A REHABILITATION AND REVEGETATION PLAN FOR THE PROPOSED COMBINED CYCLE GAS TURBINE (CCGT) POWER PLANT AND ASSOCIATED INFRASTRUCTURE, SALDANHA BAY LOCAL MUNICIPALITY, WEST COAST DISTRICT MUNICIPALITY, WESTERN CAPE PROVINCE

An EOH Company

Prepared for: **VORTUM ENERGY (PTY) LTD**

Prepared by: **Exigo Sustainability**

Email info@exigo3.com
Tel +27 012 751 2160
Fax +27 086 607 2406

The Village Office Park (Block E),
309 Glenwood Road, Faerie Glen,
Pretoria, 0043

Postnet Suite 74,
Private Bag X07,
Arcadia, 0007

An EOH Company

Innovation in Sustainability

www.exigo3.com

A REHABILITATION AND REVEGETATION PLAN FOR THE PROPOSED COMBINED CYCLE GAS TURBINE (CCGT) POWER PLANT AND ASSOCIATED INFRASTRUCTURE, SALDANHA BAY LOCAL MUNICIPALITY, WEST COAST DISTRICT MUNICIPALITY, WESTERN CAPE PROVINCE

ECOLOGICAL REPORT

April 2016

Conducted on behalf of:
Vortum Energy (Pty) Ltd

Compiled by:

Dr. BJ Henning (PhD plant Ecology; M.Sc Botany - Soil Science related Pr.Sci.Nat)

Reviewed by:

Ms. E. Grobler (EAP.)

REPORT DISTRIBUTION LIST

Name	Institution
Mr. D. Ventura	Vortum Energy (Pty) Ltd
Ms. E. Grobler	AGES Limpopo

DOCUMENT HISTORY

Date	Version	Status
February 2016	1.0	Draft 1
April 2016	2.0	Final

Table of contents

1 ASSIGNMENT

Exigo Sustainability was appointed by AGES Limpopo to compile a rehabilitation and revegetation plan for the proposed establishment of an energy generation facility (thermal power plant) with associated infrastructure and structures on a portion (±130 ha) of the Remainder of the Farm LANGEBERG 188, Malmesbury RD (861.6007 ha in extent), located within the Saldanha Bay Local Municipality, West Coast District Municipality, Western Cape Province. The development also includes the development of a new powerline corridor between the site and the Aurora Substation, as well as a natural gas or liquid fuel supply pipeline.

The assignment is interpreted as follows: Compile a management plan to be implemented by the Environmental Control Officer (ECO) for the rehabilitation and revegetation of the proposed development site. The study will be done according to guidelines stipulated by the Department of Environmental Affairs and Tourism (DEAT.

1.1 INFORMATION SOURCES

The following information sources were obtained:

1. All relevant maps through Geographical Information Systems (GIS) mapping, and information (previous studies and environmental databases) on the rehabilitation and revegetation of the site concerned;
2. Requirements regarding the management plan as requested by DEAT;
3. Information on the micro-habitat level was obtained through obtaining a first-hand perspective from the ecological study compiled by Hoare (2012) was also utilized for this study.

1.2 REGULATIONS GOVERNING THIS REPORT

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 38282 Government Notice R. 982. Appendix 6 – Specialist reports includes a list of requirements to be included in a specialist report:

1. A specialist report or a report prepared in terms of these regulations must contain:
    a. Details of
        i. The specialist who prepared the report; and
        ii. The expertise of that specialist to compile a specialist

report, including a curriculum vitae;

b. A declaration that the specialist is independent in a form as may be specified by the competent authority;

c. An indication of the scope of, and purpose for which, the report was prepared;

d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment;

e. A description of the methodology adopted in preparing the report or carrying out the specialized process;

f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;

g. An identification of any areas to be avoided, including buffers;

h. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;

i. A description of any assumptions made and any uncertainties or gaps in knowledge;

j. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;

k. any mitigation measures for inclusion in the EMPr;

l. any conditions for inclusion in the environmental authorisation;

m. any monitoring requirements for inclusion in the EMPr or environmental authorisation

n. a reasoned opinion –

   i. As to whether the proposed activity or portions thereof should be authorised and

   ii. If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr and where applicable, the closure

plan;

o. A description of any consultation process that was undertaken during the course of preparing the specialist report;

p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

q. Any other information requested by the competent authority.

1.3 TERMS OF REFERENCE

1.3.1 Objectives

a. The main aim of the plan is to provide guidelines to be implemented after the construction phase of the development to ensure that previous impacts are rectified by rehabilitating or restoring the affected environment. This will include attempts at habitat re-creation, to restore the original land uses and biodiversity values;
b. Provide management and rehabilitation guidelines to ensure that the biodiversity will form part of a sustainable environment after rehabilitation;
c. Make recommendations in terms of revegetation ecological management and rehabilitation procedures for the general environment of the site and surrounding areas;

1.3.2 Limitations and assumptions

- In order to obtain a comprehensive understanding of the dynamics of rehabilitation and revegetation plan, monitoring should ideally be replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible;
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative sections, as well as general observations, generic data and a desktop analysis;

2 INTRODUCTION

Rehabilitation can be defined as the return of disturbed areas to a safe, stable, productive and self-sustaining condition that promotes bio diverse land use. Land rehabilitation techniques can be used to speed up the time required to restore the impacted area back to its original, or better, state. To re-create and maintain a sustainable environment it is important to plan how the areas to be impacted by the construction of the Shirley Solar Park will be rehabilitated and revegetated.

A central purpose in rehabilitation planning should be to promote the ecological integrity of each site and surrounding landscapes. The application of ecological restoration principles requires that plans are developed consistent with regional or landscape level ecological objectives. At the local scale, this involves an examination of surrounding landscapes, in combination with determining predicted successional trends of vegetation communities appropriate to enhance local and regional ecosystems.

At the site level, emphasis is placed on rehabilitation techniques such as land-form replication and planting species that will promote site stability and sustainability. Re-vegetation should use indigenous species that contribute most to the compatibility of the local ecology and increase biodiversity.

The final goal of the rehabilitation planning process is a practical, achievable and adequately resourced rehabilitation programme. Rehabilitation of the disturbed areas should be done in such a way to ensure that the rehabilitation and revegetation on the site for the Shirley Solar Park will be sustainable in the long term.

3 STUDY AREA

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

The project site consists of a portion (±130 ha) of the Remainder of the Farm LANGEBERG 188, Malmesbury RD (861.6007 ha in extent), located within the Saldanha Bay Local Municipality, West Coast District Municipality, Western Cape Province. The project site is located 9 km North-East of the Port of Saldanha Bay, West of the regional road R27, in an area excluded from the provisions of the Subdivision of Agricultural Land Act (Act 70 of 1970) and already earmarked for Industrial Uses.

The Eskom Blouwater Distribution Substation is located 3.2 km South-West of the project site; the Saldanha Steel Works is 5km West-South-West from the project site; the Langebaanweg Military Airport is 7.5 km East of the project site.

Access to the project site would be either:

- From the regional road R27, which runs adjacent to the eastern boundary of the project site; or
- From a secondary road (R79) linking the regional road R27 with the regional road R399, which runs adjacent to the southern boundary of the project site.

The developed area (footprint) will be up to 80 hectares. The energy generation facility will be a thermal power plant with a maximum generation capacity up to 1200 MWel (electrical rated power). The aerial image of the site is indicated in figure 2.

The name of the facility will be VORTUM THERMAL POWER PLANT. The characteristics, the technology and the extent of the initiative are defined more in detail below.

The proposed thermal power plant will be a Combined Cycle Gas Turbine (CCGT) power plant, to be fuelled with natural gas imported by means of one or more gas import facilities (e.g. LNG Import Terminal(s) and/or new gas pipeline(s)). Indeed the Department of Energy is investigating the feasibility of new gas pipelines and LNG Import Terminals, in order to import natural gas from new offshore gas fields and/or from other countries (e.g. Mozambique). The securing of new energy sources, like natural gas, has become high priority for the Government, considering that the current energy production is not able to meet the increased energy demand of the Country. This leads to frequent electricity shortage and fluctuations in supply (“load shedding”), detrimental to the economic development of South Africa.

Should natural gas not be available at the time of the commissioning of the Vortum Thermal Power Plant, the proposed facility may be fuelled with liquid fuel (diesel or other types of liquid fuels) until natural gas is available. Gas turbines can be fuelled either with natural gas or

liquid fuel.

Due to the current electricity shortage and the urgent need for new power generation units in the Country, the Vortum Thermal Power Plant may operate as an Open Cycle Gas Turbine (OCGT) power plant as a first phase and in the second phase, with the “closure” of the open cycle (by means of steam turbine units added to the gas turbine unites), as a Combined Cycle Gas Turbine (CCGT) power plant. The construction timeframe of an OCGT plant is notably shorter than that of a CCGT plant.

In a CCGT power plant a Rankine cycle (steam cycle) is added to a Brayton cycle (gas cycle). The combination of the two thermodynamic cycles results in improved overall efficiency as less heat is wasted because heat is recovered - the "waste" heat from the gas cycle is utilised to produce steam to generate additional electricity via steam turbine units, enhancing the efficiency of overall electricity generation. The thermal efficiency of a CCGT power plant is up to 62%.

A Combined Cycle Gas Turbine (CCGT) power plant consists of gas turbine units coupled with steam turbine units: the "waste" heat from each gas turbine is sent to heat recovery steam generators (HRSG) to generate high pressure steam; the steam from the HRSG drives steam turbines coupled with generators, in order to generate electricity increasing the efficiency of the power plant.

