
PROPOSED SANNASPOS PHOTOVOLTAIC (PV) SOLAR ENERGY FACILITY-PHASE 1 NEAR BLOEMFONTEIN, FREE STATE PROVINCE

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

Submitted as part of the Final Environmental Impact
Assessment Report

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PROJECT DETAILS

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DEFINITIONS AND TERMINOLOGY

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Archaeological material: Remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

Cumulative impacts: The impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable

'Do nothing' alternative: The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Endemic: An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

Environment: the surroundings within which humans exist and that are made up of:

- i. The land, water and atmosphere of the earth;
- ii. Micro-organisms, plant and animal life;

- iii. Any part or combination of (i) and (ii) and the interrelationships among and between them; and
- iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental impact: An action or series of actions that have an effect on the environment.

Environmental impact assessment: Environmental Impact Assessment (EIA), as defined in the NEMA Environmental Assessment Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental management programme: An operational plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000).

Indigenous: All biological organisms that occurred naturally within the study area prior to 1800

Indirect impacts: Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

Interested and affected party: Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local

communities, investors, work force, consumers, environmental interest groups and the general public.

Photovoltaic effect: Electricity can be generated using photovoltaic panels (semiconductors) which are comprised of individual photovoltaic cells that absorb solar energy to produce electricity. The absorbed solar radiation excites the electrons inside the cells and produces what is referred to as the Photovoltaic Effect.

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare".

Red data species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Significant impact: An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

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PROJECT DETAILS

CHAPTER 1

SolaireDirect Southern Africa (Pty) is proposing the establishment of a commercial solar energy facility (using photovoltaic technology) for electricity generation of up to 75 MW in capacity (90 MW installed capacity). The facility is proposed to be established on Portion 0 of Farm 2962 Lejwe and Portion 0 of Farm 1808 Besemkop located approximately 45 km east of Bloemfontein in the Free State Province of South Africa (refer to **Figure 1.1**).

The purpose of the proposed facility is to sell the electricity generated to Eskom as part of the Renewable Energy Independent Power Producers (IPP) Procurement Programme. The IPP Procurement Programme has been introduced by the Department of Energy (DoE) to promote the development of renewable power generation facilities by IPPs. Selling of electricity according to the IPP Procurement Programme has the advantage of giving developers long-term stability and predictability, as well as providing the opportunity for the South African Government to introduce renewable energy into the power generation technology mix within the country.

The facility (see **Figure 1.2**) is expected to require an area of approx. 150 ha within which the following infrastructure will be established:

- » An on-site substation and 132kV overhead power line to facilitate the connection between the solar energy facility and the Eskom electricity grid,
- » Internal access roads,
- » Guard house,
- » Laydown, campsite and assembly area,
- » Office and Control centre.

The proposed project will be referred to as the **Sannaspos Photovoltaic (PV) Solar Energy Facility - Phase 1**.

SolaireDirect Southern Africa (Pty) is also undertaking a separate Basic Assessment process¹ for the development of a 10 MW commercial photovoltaic (PV) facility and associated infrastructure on Portion 0 of Farm 2962 Lejwe which is referred to as Sannaspos Photovoltaic (PV) Solar Energy Facility - Phase 2.

¹ This project has been registered with the Department of Environmental Affairs (DEA) under EIA Reference number: 14/12/16/3/3/1/615

