perennial shrublet	Grassland.	Very Low
29	*Richardia brasiliensis*	Mexican richardia	Herbs	Exotic	LC	Spreading herb	Weed of disturbed areas.	Low
30	*Tephrosia purpurea*	Silver tephrosia	Herbs		LC	Shrublet	Cosmopolitan weed of coastal sand dunes and forest margins.	Very Low
31	*Vernonia centauroides*		Herbs		LC	Herb	Grassland and woodland, sandy soils.	Low
32	*Vigna unguiculata*	Wild cow pea	Herbs		LC	Herb	Grassland and woodland.	Low
33	*Chrysanthemoides monilifera*	Bush tick-berry	Low shrubs		LC	Shrublet	Coastal bush, dune vegetation.	Very Low
34	*Crotalaria monteiroi var. monteiroi*	Small-leaved Rattle-pod	Low shrubs		LC	Many branched shrub	Woodland, stream banks.	Low
35	*Helichrysum kraussii*	Straw Everlasting	Low shrubs		LC	Aromatic shrublet	Coastal grassland, open woodland.	Very High
36	*Helichrysum ruderale*		Low shrubs		LC	Herb	Dense stands in disturbed areas.	Low
37	*Parinari capensis subsp. incohata*	Sand mobola-plum	Low shrubs		LC	Dwarf woody shrublet	Bushveld and grassland in deep sandy soils across the Maputaland coastal plain.	Very High
38	*Acacia mearnsii*	Black wattle	Trees & Tall shrubs	Exotic (2)	LC	Small to medium evergreen tree	Invader of grasslands, forest gaps, roadsides and watercourses.	Very Low
39	*Albizia adianthifolia*	Flat crown	Trees & Tall shrubs		LC	Small to medium tree	Bushveld, often on sandy soils.	Very Low
40	*Brachylaena discolor*	Coastal silver-oak	Trees & Tall shrubs		LC	Shrub or small tree	Coastal bush and bushveld.	Low
41	*Dichrostachys cinerea subsp. nyassana*	Large-leaved Sickle bush	Trees & Tall shrubs		LC	Shrub to small tree	Bushveld (invading over-grazed areas usually).	Moderate
42	*Diospyros lycoides subsp. sericea*	Bluebush	Trees & Tall shrubs		LC	Shrub to small-medium tree	Wide variety of habitats.	Low
43	*Erythrina lysistemon*	Coral tree	Trees & Tall shrubs		LC	Small to medium deciduous tree	Bushveld and coastal bush.	Very Low
44	*Eucalyptus spp.*	Gum tree	Trees & Tall shrubs	Exotic (1b/2)	LC	Large evergreen tree	Planted exotic of commercial forestry plantations.	Low

No.	Botanical Name	Common Name	Type	Status	Threat Status	Description	Habitat	Abundance
45	*Hyphaene coriacea*	Lala palm	Trees & Tall shrubs	SA Endemic	LC	Palm tree	Bushveld, coastal bush, coastal grassland.	Very Low
46	*Phoenix reclinata*	Wild date palm	Trees & Tall shrubs		LC	Palm/tree/shrub	Bushveld, grassland, often along streams.	Very Low
47	*Psidium guajava*	Guava	Trees & Tall shrubs	Exotic (2)	LC	Evergreen shrub or small tree	Invader of grasslands, forest gaps, roadsides and watercourses.	High
48	*Sesbania bispinosa*	Spiny sesbania	Trees & Tall shrubs	Exotic	LC	Shrub	Weed of disturbed areas.	Very Low
49	*Strychnos spinosa*	Green monkey-orange	Trees & Tall shrubs		LC	Armed deciduous shrub or small tree	Bushveld, sand forest, coastal bush.	Low
50	*Syzygium cordatum*	Waterberry, Umdoni	Trees & Tall shrubs		LC	Medium to large evergreen tree	Wooded areas and riparian forest.	Moderate
51	*Smilax anceps*	Thorny rope	Woody climbers		LC	Scrambling climber	Grassland, thicket, forest.	Low

Annexure C: Impact Assessment Method.

Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact (or resource being affected), and the likelihood / probability of the impact occurring. In light of this understanding, significance can only be assessed if one knows the importance or value of the environmental change/impact. Thus, end point or eventual impacts that can be valued like impacts to water resources, ecosystem services and biodiversity conservation can only be assessed in terms of significance and are referred to as ultimate consequences of an activity or a suite of impacts. Put another way, the significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed.

For the purposes of this assessment, the assessment of potential impacts was undertaken using an "Impact Assessment Methodology for EIAs" provided by Savannah Environmental.

The approach adopted is to identify and describe all potential primary (direct), secondary (indirect) and cumulative impacts resulting from the proposed construction and operational activities. As a starting point the extent of the impact is defined upfront. Thereafter, remaining impact rating criteria are scored based on the predefined extent of impacts. Intensity is rated as the realistic consequence (end-point) of an activity under the various mitigation scenarios. The rating of intensity has been specifically defined for specialist terrestrial and aquatic impacts so as to reduce ambiguity that could arise in the assessment process. Probability rates the likelihood of the impact (s) being assessed occurring across the predefined extent of the anticipated impacts and has been specifically linked to expected probabilities of occurrence. Finally, impact duration rates the time period or lifecycle of a specific impact.

The assessment of impact significance is based on the basic risk formula **Risk = consequence x probability:**

$$S = (E + D + M) * P$$

Where:

S = Significance weighting
E = Extent of impact
D = Duration of impact
M = Magnitude of impact (consequences)
P = Probability of occurrence

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

The **significance weightings** for each potential impact are as follows:

Impact Significance	Impact Significance Score Range	Definition
High	>60	The impact must have an influence on the decision process to develop in the area.
Medium	30-60	The impact could influence the decision to develop in the area unless it is effectively mitigated.
Low	<30	This impact would not have a direct influence on the decision to develop in the area.