Each gas turbine and steam turbine is coupled to the single generator in a tandem arrangement, on a single shaft (single-shaft configuration). The CCGT power plant will consist of the following components:

- Two or more gas turbine units with a capacity up to 400 MWel (electrical rated power) each;
- Fuel storage facility (in case of liquid fuel);
- Heat recovery steam generators (HRSG) to generate steam;
- Two or more steam turbine units with a capacity up to 220 MWel (electrical rated power) each;
- Electrical generators, which convert the mechanical energy of the gas and steam turbine units to electricity;
- Gas compressors and combustors, for the gas cycle;
- Water pumps and pressurisers, for the steam cycle;
- Cooling system, with condensers & cooling towers, in order to condensate the steam

to water;

- A dam, to collect the water necessary for the generation of steam;
- A control room with offices;
- Warehouses;
- A natural gas or liquid fuel supply pipeline;
- A water supply pipeline;
- On-site high voltage substation;
- High-voltage power lines, for the connection to the Eskom grid.

The number and size (capacity) of the gas and steam turbine units has not been finalised yet and will depend on the load (demand) curve required by the grid. This will be assessed during the scoping phase in consultation with Eskom.

The CCGT power plant may consist of - e.g.:

- 2 gas turbines units of 375 MWel each + 2 steam turbines units of 200 MWel each (overall installed capacity: 1150 MWel); or (e.g.)
- Gas turbines units of 150 MWel each + 5 steam turbines units of 80 MWel each (overall installed capacity: 1150 MWel); or (e.g.);
- A combination of different sizes of gas and steam turbine units.

The overall installed capacity will nevertheless be up to 1200 MWel. The Vortum Thermal Power Plant will deliver the energy to the Eskom AURORA main transmission substation via one or more 400 kV power lines approximately 27 km long. The number of new 400 kV power lines will be assessed during the scoping phase in consultation with Eskom. The proposed power line corridor runs parallel to existing Eskom high-voltage power lines and may cross through the following properties (please refer to Locality Map Figure 1)

- Portions 1 and 9 (Remaining Extent) of the Farm LANGEBERG 187;
- Portions 1 and Remainder of the Farm UYEKRAAL 189;
- Farm EVERTS HOPE 190;
- Farm WASCHKLIP 183;
- Farm ZOUTEKUYLEN 179;
- FARM 1162;
- Portions 3 and 8 of the Farm LANGVERWACHT 178;

- Farm ADJOINING SPRINGFONTEIN 174;
- Portions 3 and 4 of the Farm DRIEHOEKS FONTEIN 176

A natural gas / fuel supply pipeline is also planned as part of the development.

Vortum Thermal Power Plant Rehabilitation & Revegetation Plan

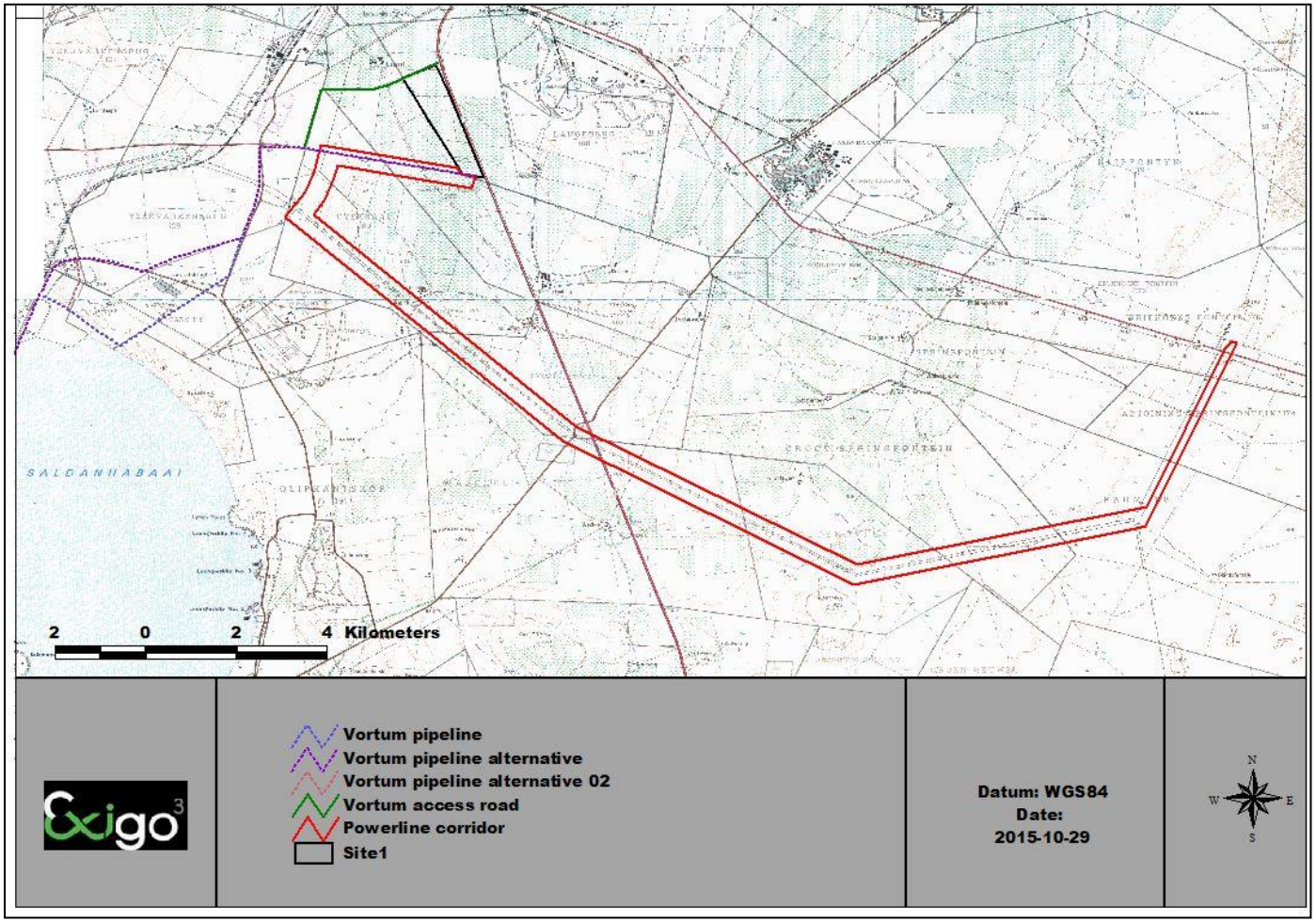

Figure 1. Regional Location Map

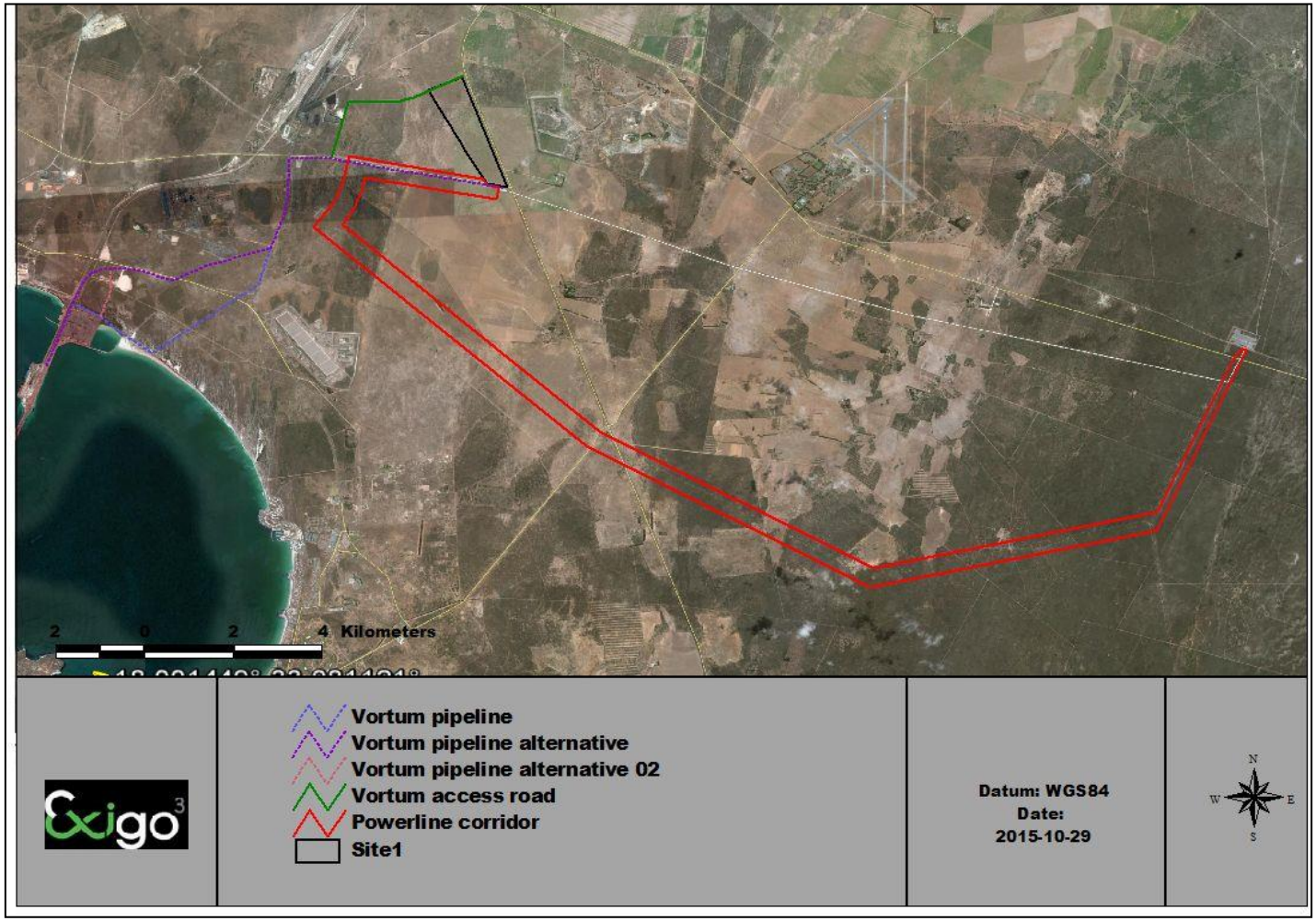

Figure 2. Satelite image showing the project area (Google Pro, 2010)