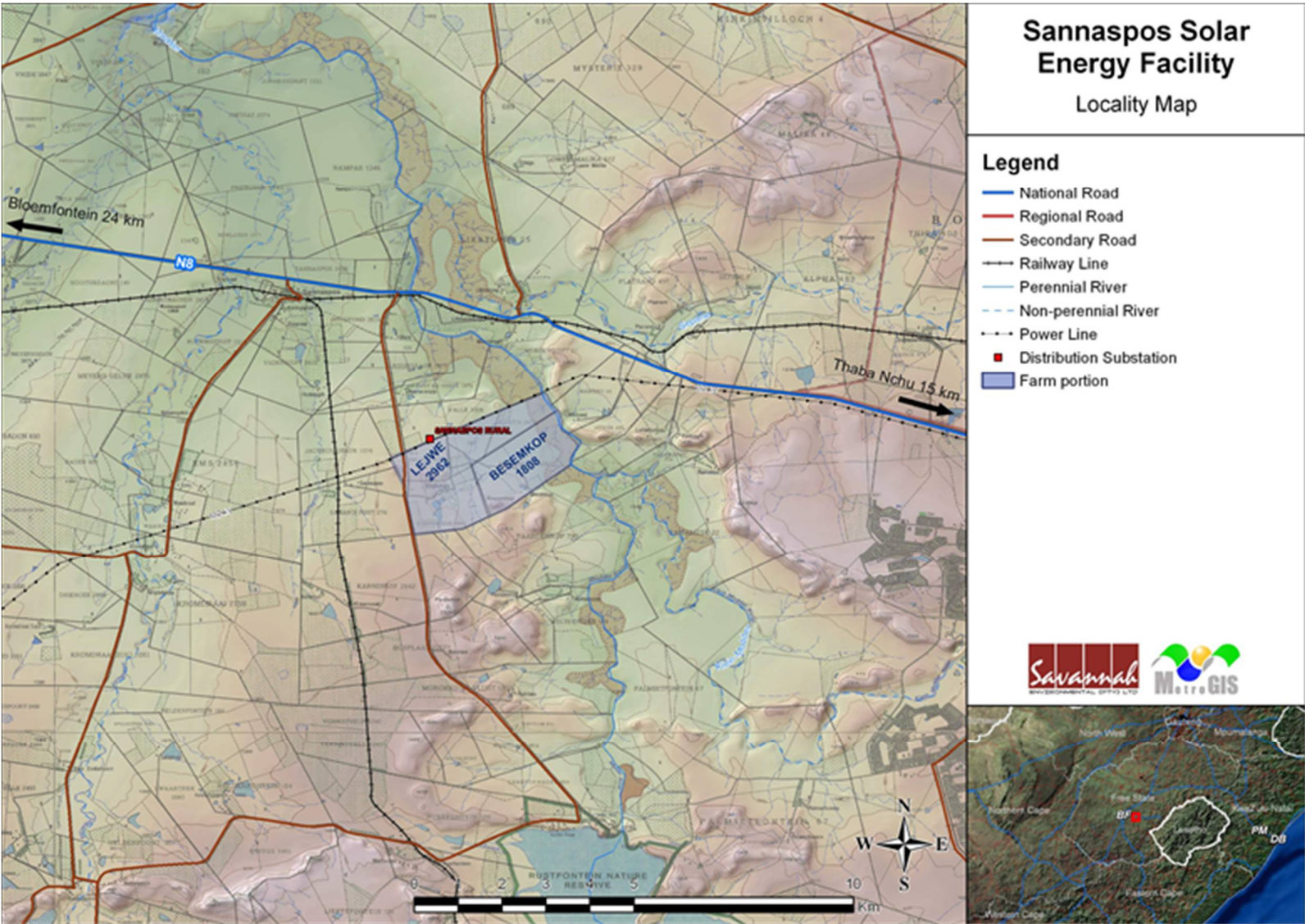


Figure 1.1: Locality map

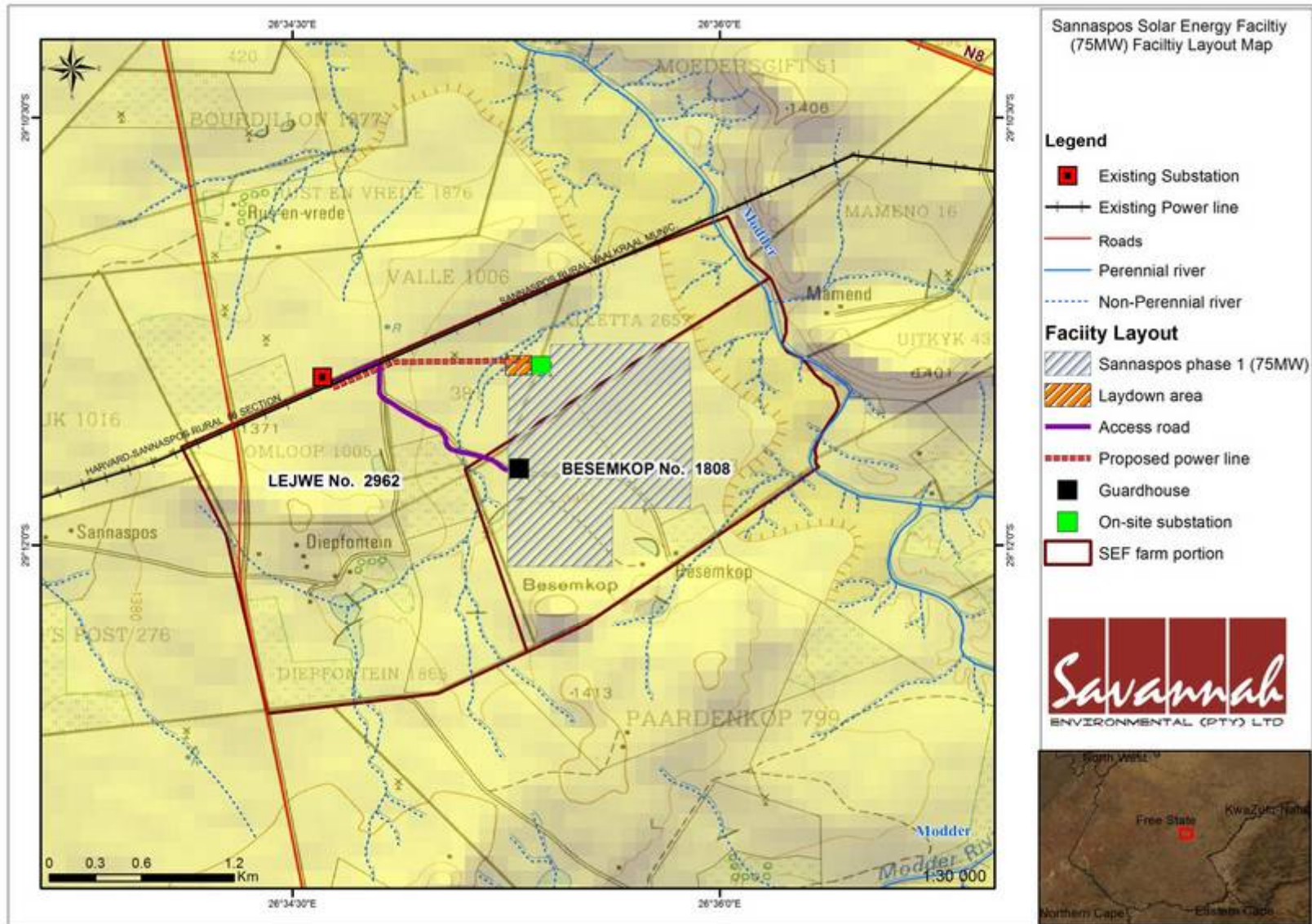


Figure 1.2: Facility Layout Plan showing the proposed Sannaspos facility as well as infrastructure.

1.1. Activities and Components associated with the Solar Energy Facility

The main activities/components associated with the proposed facility are detailed in the tables which follow.

Construction Phase:

The construction of the facility is unlikely to be phased, with the full 75 MW (90 MW installed capacity) most likely being installed in one phase (75 MW is the current limit for solar projects set by the Department of Energy). The construction phase is expected to extend over a period of 18-24 months and create approximately 291 employment opportunities at peak construction. It is anticipated that approximately 60% (175) of the employment opportunities will be available to low skilled (construction labourers, security staff etc.), 15% (43) semi-skilled workers (drivers, equipment operators etc.) and 25% (73) to skilled personnel (engineers, land surveyors, project managers etc.). The majority of the employment opportunities, specifically the low and semi-skilled opportunities, are likely to be available to local residents in the area, specifically residents from the town of Botshabelo and Thaba Nchu. The majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community. This would represent a significant positive social benefit in an area with limited employment opportunities

Typically the construction will operate as a 'follow the leader' where the groundworks will be prepared followed by the erection of mounting structures and then followed by the attachment of the solar panels and the integration of the electrical equipment. The following construction activities are expected to form part of the project's scope of works.

Table 1.1: Activities associated with the construction of a PV facility

Activity	Description
Pre-construction surveys	Prior to initiating construction, a number of detailed surveys will be required including, but not limited to: <ul style="list-style-type: none"> » <i>Geotechnical survey</i> – the geology and topography of the study area will be confirmed. The geotechnical study will look at flood potential, foundation conditions, potential for excavations, and the availability of natural construction materials. This study will serve to inform the type of foundations required to be built and the extent of earthworks and compaction required in the establishment of any internal access roads. » <i>Site survey</i> – this will be required to finalise the design layout of the solar field and other associated infrastructure. The finalisation will need to be confirmed in line with the Environmental Authorisation issued for the facility. » <i>Power line servitude survey</i> – once the placement of the towers for the power line has been finalised, a walk through survey will be undertaken for ecological, archaeology and heritage resources which may necessitate certain towers to be moved to avoid sensitivities.
Establishment of access roads	<ul style="list-style-type: none"> » The project development site is accessible from the N8 highway towards Botsabelo linking into a secondary road S417 (gravel) and an existing access road (gravel) on the proposed farm portion, this will be upgraded and used to access the facility site. » A safety firebreak band and roadway will be constructed around the perimeter of the site in order to prevent the spread of external fires entering the park and accommodate light service and maintenance vehicles. On the same principle, road design will be determined within detailed engineering in accordance with SABS standards and South African requirements (e.g. compacted road layer works and crushed stone surfacing).
Undertake site preparation	<ul style="list-style-type: none"> » Site preparation activities will include clearance of vegetation at the footprint of the area infrastructure (i.e. PV panels, substation, ancillary buildings) and linear components (i.e. power line, internal access roads). These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site.
Transport of components and equipment to site	<ul style="list-style-type: none"> » The components for the proposed facility will be transported to site, in sections, by road. Some of the components for the power generation block may be defined as abnormal loads in terms of the Road Traffic Act (Act No. 29 of 1989)² by virtue of the dimensional limitations (i.e. length and weight). The typical civil engineering construction equipment will need to be brought to the site (e.g. excavators, trucks, graders, and

² A permit will be required for the transportation of any abnormal loads on public roads.

Activity	Description
	<p>compaction equipment etc.) as well as components required for the establishment of the substation and power line.</p> <ul style="list-style-type: none"> » In some instances, the dimensional requirements of the loads to be transported during the construction phase (e.g. the transformer of the substation) may require alterations to the existing road infrastructure (e.g. widening on corners), and protection of road-related structures (i.e. bridges, culverts, etc.) because of abnormal loading.
<p>Establishment of construction camps, workshops, and temporary laydown areas</p>	<ul style="list-style-type: none"> » Once the required construction equipment has been transported to site, dedicated equipment camp(s) and laydown area(s) will be required which will be of a temporary nature and approximately 150 m x 150 m in size. These construction camp(s) will serve to confine activities and storage of equipment to designated area(s) to limit the potential ecological impacts associated with this phase of the project. The laydown area(s) will be used for assembly purposes and the general placement/storage of construction equipment. » Fuel required for the on-site construction vehicles and equipment will need to be secured in a temporary bunded facility within the construction camp(s) to prevent leakages and soil contamination.
<p>Establishment of PV panels</p>	<ul style="list-style-type: none"> » Photovoltaic panel: A group of modules fastened together, pre-assembled and wired, designed to serve as an installable unit in a photovoltaic array. » Photovoltaic module: The smallest complete environmentally protected assembly of interconnected photovoltaic cells. This 'module' is then typically mounted in an aluminium frame. » Mounting structure: With the rapid growth of grid-connected distributed systems, a wide range of products have been developed for installing PV modules. Panels would be attached to steel screw piles of approximately 1500 mm long. » Ready mix cement will be used to stabilise the foundation. Ready-mix cement will be prepared off-site and transported from the closest centre to the development. This however, does not rule out the possibility of onsite batching. » A service cage will be erected around the foundation unit to allow for the establishment of the electrical and hydraulic infrastructure). This includes the inverter. » A drive head will be positioned on top of the foundation unit as a connection point for the PV panel which allows for the dual axis tracking. » Trenches- Cabling sleeves shall be installed as part of the Civil Works. Trenches will be in accordance with SABS standards. » Foundation/Anchoring- Screw or ram pile will be used provided soil conditions allow such solution.

Activity	Description
	Alternatively concrete ballast foundations will be used.
Establishment of substation and power line	<ul style="list-style-type: none"> » Ancillary infrastructure includes an overhead power line feeding into the Eskom electricity network by connecting directly into the existing Sannaspos substation, workshop, storage areas as well as a temporary contractor’s equipment camp. » An 132 kV overhead power line will be constructed from the new substation connecting to the Sannaspos Rural substation, which is located west of the proposed Sannaspos Solar Facility-phase 1. The power line will be 1200m in length. The following route is proposed: from the facility the power line will follow a route 1200m west of the facility to connect to the existing substation. Note that the final grid connection will ultimately depend on Eskom. » The establishment of the above ancillary infrastructure will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.
Undertake site rehabilitation	<ul style="list-style-type: none"> » Once construction is complete and all construction equipment is removed, the site must be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site that are not required during the operational phase must be closed and prepared for rehabilitation.