Vortum Thermal Power Plant Rehabilitation & Revegetation Plan

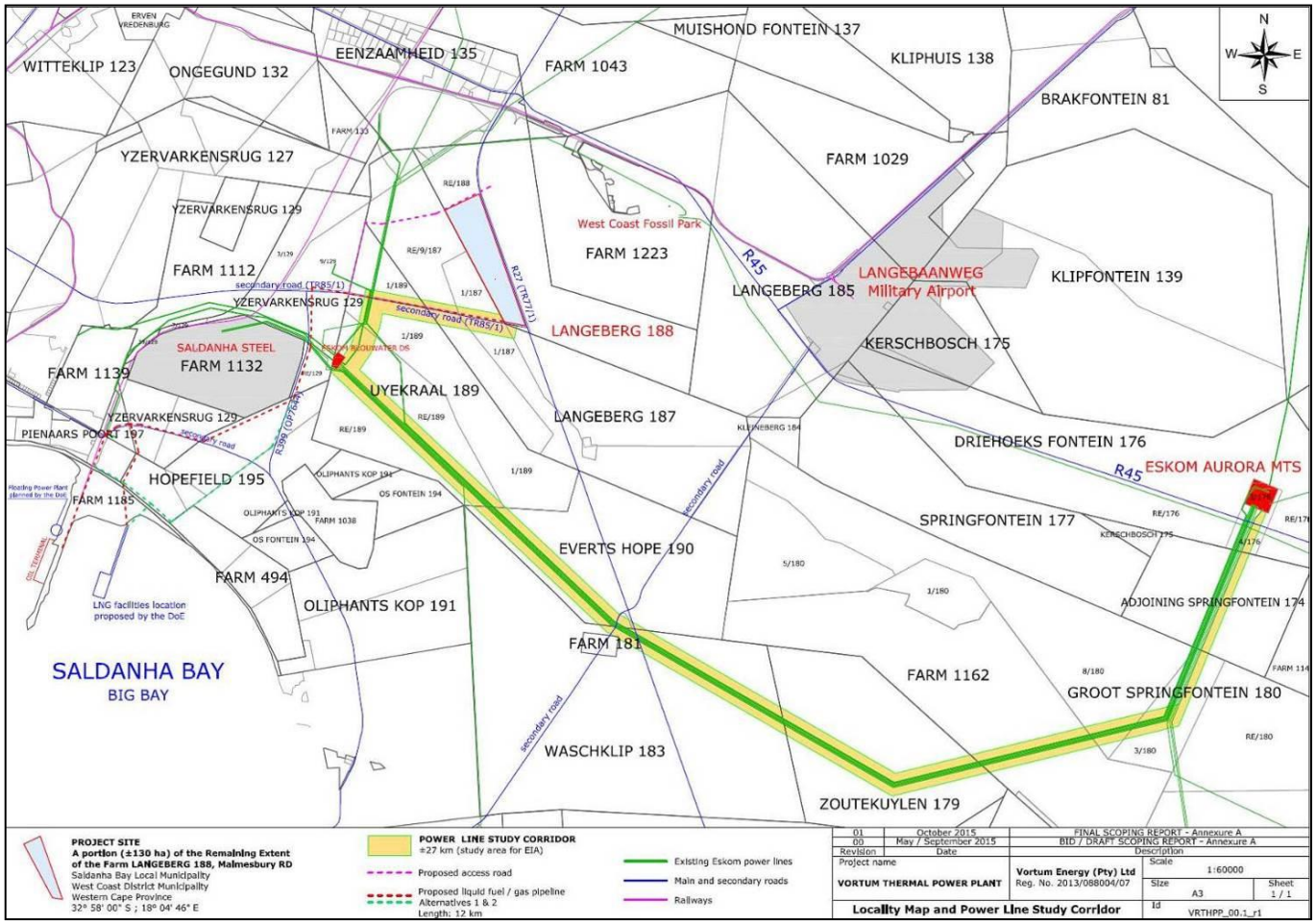

Figure 3. Layout Map of the proposed Vortum Thermal Power Plant and associated powerline and gas / fuel pipelines

4 PRINCIPLES OF ENVIRONMENTAL REHABILITATION

4.1 BEST PRACTICES IN REHABILITATION PLANNING AND MANAGEMENT

Use of rehabilitation planning and environmental management that aims for sustainability is encouraged in all aspects of reclamation planning, design and implementation. Environmental Guidelines by the Department of Water Affairs and Forestry (DWAF), 2005 aims to guide environmental management during all phases of a project lifecycle.

These Environmental Best Practice Guidelines for; Planning; Construction, Operation and Decommissioning Planning provide a scientific-based, comprehensive and integrated strategies to also perform rehabilitation for developments and therefore mitigate against safety hazards and environmental degradation.

4.2 APPLIED PRINCIPLES OF ECOLOGICAL RESTORATION

A central purpose in rehabilitation planning should be to promote the ecological integrity of each site and surrounding landscapes. The application of ecological restoration principles requires that plans are developed consistent with regional or landscape level ecological objectives. At the local scale, this involves an examination of surrounding landscapes, in combination with determining predicted successional trends of vegetation communities appropriate to enhance local and regional ecosystems.

At the site level, emphasis is placed on rehabilitation techniques such as land-form replication and planting species that will promote site stability and sustainability. Re-vegetation should use indigenous species that contribute most to the compatibility of the local ecology and increase biodiversity.

Ecological restoration with biodiversity benefits in mind must involve an orderly set of considerations that promote successful procedures and practices. Often these practices, although based on similar general considerations, will need to be innovative because of the unique set of circumstances that each area and ecosystem to be restored represents. The restoration objectives must be formulated from a detailed knowledge of the basic structural and functional characteristics of natural ecosystems.

The development of measurable criteria for judging restoration success has proved difficult but they are usually derived from the particular community and ecosystem characteristics desired as restoration objectives (Johnson and Putwain 1981; Hobbs and Norton 1996). Cairns (1993) provides three general success guidelines that the restored ecosystem should attain: (i) self-regulation for some set period of time, where self-regulation means the structural and functional attributes persist in the absence of whatever “subsidies” (fertilizer, seeding etc.) may have been necessary during the initial phases of implementation; (ii) the design criteria (restoration goal and objectives) established before restoration was undertaken; (iii) no observable adverse effects in the larger ecological landscape.

From these criteria, it can be seen that it is absolutely necessary to have restoration objectives that have unambiguous operational definitions (technically feasible), which are ecologically sound (scientifically valid) and socially relevant, and that are receptive to measurement and prediction (Cairns 2000). The ecosystem characteristics measured are usually those related to the composition, structure, and pattern of the vegetation as a key component of the biodiversity pool (Allen 1992). It is notable that some important structural measurements of biodiversity are usually omitted (Chambers et al. 1994). In particular, measurements concerning the soil biotic community and animal species numbers are not usually made, even though they can often provide important indications of long-term productivity and successional pathways (Chambers and Wade 1992).

Ecosystem characteristics for consideration as ecological restoration objectives (adapted from Hobbs (1999) are:

- Composition: species presence and their relative abundance;
- Structure: vertical arrangement of vegetation and soil components;
- Pattern: horizontal arrangement of system components;
- Heterogeneity: a variable composing of characteristics 1–3;
- Function: performance of basic ecosystem processes (energy capture, water retention, nutrient cycling);
- Species Interactions, e.g., pollination, seed dispersal etc.;
- Dynamics and resilience: succession and state-transition processes, ability to recover from normal episodic disturbance events (e.g., floods, drought, fire).

In the restoration of sites where the topsoil has been lost, the major ecological challenges are still concerned with plant species–substrate interactions, i.e., revegetation. Restoration practice where topsoil has been retained focuses less on vegetation establishment and more on the spatial and temporal factors affecting species colonization and establishment, the criteria for monitoring and assessing success, particularly in the longer term, and the restoration of natural indigenous ecosystems and biodiversity values.

4.3 COMPATIBILITY IN LAND USE, LAND COVER AND LANDSCAPE DESIGN

Final rehabilitation plans and designs should ensure that the natural ecological land use system of the site is restored and maintained through a sustainable development solution. Landscape design and development plans should be incorporated into the rehabilitation planning process; including landforms, structures, planting pallet development and surrounding developments interface with the site and natural drainage system.

5 THE REHABILITATION WORKS/METHODS

The Environmental Rehabilitation process at the site should form an integral part of site development, operation and closure activities. A Rehabilitation Specialist and/or Environmental Control Officer (ECO) should therefore be appointed, and be available on-site as part of the rehabilitation management / construction team. The ECO should form an integral part of the management team, attending regular site meetings, receiving Project Meeting Minutes and being kept fully updated regarding the closure plan and site rehabilitation process.

This information is vital in ensuring that the necessary preventative measures and Search and Rescue activities are affected timeously.

5.1 IDENTIFICATION AND PROTECTION OF ENVIRONMENTALLY SENSITIVE AREAS

The on-site Environmental Control Officer and/or Rehabilitation Specialist should be fully aware of the scale and extent of the rehabilitation operations. No further vegetation clearing, levelling, excavation, topsoil removal or plant material removal is to be permitted without prior consent from the ECO and Rehabilitation Specialist based on the rehabilitation plan for the site unless instructed by them. Care must be taken during rehabilitation to avoid the natural drainage areas occurring on the property. No vegetation clearance, topsoil collection or movement of machinery and vehicles should be allowed here as to keep the ecological integrity of the drainage areas intact.

5.2 COMPREHENSIVE PHOTOGRAPHIC RECORD

In order for practical and attainable rehabilitation goals to be defined, it is recommended that a comprehensive photographic record of the entire property be created. Video footage may also be useful in compiling such a record. A photographic record of the entire property should be kept as it could become a very valuable tool for the Rehabilitation Works in future. It would serve as the basis for rehabilitation requirements, informing decisions on drainage, soil shaping, levels, plant choices and rehabilitation in general. It can also serve as a verification report to authorities and land administrators regarding the legislative processes, sustainable approach and progressive improvement.

5.3 SEARCH AND RESCUE ACTIVITIES

Search and rescue should be considered only as a last resort and sensitive areas and SCC should be avoided first. If search and rescue is deemed necessary, a safe receiving environment must be identified first, in collaboration with Cape Nature

.Search and Rescue activities could be initiated as part of the Rehabilitation process. Where rehabilitation actions will commence, viable, transplantable plant species could be identified by the ECO / Rehabilitation Specialist, removed and stored in a potential ‘on-site’, self

sustaining nursery, to be re-used in rehabilitation activities in future.

Plant material that is to be “rescued” must be potted up into bags utilising local soil obtained from the previously stored topsoil heap. Adequate root systems per plant material type must be carefully excavated and retained in order for plant material to remain viable. Search and Rescue activities would include the removal of grass clumps, smaller transplantable shrubs and trees and endangered species such as geophytes and succulents should be placed into bags using local soil.

Animals like small mammals, reptiles and birds encountered during rehabilitation operations should be captured or moved by a specialist and released in a safe area. No animals may be poached at the property or adjacent areas. Many animals are protected by law and poaching or other interference could result in a fine or jail term.

5.4 CLEARED INDIGENOUS PLANT MATERIAL

Where construction or rehabilitation activities are to commence in a specific area, certain indigenous plant material from the construction footprint area could be collected and bagged to be used in re-vegetation or as mulch during rehabilitation.. To protect exposed, erosion prone areas, Sickle bush could be cut and used to *“brush pack”* these problem areas to protect it. This will also restrict movement of animals and humans over sensitive erosion probe areas until pioneer vegetation has established.

5.5 TOPSOIL, STOCKPILES AND BACKFILLING

The manner in which topsoil and stockpiles are created and maintained is important with regards to the implementation of a successful rehabilitation process. Soil management practices must be adhered to in order to reduce soil loss and to encourage rehabilitation post-construction. The two most important aspects to consider when removing topsoil are the depth of soil to be removed and the conditions of storage.

The topsoil layer (0-25 cm) is important as it contains nutrients, organic material, seed, and communities of micro-organisms, fungi and soil fauna. The biologically active upper layer of soil is fundamental in the development of soils and the sustainability of the entire ecosystem. The correct handling of topsoil is vital in conserving the seed bank and nutrients which occur within this layer thereby ensuring successful rehabilitation.

- Topsoil must only be used for rehabilitation purposes and not for any other use example i.e. construction of roads. Topsoil should not be stored for longer than 3 months otherwise any seedbank that may be contained will not be viable;
- Previously excavated areas on the site should be backfilled with suitable topsoil, levelled to resemble the surrounding topography and slopes and scarified for re-vegetation/re-seeding.

- On steeper slopes rehabilitation measures may include systems such as soil terracing, berm creation, grass blocks, fascine work, gabion basket work, reno mattresses, retaining block mechanisms, sand bags, boulder and rock placement, stone pitching, and grading.
- Erosion control netting or matting (GeoJute or Bio-Jute) may be utilised on steep slopes to assist with soil retention, weed control and vegetation establishment. The netting material helps protect the soil from wind and water erosion, and the required rehabilitation plant material can be installed by making small incisions for planting. The netting is biodegradable and will eventually break down and form a mulch layer.

5.6 COMPACTION REHABILITATION MEASURES

Soil compaction is often an effect of high traffic areas on development sites. It can become a major problem and can be recognized by:

- Excess surface moisture and slow drying soils due to deeper compaction preventing the percolation of water through the soil profile;
- Water runoff due to surface compaction preventing penetration and absorption (ponding of water), especially on banks and sloping surfaces.
- Large clear or sparsely covered areas devoid of a good vegetative cover due to hardened topsoil layers

Rip and/or scarify all disturbed areas, including roads that are no longer in use (preferably before the rainy season). Do not rip and/or scarify areas under wet conditions, as the soil will not loosen.

Compacted soil can also be decompacted by “Rotary Decompactors” to effectively aerate soils for vegetation establishment.

5.7 EROSION REHABILITATION MEASURES

Water has the gift to sustain life, but also the potential to maim, damage and destroy if not managed correctly. Remedial actions must be established to ensure that potential erosion is addressed with an erosion control strategy towards long-term rehabilitation. It is important to take note of the following generic points regarding erosion risks in the study area:

- Soil loss will be greater during wetter periods. However, the provision of erosion control measures for the through the drier months of the year is equally as important;
- Soil loss from the site is proportionally related to the time the soils are exposed, prior to rehabilitation. The time from commencement of rehabilitation activities to finalization thereof should be limited. Rehabilitation efforts should commence as soon as practical;
- Construction staging and progressive/concurrent rehabilitation is important; and
- The extent of the disturbance that will take place will influence the risk and consequences of erosion on the site.
- Avoid over-wetting, saturation and unnecessary run-off during dust control activities and irrigation.
- Retain natural indigenous grass and shrubs and re-vegetate bare areas as soon as possible.

5.8 RE-VEGETATION

Plant species that have been rescued or removed and relocated to the temporary nursery could be used in replanting rehabilitation areas.

Additional plant material (indigenous trees) as required should be sourced from local indigenous nurseries and specifications regarding plant sizes, heights and the installation process of these plants should be developed by the On Site ECO and Rehabilitation Specialist. Standard horticultural best practice would apply, with specific reference to the fact that the plant material would have to be in good condition, free from pests and diseases (any such plant would have to be removed from the site), well formed and well rooted, potting materials are weed free and with sufficient root cover. Groundcovers and sedges are often supplied in trays, and the same standards would apply.

- A grass seed specification for reseeding the rehabilitated areas should coincide with the natural vegetation of the area and should be recommended by a rehabilitation specialist. Re-grassing should be undertaken (as far as possible) during the summer months, as germination and establishment is best at this time of year. Spring rains are also conducive to good germination results, and as such rehabilitation

programmes should take these factors into consideration.

- There are two methods for seeding, hand broadcasting and hydro-seeding. The methods utilised will be site specific and the On Site ECO and Rehabilitation Specialist will determine them.
- In certain areas grass runners may be required, and grass sods where instant cover is necessary.

5.9 INVASIVE PLANT SPECIES

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) holds landowners legally responsible for the control of invasive alien plants on their properties.

Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the Conservation of Agricultural Resources Act or in terms of Working for Water guidelines.

Scientists and field workers use a range of methods to control invasive alien plants. These include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

The following management principles should be implemented:

- The Contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase. Alien invasive tree species such as black wattle and blue gum should be eradicated.
- Topsoil should not be stored for longer than 3 months otherwise any seedbank that may be contained will not be viable. Only locally indigenous grass species and shrubs should be used for rehabilitation purposes.
- Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-

residual insecticides prior to transport to or in a quarantine area on site. The Argentine ant is nearly impossible to eradicate once it has established itself.

- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds. Specific "problem areas" where clearing needs to be done with extreme caution to prevent impact on surrounding natural vegetation include:
    - Sand fynbos areas
    - Natural strandveld habitats
- Ongoing, annual alien plant management must be undertaken in the High and Medium sensitivity sections of the servitudes. Methodology used must comply with DWAF methodology for control of *Acacia saligna* and *Acacia cyclops*
- Key elements include: alien clearing must be undertaken by well trained teams using the right equipment; all stems must be cut by hand (not heavy machinery); all cut stumps must immediately (within 5 minutes) be painted with a suitable herbicide that contains a visible dye (in order to prevent resprouting, and to ensure that all stems are painted); no spraying of herbicide; cut stems must be neatly stacked at the outside edges of the servitudes, or preferably removed from the servitudes to an approved organic waste dump site. Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.
- Bi-annual monitoring should be undertaken by an independent consultant to ensure that alien vegetation is being cleared appropriately from the High sensitivity areas, and to ensure that these areas are not being bushcut more than once every ten years.
- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the Conservation of Agricultural Resources Act or in terms of Working for Water guidelines.
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.

- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds.
- During site visits in November 2015 no serious problem areas in terms of invasive plants were noticed apart from a few solitary species like the *Acacia cyclops* and *Acacia mearnsii*. Invasive plants should be monitored and eradicated as soon as they appear in the project area.