Operation and Maintenance Phase:

It is anticipated that during this phase ~ 60 permanent employment opportunities, of this total ~ 30 (50%) will be low skilled (security and maintenance), 10 (17%) semi-skilled and 20 (33%) skilled employees. As indicated above, due the proximity of the site to Bloemfontein, Botshabelo and Thaba Nchu, the majority of the work opportunities associated with the operational phase are likely to be taken up by members from the local community. It is expected that during this time, full time security, maintenance, supervision and monitoring teams will be required on site. Maintenance activities will include *inter alia*, replacement and cleaning of the panels (using water and/or pressurised air).

The operational phase is expected to extend for a period of approximately 20 years with plant maintenance, depending on the energy requirements of the country. It is anticipated that during this time full time security, maintenance, supervision and monitoring teams will be required on site. Maintenance activities will include *inter alia*, replacement and cleaning of the panels

(using pressurised air) and the maintenance of the solar facility components and associated infrastructure (such as access roads). The photovoltaic plant will be operational during daylight hours only. However, it will not be operational under circumstances of mechanical breakdown, extreme weather conditions or maintenance activities. No energy storage mechanisms (i.e. batteries) which would allow for continued generation at night or on cloudy days are proposed.

Activity	Description
Operation of the PV panels and the associated electrical infrastructure	<ul style="list-style-type: none"> » The PV panels will convert the light energy from the incoming radiation into electrical energy (i.e. as direct current). » The PV panels will convert the light energy from the incoming radiation into electrical energy (i.e. as direct current). » The transformers will change the power to alternating current, where after the electricity will be conveyed to the switchgear, the underground cables and then to the existing Sannaspos Substation.
Site operation and maintenance	<ul style="list-style-type: none"> » Full-time security, maintenance, and control room staff will be required on site. » Each component within the solar energy facility will be operational except under circumstances of mechanical breakdown, unfavourable weather conditions, or routine maintenance activities. » The access to the site and the internal access roads will be maintained during the operational phase.

Decommissioning Phase

The PV panels and associated infrastructure would only be decommissioned once they have reached the end of their economic life. It is most likely that decommissioning activities would comprise the disassembly and replacement of the individual components with more appropriate technology/infrastructure available at that time. The following decommissioning activities will form part of the project scope.

Activity	Description
Site preparation	Site preparation activities will include confirming the integrity of the access to the site to accommodate the required equipment (e.g. lay down areas and decommissioning camp) and the mobilisation of decommissioning equipment.
Disassemble existing	The components would be disassembled, and reused and recycled (where possible), or disposed of in accordance

components with regulatory requirements.

1.2. Findings of the Environmental Impact Assessment Process

Through the environmental assessment of impacts associated with the Sannaspos Solar Energy Facility-Phase 1, both potentially positive and negative impacts have been identified. The most significant environmental impacts associated with the proposed project include:

Ecology Impacts

- » The overall impact on ecology is likely to be of **medium significance**. Development will have to be restricted to the grasslands in order to minimise impacts, and it will be important to monitor and mitigate erosion from construction to decommissioning phase. The most important part of mitigation would be the most appropriate site location and to maintain as dense a perennial herbaceous layer below the development as possible.
- » Potentially significant negative impacts on the ecological environment would include soil degradation issues (erosion, depletion of nutrients) as a result of construction activity and the operation of the facility; possible introduction of alien invasive plants and a long-term (more than 8 months) low or absent vegetation cover after construction. In addition, a loss of niches and specialised habitats for flora and fauna could occur with the removal or significant degradation of large expanses of vegetation. With the diligent implementation of mitigating measures by the developer, contractors, and operational staff, the severity of these impacts can be minimised.
- » Runoff from the proposed development area is channeled via the drainage line into the nearby Modder River and associated downstream water bodies. Due care will thus have to be taken to not only prevent excessive erosion of riparian areas, but also any kind of pollution within the development that could end up in the downstream wetlands.
- » Several protected and red-data species potentially occur on the site, apart from those already recorded. At the time of the field visit, most grasses just started sprouting, a small number of geophytic species could already be observed, but the herbaceous layer was still poorly developed. Most of the species that just started emerging were too small to be identifiable at the time of the survey. It is thus imperative that a detailed site-walk be undertaken during optimal growing conditions (late November to early February) to enable all potentially rare and protected plant species to be recorded and relocated.
- » The impact on fauna is expected to be negligible. Currently there is minimal presence of wild animals due to current land use patterns. Animals that may be present are mobile and will move away during construction, possibly resettling after construction. No restricted or specific habitat of vertebrates will be affected by the proposed development; especially if the proposed development remains outside the more sensitive areas.