5.10 FIRE HAZARD

Wildfires can be started both by people and by acts of nature. They are often associated with slash and burn activities, which in times of drought, can pose greater hazards. Negligence of people often plays a major role in such a hazard. Factors affecting the impact of vegetation fire hazards are:

  - Vegetation dryness (moisture content and amount of living vegetation);
  - Changes in weather variables that influence the spread and intensity of fires;
  - Availability of combustibles; and
  - Long term drought in the dry season.

- The grass cover along the boundary fences of the adjacent properties should be kept short (30 cm) in order to minimise the fire hazards;
- Adequate precautions have to be taken to ensure that fires are not started on site;
- Do not permit any fires or open flames anywhere on the site, except at designated areas;
- Cleared vegetation must not be burned on the site.

5.11 FAUNA

- Rehabilitation should be done to ensure that fauna which occurred in the area of the solar farm return to the area. The reduction of construction activities and vehicles on the site should allow faunal populations to utilise the rehabilitated area once again;
- If pesticides or herbicides are used, the products should be chosen responsibly to act in accordance with the sensitive environment and associated ecology. Storage, administering and disposal must be done according to the prescribed methods. Care should be taken to prevent any of the pollution from ending up in the drainage channels;
- The restoration or rehabilitation actions will need the implementation of a faunal monitoring program as a barometer for the management to recognise positive changes and trends in the

biodiversity of the development area during and after closure. The objectives of such a programme may include:

  - Assessment of future improvement/deterioration of the faunal biodiversity of the area (thus a measure of success of environmental management);
  - Increase the accuracy of present status determination (actual species present vs. expected species) of the area with every survey;
  - Determination of both temporal and spatial trends in faunal biodiversity on the area;
  - Assist in future management of the area by providing recommendations and guidelines regarding future activities and rehabilitation;

- Biodiversity management actions during closure should include controlling and monitoring of numbers of alien invasive fauna numbers by eradication, habitat modification, resource limitation and public education.
- Young nutrient rich growth may entice herbivores to rehabilitated areas. The increased grazing pressure may decrease the rate of rehabilitation. Herbivore-proof fencing or brush packing may be required around the rehabilitation zones in the early stages to protect seedlings from grazers if grazing pressure is found to significantly affect growth;
- Revegetation programs will include consideration of the possibility of reconstructing fauna habitats. Old salvage logs from cleared areas will be replaced after construction where possible, to provide habitat for fauna;

6 REHABILITATION AND REVEGETATION OF THE SITE

The following methods and principles apply for rehabilitation purposes:

- All areas where material will be removed for backfill and rehabilitation construction purposes should be graded and shaped in such a way as to resemble the natural surrounding landscape;
- All bare areas should be ripped/scarified;
- A grass seed specification for re-seeding the rehabilitated areas is provided below. Re-grassing should be undertaken (as far as possible) during the summer months, as germination and establishment is best at this time of year. Spring rains are also conducive to good germination results, and as such rehabilitation programmes should take these factors into consideration.
    - There are two methods for seeding, hand broadcasting and hydroseeding. The methods utilised will be site specific and the on Site ECO and Rehabilitation Specialist will determine them.
    - In certain areas grass runners may be required, and grass sods where instant cover is necessary.
    - A typical grass seed mixture (hand sowing) typical of the Western Cape Sand Fynbos should be used for rehabilitation activities at a specification of 4-5kg/ha;

7 MAINTENANCE AND MONITORING

Several methods exist to monitor rehabilitated areas to scientifically prove that a self-sustainable ecosystem has developed or show a positive trend towards successful rehabilitation. This will prove that environmental degradation and biological diversity have been mitigated and restored where it has been negatively impacted upon. The important aspect to keep in mind is that it is not only a visual inspection, but measurable information gathering e.g. water samples, soil samples, vegetation diversity, biomass, basal cover, species composition etc. The monitoring data must be of such a standard that meaningful conclusions can be made and a trend indicated. Good record keeping is essential. All illegal invader plants and weeds shall be eradicated as required in terms of Sections 119 to 126 of The National Environmental Management Act.

Monitoring should take place on regular time intervals to establish if the revegetation strategy was successful. The site must be monitored for at least two years in order to observe any possible invasion by alien species and, if they appear, they must be controlled as is appropriate. Also to monitor and correct possible erosion, storm water and siltation problems. Soil sampling and analysis should be done every two years to monitor the development of the soil and need for supplementary fertilization.

8 REFERENCES

GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y and KEITH, M. (eds.) (2006). A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41, SABONET, Pretoria.

Henning B. 2014. Specialist ecological study for the proposed Shirley Solar Park. Exigo Sustainability (Pty) Ltd.

IUCN (2001). IUCN Red Data List categories and criteria: Version 3.1. IUCN Species Survival Commission: Gland, Switzerland.

MUCINA, L., RUTHERFORD, M.C., PALMER, A.R., MILTON, S.J., SCOTT, L., VAN DER MERWE, B., HOARE, D.B., BEZUIDENHOUT, H., VLOK, J.H.J., EUSTON-BROWN, D.I.W., POWRIE, L.W. & DOLD, A.P. 2006. Dwaalboom Thornveld. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

MUELLER-DOMBOIS, D. AND ELLENBERG, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

RUTHERFORD, M.C. & WESTFALL, R.H. (1994). Biomes of southern Africa: an objective categorization. Memoirs of the Botanical Survey of South Africa No. 63.

9 APPENDIX A. PLANT SPECIES LISTS FOR QDS

Family	*Species*	Threat status	SA Endemic
AIZOACEAE	*Aizoon paniculatum L.*	LC	No
AIZOACEAE	*Galenia africana L.*	LC	No
AIZOACEAE	*Tetragonia fruticosa L.*	LC	No
AIZOACEAE	*Tetragonia rosea Schltr.*	LC	No
AMARYLLIDACEAE	*Amaryllis belladonna L.*	LC	No
AMARYLLIDACEAE	*Boophone haemanthoides F.M.Leight.*	LC	No
AMARYLLIDACEAE	*Brunsvigia orientalis (L.) Aiton ex Eckl.*	LC	No
AMARYLLIDACEAE	*Gethyllis afra L.*	LC	No
AMARYLLIDACEAE	*Gethyllis ciliaris (Thunb.) Thunb. subsp. ciliaris*	NT	No
AMARYLLIDACEAE	*Gethyllis lanuginosa Marloth*	LC	No
AMARYLLIDACEAE	*Haemanthus pubescens L.f. subsp. pubescens*	LC	No
AMARYLLIDACEAE	*Hessea mathewsii W.F.Barker*	CR	No
AMARYLLIDACEAE	*Strumaria chaplinii (W.F.Barker) Snijman*	EN	No
AMARYLLIDACEAE	*Strumaria tenella (L.f.) Snijman subsp. tenella*	LC	No
ANACARDIACEAE	*Searsia dissecta (Thunb.) Moffett*	LC	No
ANACARDIACEAE	*Searsia glauca (Thunb.) Moffett*	LC	No
ANACARDIACEAE	*Searsia laevigata (L.) F.A.Barkley var. laevigata forma laevigata*	Not Evaluated	No
ANACARDIACEAE	*Searsia pterota (C.Presl) Moffett*	LC	No
ANACARDIACEAE	*Searsia undulata (Jacq.) T.S.Yi, A.J.Mill. & J.Wen*	LC	No
ANTHERICACEAE	*Chlorophytum comosum (Thunb.) Jacques*	LC	No
ANTHERICACEAE	*Chlorophytum triflorum (Aiton) Kunth*	LC	No
APIACEAE	*Annesorhiza grandiflora (Thunb.) M.Hiroe*	LC	No
APIACEAE	*Annesorhiza macrocarpa Eckl. & Zeyh.*	LC	No
APIACEAE	*Arctopus dregei Sond.*	NT	No
APIACEAE	*Arctopus echinatus L.*	LC	No
APIACEAE	*Berula thunbergii (DC.) H.Wolff*	LC	No
APIACEAE	*Capnophyllum africanum (L.) Gaertn.*	NT	No
APIACEAE	*Capnophyllum leiocarpon (Sond.) Manning & Goldblatt*	Declining	No
APIACEAE	*Centella affinis (Eckl. & Zeyh.) Adamson var. affinis*	LC	No
APIACEAE	*Cynorhiza meifolia (Eckl. & Zeyh.) Magee*	DDD	No
APIACEAE	*Cynorhiza typica Eckl. & Zeyh.*	LC	No
APIACEAE	*Dasispermum hispidum (Thunb.) Magee & B.-E.van Wyk*	LC	No
APIACEAE	*Lichtensteinia obscura (Spreng.) Koso-Pol.*	LC	No
APIACEAE	*Torilis arvensis (Huds.) Link*	Not Evaluated	No
APOCYNACEAE	*Asclepias crispa P.J.Bergius var. crispa*	LC	No
APOCYNACEAE	*Cynanchum obtusifolium L.f.*	LC	No
APOCYNACEAE	*Microloma sagittatum (L.) R.Br.*	LC	No
APOCYNACEAE	*Orbea variegata (L.) Haw.*	LC	No
ASPARAGACEAE	*Asparagus aethiopicus L.*	LC	No

Family	*Species*	Threat status	SA Endemic
ASPARAGACEAE	*Asparagus capensis L. var. capensis*	LC	No
ASPARAGACEAE	*Asparagus declinatus L.*	LC	No
ASPARAGACEAE	*Asparagus exuvialis Burch. forma exuvialis*	Not Evaluated	No
ASPARAGACEAE	*Asparagus fasciculatus Thunb.*	LC	No
ASPARAGACEAE	*Asparagus kraussianus (Kunth) J.F.Macbr.*	LC	No
ASPARAGACEAE	*Asparagus lignosus Burm.f.*	LC	No
ASPARAGACEAE	*Asparagus retrofractus L.*	LC	No
ASPARAGACEAE	*Asparagus rubicundus P.J.Bergius*	LC	No
ASPARAGACEAE	*Asparagus undulatus (L.f.) Thunb.*	LC	No
ASPHODELACEAE	*Aloe microstigma Salm-Dyck subsp. framesii (L.Bolus) Glen & D.S.Hardy*	NT	No
ASPHODELACEAE	*Aloe perfoliata L.*	LC	No
ASPHODELACEAE	*Bulbine annua (L.) Willd.*	LC	No
ASPHODELACEAE	*Bulbine favosa (Thunb.) Schult. & Schult.f*	LC	No
ASPHODELACEAE	*Bulbine minima Baker*	LC	No
ASPHODELACEAE	*Bulbine praemorsa (Jacq.) Spreng.*	LC	No
ASPHODELACEAE	*Bulbine sedifolia Schltr. ex Poelln.*	LC	No
ASPHODELACEAE	*Bulbinella cauda-felis (L.f.) T.Durand & Schinz*	LC	No
ASPHODELACEAE	*Bulbinella nutans (Thunb.) T.Durand & Schinz subsp. nutans*	LC	No
ASPHODELACEAE	*Bulbinella triquetra (L.f.) Kunth*	LC	No
ASPHODELACEAE	*Kniphofia uvaria (L.) Oken*	LC	No
ASPHODELACEAE	*Trachyandra ciliata (L.f.) Kunth*	LC	No
ASPHODELACEAE	*Trachyandra divaricata (Jacq.) Kunth*	LC	No
ASPHODELACEAE	*Trachyandra hispida (L.) Kunth*	LC	No
ASPHODELACEAE	*Trachyandra revoluta (L.) Kunth*	LC	No
ASPHODELACEAE	*Trachyandra scabra (L.f.) Kunth*	LC	No
ASTERACEAE	*Amellus asteroides (L.) Druce subsp. asteroides*	LC	No
ASTERACEAE	*Amellus capensis (Walp.) Hutch.*	VU	No
ASTERACEAE	*Amellus tenuifolius Burm.*	LC	No
ASTERACEAE	*Anthemis cotula L.*	Not Evaluated	No
ASTERACEAE	*Arctotheca calendula (L.) Levyns*	LC	No
ASTERACEAE	*Arctotheca populifolia (P.J.Bergius) Norl.*	LC	No
ASTERACEAE	*Arctotis hirsuta (Harv.) Beauverd*	LC	No
ASTERACEAE	*Arctotis revoluta Jacq.*	LC	No
ASTERACEAE	*Berkheya rigida (Thunb.) Erwart, Jean White & B.Rees*	LC	No
ASTERACEAE	*Chrysanthemoides incana (Burm.f.) Norl.*	LC	No
ASTERACEAE	*Chrysocoma ciliata L.*	LC	No
ASTERACEAE	*Conyza canadensis (L.) Cronquist*	Not Evaluated	No
ASTERACEAE	*Cotula coronopifolia L.*	LC	No
ASTERACEAE	*Cotula duckittiae (L.Bolus) K.Bremer & Humphries*	VU	No
ASTERACEAE	*Cotula eckloniana (DC.) Levyns*	EN	No

Family	*Species*	Threat status	SA Endemic
ASTERACEAE	*Cotula filifolia Thunb.*	CR	No
ASTERACEAE	*Cotula turbinata L.*	LC	No
ASTERACEAE	*Didelta carnosa (L.f.) Aiton var. carnosa*	LC	No
ASTERACEAE	*Didelta carnosa (L.f.) Aiton var. tomentosa (Less.) Roessler*	LC	No
ASTERACEAE	*Dimorphotheca sinuata DC.*	LC	No
ASTERACEAE	*Dimorphotheca tragus (Aiton) B.Nord.*	LC	No
ASTERACEAE	*Eriocephalus africanus L. var. paniculatus (Cass.) M.A.N.Müll.,P.P.J.Herman & Kolberg*	LC	No
ASTERACEAE	*Eriocephalus racemosus L. var. affinis (DC.) Harv.*	LC	No
ASTERACEAE	*Eriocephalus racemosus L. var. racemosus*	LC	No
ASTERACEAE	*Euryops linifolius (L.) DC.*	LC	No
ASTERACEAE	*Euryops multifidus (Thunb.) DC.*	LC	No
ASTERACEAE	*Felicia bergeriana (Spreng.) O.Hoffm.*	LC	No
ASTERACEAE	*Felicia dregei DC.*	LC	No
ASTERACEAE	*Felicia elongata (Thunb.) O.Hoffm.*	VU	No
ASTERACEAE	*Felicia elongata (Thunb.) O.Hoffm.*	VU	No
ASTERACEAE	*Felicia filifolia (Vent.) Burtt Davy subsp. schlechteri (Compton) Grau*	LC	No
ASTERACEAE	*Felicia heterophylla (Cass.) Grau*	LC	No
ASTERACEAE	*Felicia hyssopifolia (P.J.Bergius) Nees subsp. glabra (DC.) Grau*	LC	No
ASTERACEAE	*Felicia merxmuelleri Grau*	LC	No
ASTERACEAE	*Felicia merxmuelleri Grau*	LC	No
ASTERACEAE	*Felicia tenella (L.) Nees subsp. pusilla (Harv.) Grau*	LC	No
ASTERACEAE	*Foveolina tenella (DC.) Källersjö*	LC	No
ASTERACEAE	*Gymnodiscus capillaris (L.f.) DC.*	LC	No
ASTERACEAE	*Helichrysum bachmannii Klatt*	VU	No
ASTERACEAE	*Helichrysum cochleariforme DC.*	NT	No
ASTERACEAE	*Helichrysum indicum (L.) Grierson*	LC	No
ASTERACEAE	*Helichrysum litorale Bolus*	LC	No
ASTERACEAE	*Helichrysum niveum (L.) Less.*	LC	No
ASTERACEAE	*Helichrysum patulum (L.) D.Don*	LC	No
ASTERACEAE	*Helichrysum revolutum (Thunb.) Less.*	LC	No
ASTERACEAE	*Helichrysum tricostatum (Thunb.) Less.*	NT	No
ASTERACEAE	*Ifloga ambigua (L.) Druce*	LC	No
ASTERACEAE	*Ifloga verticillata (L.f.) Fenzl*	LC	No
ASTERACEAE	*Leucanthemum vulgare Lam.*	Not Evaluated	No
ASTERACEAE	*Leysera gnaphalodes (L.) L.*	LC	No
ASTERACEAE	*Metalasia densa (Lam.) P.O.Karis*	LC	No
ASTERACEAE	*Metalasia muricata (L.) D.Don*	LC	No
ASTERACEAE	*Nidorella foetida (L.) DC.*	LC	No
ASTERACEAE	*Oedera imbricata Lam.*	LC	No
ASTERACEAE	*Oedera uniflora (L.f.) Anderb. & K.Bremer*	LC	No
ASTERACEAE	*Oncosiphon sabulosum (Wolley-Dod) Källersjö*	LC	No

Family	*Species*	Threat status	SA Endemic
ASTERACEAE	*Oncosiphon suffruticosum (L.) Källersjö*	LC	No
ASTERACEAE	*Osteospermum grandiflorum DC.*	LC	No
ASTERACEAE	*Osteospermum pinnatum (Thunb.) Norl. var. pinnatum*	LC	No
ASTERACEAE	*Othonna arborescens L.*	LC	No
ASTERACEAE	*Othonna coronopifolia L.*	LC	No
ASTERACEAE	*Othonna cylindrica (Lam.) DC.*	LC	No
ASTERACEAE	*Othonna frutescens L.*	LC	No
ASTERACEAE	*Othonna mucronata Harv.*	LC	No
ASTERACEAE	*Othonna perfoliata (L.f.) Jacq.*	LC	No
ASTERACEAE	*Othonna quercifolia DC.*	LC	No
ASTERACEAE	*Poecilolepis ficoidea (DC.) Grau*	LC	No
ASTERACEAE	*Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt*		No
ASTERACEAE	*Pteronia divaricata (P.J.Bergius) Less.*	LC	No
ASTERACEAE	*Pteronia incana (Burm.) DC.*	LC	No
ASTERACEAE	*Pteronia onobromoides DC.*	LC	No
ASTERACEAE	*Pteronia onobromoides DC.*	LC	No
ASTERACEAE	*Pteronia uncinata DC.*	LC	No
ASTERACEAE	*Rhynchopsidium pumilum (L.f.) DC.*	LC	No
ASTERACEAE	*Senecio arenarius Thunb.*	LC	No
ASTERACEAE	*Senecio arniciflorus DC.*	LC	No
ASTERACEAE	*Senecio burchellii DC.*	LC	No
ASTERACEAE	*Senecio elegans L.*	LC	No
ASTERACEAE	*Senecio littoreus Thunb. var. hispidulus Harv.*	LC	No
ASTERACEAE	*Senecio littoreus Thunb. var. littoreus*	LC	No
ASTERACEAE	*Senecio maritimus L.*	LC	No
ASTERACEAE	*Senecio pterophorus DC.*	LC	No
ASTERACEAE	*Senecio sarcoides C.Jeffrey*	LC	No
ASTERACEAE	*Steirodiscus tagetes (L.) Schltr.*	VU	No
ASTERACEAE	*Tripteris calcicola J.C.Manning & Goldblatt*	VU	No
ASTERACEAE	*Tripteris sinuata DC. var. sinuata*	LC	No
ASTERACEAE	*Ursinia anethoides (DC.) N.E.Br.*	LC	No
ASTERACEAE	*Ursinia anthemoides (L.) Poir. subsp. anthemoides*	LC	No
BORAGINACEAE	*Amsinckia retrorsa Suksd.*	Not Evaluated	No
BORAGINACEAE	*Echiostachys spicatus (Burm.f.) Levyns*	EN	No
BORAGINACEAE	*Echiostachys spicatus (Burm.f.) Levyns*	EN	No
BORAGINACEAE	*Heliotropium supinum L.*	Not Evaluated	No
BORAGINACEAE	*Myosotis discolor Pers.*	Not Evaluated	No
BRASSICACEAE	*Barbarea verna (Mill.) Asch.*	Not Evaluated	No
BRASSICACEAE	*Heliophila acuminata (Eckl. & Zeyh.) Steud.*	LC	No
BRASSICACEAE	*Heliophila adpressa O.E.Schulz*	LC	No

Family	*Species*	Threat status	SA Endemic
BRASSICACEAE	*Heliophila africana (L.) Marais*	LC	No
BRASSICACEAE	*Heliophila elata Sond. var. elata*	Not Evaluated	No
BRASSICACEAE	*Heliophila linearis (Thunb.) DC. var. linearifolia (Burch. ex DC.) Marais*	LC	No
BRASSICACEAE	*Heliophila macowaniana Schltr.*	LC	No
BRASSICACEAE	*Raphanus raphanistrum L.*	Not Evaluated	No
BRYACEAE	*Bryum torquescens Bruch ex De Not.*		No
BUDDLEJACEAE	*Buddleja glomerata H.L.Wendl.*	LC	No
CAMPANULACEAE	*Microcodon glomeratum A.DC.*	LC	No
CAMPANULACEAE	*Prismatocarpus crispus L'Hér.*	LC	No
CAMPANULACEAE	*Roella prostrata E.Mey. ex A.DC.*	LC	No
CAMPANULACEAE	*Wahlenbergia adpressa (Thunb.) Sond.*	LC	No
CAMPANULACEAE	*Wahlenbergia androsacea A.DC.*	LC	No
CAMPANULACEAE	*Wahlenbergia capensis (L.) A.DC.*	LC	No
CAMPANULACEAE	*Wahlenbergia exilis A.DC.*	LC	No
CAMPANULACEAE	*Wahlenbergia hispidula (Thunb.) A.DC.*	LC	No
CAMPANULACEAE	*Wahlenbergia obovata Brehmer*	LC	No
CAMPANULACEAE	*Wahlenbergia paniculata (Thunb.) A.DC.*	LC	No
CAMPANULACEAE	*Wahlenbergia suffruticosa C.N.Cupido*		No
CARYOPHYLLACEAE	*Silene burchellii Otth var. angustifolia Sond.*	Not Evaluated	No
CARYOPHYLLACEAE	*Silene ornata Aiton*	DDT	No
CARYOPHYLLACEAE	*Silene undulata Aiton*	LC	No
CARYOPHYLLACEAE	*Spergularia media (L.) C.Presl*	Not Evaluated	No
CELASTRACEAE	*Cassine peragua L. subsp. barbara (L.) R.H.Archer*	LC	No
CELASTRACEAE	*Gymnosporia buxifolia (L.) Szyszyl.*	LC	No
CELASTRACEAE	*Maytenus lucida (L.) Loes.*	LC	No
CELASTRACEAE	*Pterocelastrus tricuspidatus (Lam.) Walp.*	LC	No
CELASTRACEAE	*Putterlickia pyracantha (L.) Szyszyl.*	LC	No
CELASTRACEAE	*Putterlickia pyracantha (L.) Szyszyl.*	LC	No
CHENOPODIACEAE	*Atriplex cinerea Poir. subsp. bolusii (C.H.Wright) Aellen var. adamsonii Aellen*	LC	No
CHENOPODIACEAE	*Atriplex lindleyi Moq. subsp. inflata (F.Muell.) Paul G.Wilson*	Not Evaluated	No
CHENOPODIACEAE	*Atriplex semibaccata R.Br. var. appendiculata Aellen*	LC	No
CHENOPODIACEAE	*Bassia diffusa (Thunb.) Kuntze*	LC	No
CHENOPODIACEAE	*Chenopodium ambrosioides L.*	Not Evaluated	No
CHENOPODIACEAE	*Salicornia meyeriana Moss*	LC	No
CHENOPODIACEAE	*Sarcocornia capensis (Moss) A.J.Scott*	LC	No
CHENOPODIACEAE	*Sarcocornia littorea (Moss) A.J.Scott*	LC	No
CHENOPODIACEAE	*Sarcocornia mossiana (Toelken) A.J.Scott*	LC	No
CHENOPODIACEAE	*Sarcocornia natalensis (Bunge ex Ung.-Sternb.) A.J.Scott var. natalensis*	LC	No
CHENOPODIACEAE	*Sarcocornia perennis (Mill.) A.J.Scott var. perennis*	LC	No

Family	*Species*	Threat status	SA Endemic
CHENOPODIACEAE	*Sarcocornia pillansii (Moss) A.J.Scott var. pillansii*	LC	No
COMMELINACEAE	*Tradescantia fluminensis Vell.*	Not Evaluated	No
CONVOLVULACEAE	*Cuscuta nitida Choisy*	LC	No
CRASSULACEAE	*Crassula decumbens Thunb. var. brachyphylla (Adamson) Toelken*	NT	No
CRASSULACEAE	*Crassula dejecta Jacq.*	LC	No
CRASSULACEAE	*Crassula dichotoma L.*	LC	No
CRASSULACEAE	*Crassula expansa Dryand. subsp. expansa*	LC	No
CRASSULACEAE	*Crassula glomerata P.J.Bergius*	LC	No
CRASSULACEAE	*Crassula nudicaulis L. var. nudicaulis*	LC	No
CRASSULACEAE	*Crassula thunbergiana Schult. subsp. thunbergiana*	LC	No
CRASSULACEAE	*Crassula tomentosa Thunb. var. tomentosa*	LC	No
CUCURBITACEAE	*Kedrostis psammophylla Bruyns*	LC	No
CYPERACEAE	*Bolboschoenus maritimus (L.) Palla*	LC	No
CYPERACEAE	*Ficinia bulbosa (L.) Nees*	LC	No
CYPERACEAE	*Ficinia secunda (Vahl) Kunth*	LC	No
CYPERACEAE	*Isolepis levynsiana Muasya & D.A.Simpson*	LC	No
CYPERACEAE	*Isolepis marginata (Thunb.) A.Dietr.*	LC	No
CYPERACEAE	*Isolepis rubicunda (Nees) Kunth*	LC	No
CYPERACEAE	*Schoenoplectus corymbosus (Roth ex Roem. & Schult.) J.Raynal*	LC	No
CYPERACEAE	*Schoenoplectus triqueter (L.) Palla*	Not Evaluated	No
EBENACEAE	*Diospyros austro-africana De Winter var. austro-africana*	LC	No
EBENACEAE	*Euclea natalensis A.DC. subsp. capensis F.White*	LC	No
EBENACEAE	*Euclea racemosa Murray subsp. racemosa*	LC	No
ERICACEAE	*Erica flacca E.Mey. ex Benth.*	LC	No
ERICACEAE	*Erica inaequalis (N.E.Br.) E.G.H.Oliv.*	LC	No
ERICACEAE	*Erica mammosa L.*	LC	No
ERICACEAE	*Erica plumosa Thunb.*	LC	No
ERICACEAE	*Erica subdivaricata P.J.Bergius*	LC	No
ERICACEAE	*Erica trichostigma Salter*	VU	No
ERICACEAE	*Erica tristis Bartl.*	LC	No
EUPHORBIACEAE	*Adenocline violifolia (Kuntze) Prain*	LC	No
EUPHORBIACEAE	*Clutia affinis Sond.*	LC	No
EUPHORBIACEAE	*Clutia alaternoides L. var. alaternoides*	LC	No
EUPHORBIACEAE	*Clutia daphnoides Lam.*	LC	No
EUPHORBIACEAE	*Clutia ericoides Thunb. var. ericoides*	LC	No
EUPHORBIACEAE	*Euphorbia burmannii E.Mey. ex Boiss.*	LC	No
EUPHORBIACEAE	*Euphorbia mauritanica L. var. mauritanica*	LC	No
EUPHORBIACEAE	*Euphorbia peplus L.*	Not Evaluated	No
FABACEAE	*Acacia mearnsii De Wild.*	Not Evaluated	No
FABACEAE	*Amphithalea ericifolia (L.) Eckl. & Zeyh. subsp. erecta Granby*	CR	No

Family	*Species*	Threat status	SA Endemic
FABACEAE	*Argyrolobium velutinum Eckl. & Zeyh.*	EN	No
FABACEAE	*Calobota angustifolia (E.Mey.) Boatwr. & B.-E.van Wyk*	LC	No
FABACEAE	*Calobota cytisoides (Berg.) Eckl. & Zeyh.*	LC	No
FABACEAE	*Calobota lotononoides (Schltr.) Boatwr. & B.-E.van Wyk*	NT	No
FABACEAE	*Calobota spinescens (Harv.) Boatwr. & B.-E.van Wyk*	LC	No
FABACEAE	*Crotalaria excisa (Thunb.) Baker f. subsp. excisa*	LC	No
FABACEAE	*Dipogon lignosus (L.) Verdc.*	LC	No
FABACEAE	*Indigofera heterophylla Thunb.*	LC	No
FABACEAE	*Indigofera incana Thunb.*	LC	No
FABACEAE	*Indigofera meyeriana Eckl. & Zeyh.*	LC	No
FABACEAE	*Indigofera platypoda E.Mey.*	EN	No
FABACEAE	*Indigofera procumbens L.*	LC	No
FABACEAE	*Indigofera venusta Eckl. & Zeyh.*	LC	No
FABACEAE	*Lebeckia ambigua E.Mey.*	LC	No
FABACEAE	*Lebeckia plukenetiana E.Mey.*	EN	No
FABACEAE	*Lessertia herbacea (L.) Druce*	LC	No
FABACEAE	*Lessertia rigida E.Mey.*	LC	No
FABACEAE	*Liparia splendens (Burm.f.) Bos & de Wit subsp. splendens*	VU	No
FABACEAE	*Lotononis involucrata (P.J.Bergius) Benth. subsp. involucrata*	LC	No
FABACEAE	*Lotononis sabulosa T.M.Salter*	LC	No
FABACEAE	*Medicago polymorpha L.*	Not Evaluated	No
FABACEAE	*Melilotus indicus (L.) All.*	Not Evaluated	No
FABACEAE	*Melolobium aethiopicum (L.) Druce*	LC	No
FABACEAE	*Melolobium candicans (E.Mey.) Eckl. & Zeyh.*	LC	No
FABACEAE	*Melolobium exudans Harv.*	LC	No
FABACEAE	*Otholobium bolusii (H.M.L.Forbes) C.H.Stirt.*	NT	No
FABACEAE	*Otholobium bracteolatum (Eckl. & Zeyh.) C.H.Stirt.*	LC	No
FABACEAE	*Otholobium venustum (Eckl. & Zeyh.) C.H.Stirt.*	VU	No
FABACEAE	*Podalyria sericea (Andrews) R.Br. ex Aiton f.*	VU	No
FABACEAE	*Podalyria sericea (Andrews) R.Br. ex Aiton f.*	VU	No
FABACEAE	*Rafnia angulata Thunb. subsp. angulata*	LC	No
FABACEAE	*Rafnia capensis (L.) Schinz subsp. capensis*	LC	No
FABACEAE	*Sutherlandia frutescens (L.) R.Br.*	LC	No
FABACEAE	*Vicia benghalensis L.*	Not Evaluated	No
FABACEAE	*Vicia sativa L. subsp. sativa*	Not Evaluated	No
FABACEAE	*Wiborgia fusca Thunb. subsp. fusca*	LC	No
FABACEAE	*Wiborgia fusca Thunb. subsp. macrocarpa R.Dahlgren*	EN	No
FABACEAE	*Wiborgia leptoptera R.Dahlgren subsp. leptoptera*	LC	No
FABACEAE	*Wiborgia obcordata (P.J.Bergius) Thunb.*	LC	No
FABACEAE	*Wiborgia obcordata (P.J.Bergius) Thunb.*	LC	No

Family	*Species*	Threat status	SA Endemic
FABACEAE	*Xiphotheca reflexa (Thunb.) A.L.Schutte & B.-E.van Wyk*	EN	No
FABACEAE	*Xiphotheca reflexa (Thunb.) A.L.Schutte & B.-E.van Wyk*	EN	No
FUMARIACEAE	*Cysticapnos vesicaria (L.) Fedde subsp. vesicaria*	LC	No
GENTIANACEAE	*Chironia baccifera L.*	LC	No
GENTIANACEAE	*Chironia decumbens Levyns*	LC	No
GENTIANACEAE	*Chironia linoides L. subsp. linoides*	LC	No
GENTIANACEAE	*Orphium frutescens (L.) E.Mey.*	LC	No
GENTIANACEAE	*Sebaea aurea (L.f.) Roem. & Schult.*	LC	No
GERANIACEAE	*Pelargonium carnosum (L.) L'Hér. subsp. carnosum*	LC	No
GERANIACEAE	*Pelargonium chelidonium (Houtt.) DC.*	EN	No
GERANIACEAE	*Pelargonium hirtum (Burm.f.) Jacq.*	LC	No
HAEMODORACEAE	*Wachendorfia multiflora (Klatt) J.C.Manning & Goldblatt*	LC	No
HYACINTHACEAE	*Daubenya zeyheri (Kunth) J.C.Manning & A.M.van der Merwe*	VU	No
HYACINTHACEAE	*Eucomis regia (L.) L'Hér.*	LC	No
HYACINTHACEAE	*Lachenalia mathewsii W.F.Barker*	CR	No
HYACINTHACEAE	*Lachenalia mediana Jacq. var. mediana*	VU	No
HYACINTHACEAE	*Lachenalia pustulata Jacq.*	NT	No
HYACINTHACEAE	*Lachenalia viridiflora W.F.Barker*	CR	No
HYACINTHACEAE	*Ornithogalum juncifolium Jacq. var. juncifolium*	LC	No
HYACINTHACEAE	*Ornithogalum maculatum Jacq.*	LC	No
HYPOXIDACEAE	*Empodium veratrifolium (Willd.) M.F.Thomps.*	EN	No
HYPOXIDACEAE	*Pauridia longituba M.F.Thomps.*	EN	No
HYPOXIDACEAE	*Spiloxene serrata (Thunb.) Garside var. serrata*	LC	No
IRIDACEAE	*Babiana ambigua (Roem. & Schult.) G.J.Lewis*	LC	No
IRIDACEAE	*Babiana angustifolia Sweet*	NT	No
IRIDACEAE	*Babiana hirsuta (Lam.) Goldblatt & J.C.Manning*	NT	No
IRIDACEAE	*Babiana mucronata (Jacq.) Ker Gawl. subsp. mucronata*	LC	No
IRIDACEAE	*Babiana ringens (L.) Ker Gawl. subsp. ringens*	LC	No
IRIDACEAE	*Babiana tubiflora (L.f.) Ker Gawl.*	Declining	No
IRIDACEAE	*Ferraria densepunctulata M.P.de Vos*	VU	No
IRIDACEAE	*Ferraria foliosa G.J.Lewis*	NT	No
IRIDACEAE	*Geissorhiza lewisiae R.C.Foster*	VU	No
IRIDACEAE	*Geissorhiza monanthos Eckl.*	EN	No
IRIDACEAE	*Gladiolus alatus L.*	LC	No
IRIDACEAE	*Gladiolus floribundus Jacq.*	LC	No
IRIDACEAE	*Gladiolus gracilis Jacq.*	LC	No
IRIDACEAE	*Gladiolus orchidiflorus Andrews*	LC	No
IRIDACEAE	*Hesperantha erecta (Baker) Benth. ex Baker*	NT	No
IRIDACEAE	*Hesperantha radiata (Jacq.) Ker Gawl.*	LC	No
IRIDACEAE	*Lapeirousia anceps (L.f.) Ker Gawl.*	LC	No
IRIDACEAE	*Lapeirousia jacquinii N.E.Br.*	LC	No

Family	*Species*	Threat status	SA Endemic
IRIDACEAE	*Melasphaerula ramosa (L.) N.E.Br.*	LC	No
IRIDACEAE	*Moraea albiflora (G.J.Lewis) Goldblatt*	LC	No
IRIDACEAE	*Moraea caeca Barnard ex Goldblatt*	LC	No
IRIDACEAE	*Moraea macrocarpa Goldblatt*	LC	No
IRIDACEAE	*Romulea barkerae M.P.de Vos*	EN	No
IRIDACEAE	*Romulea saldanhensis M.P.de Vos*	EN	No
IRIDACEAE	*Romulea tabularis Eckl. ex Bég.*	LC	No
JUNCACEAE	*Juncus effusus L.*	LC	No
JUNCACEAE	*Juncus tenuis Willd.*	Not Evaluated	No
JUNCAGINACEAE	*Triglochin bulbosa L.*	LC	No
JUNCAGINACEAE	*Triglochin striata Ruíz & Pav.*	LC	No
LAMIACEAE	*Salvia africana-caerulea L.*	LC	No
LAMIACEAE	*Salvia lanceolata Lam.*	LC	No
LAMIACEAE	*Stachys arvensis L.*	Not Evaluated	No
LOBELIACEAE	*Cyphia crenata (Thunb.) C.Presl var. crenata*	LC	No
MALVACEAE	*Anisodontea biflora (Desr.) Bates*	LC	No
MALVACEAE	*Hermannia heterophylla (Cav.) Thunb.*	LC	No
MALVACEAE	*Hermannia pinnata L.*	LC	No
MALVACEAE	*Hermannia prismatocarpa E.Mey. ex Harv.*	LC	No
MALVACEAE	*Hermannia procumbens Cav. subsp. myrrhifolia (Thunb.) De Winter*	EN	No
MALVACEAE	*Hermannia scordifolia Jacq.*	LC	No
MALVACEAE	*Hermannia trifurca L.*	LC	No
MELIANTHACEAE	*Melianthus elongatus Wijnands*	LC	No
MESEMBRYANTHEMACEAE	*Amphibolia laevis (Aiton) H.E.K.Hartmann*	LC	No
MESEMBRYANTHEMACEAE	*Apatesia helianthoides (Aiton) N.E.Br.*	LC	No
MESEMBRYANTHEMACEAE	*Conicosia pugioniformis (L.) N.E.Br. subsp. pugioniformis*	LC	No