Heritage & Paleontological impacts

The overall heritage impact is likely to be of **low-medium significance** with the implementation of mitigation measures. Out of the five sites recorded, only one archaeological site was observed in the form of two MSA stone tool scatters. The significance of this site is low and no further actions with regards to its management is required. Inscriptions were also found on top of a Koppie in the Farm Besemkop and they are also of low significance and no further action is required with regards to their management. The three other sites, two cemeteries and a stone shed are deemed to be of high significance. It is proposed that the three sites should be preserved in situ and not be disturbed or altered during the Sannaspos Solar Farm construction activities. Should construction activities come closer to these sites a buffer of approximately 20m should be retained between graves and construction activities.

It is recommended that the proposed project construction phase should pay special attention to possible encounter of archaeological resources and sites such as unmarked graves or stone and iron implements (dating to Iron Age and to events of the Second South African War as discussed above). Should such sites be discovered during the construction phase, construction activities need to be stopped with immediate effect and a professional archaeologist need to be called on site to inspect and investigate the finds and make recommendations on further actions that need to take place to rescue or mitigate the finds. For example, applying for rescue permits with SAHRA-BGG Unit in case of discovery of unmarked graves and SAHRA-APM Unit in case of archaeological and paleontological remains. To achieve the above two recommendations, it is further recommended that the Environmental Control Officer should be inducted on heritage management before the commencement of construction activities and that he/she should be to take responsibility for heritage sites and resources during the construction phase of the project.

Visual Impacts

The overall results of the Visual Impact Assessment for the proposed activity will have a **medium to low Significance** from Key Observation Points identified in the middle and background (>3km). The potential impact on users of arterial and secondary roads and on residents of towns and homesteads in close proximity of the facility will be of high significance. It is important to note that there is another proposed solar energy facility that is located next to the proposed Sannaspos Solar Energy Facility-Phase 1. Cumulative impacts are expected to be limited due to the consolidation of similar infrastructure within one area.

Impacts on the Social Environment

Both positive and negative impacts on the social environment are expected as a result of the construction and operation of the proposed facility. The overall positive social impact is likely to be of a predominantly **medium significance** with the implementation of appropriate enhancement measures. The findings of the SIA undertaken for Phase 1 (75MW) of the proposed Sannaspos solar park indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. Positive impacts for the local community can be enhanced by the employment of local people as far as possible. However, the impact on individuals who are directly impacted on by construction workers and or job seekers (i.e. contract HIV/ AIDS) was assessed to be of **Medium-High negative significance**. In addition, due to the low population density of the area and the relatively small size of the labour force the potential risk to local family structures and social networks is regarded as low. The establishment of a Community Trust also creates an opportunity to support local economic development in the area. The majority of the potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. It is therefore recommended that Phase 1 (75MW) of Sannaspos solar park as proposed be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report. The establishment of the proposed Sannaspos solar park is therefore supported by the findings of the SIA.

Impacts on Soil & Agricultural Impact Assessment

The agricultural potential of the soils underlying the development site is considered medium-low under dryland (650mm/y rainfall) and irrigation conditions. The results of the Soil and Agricultural Potential Impact Assessment for the proposed Sannaspos Solar Park find the proposed activity will have a **low-medium impact** on the immediate and surrounding soil systems and on agricultural potential. Implementation and management of proposed mitigation measures will minimise loss of topsoil, prevent contamination of topsoil and stockpiled soil and prevent overall soil erosion. Renewable energy projects contribute to clean energy generation as a sustainable resource and holds huge benefits for the local region and the country as a whole. It is recommended that the proposed project be approved subject to the mitigation measures stipulated in the Impact Assessment and Environmental Management Programme.

The findings of the specialist studies undertaken within this EIA assessed both the benefits and potential negative impacts anticipated as a result of the proposed project and identified sensitive areas on the site which should be avoided as far as possible (refer to Figure 1.3). Areas of high sensitivity include rocky outcrops,

ridges, and small koppies which are a habitat for several protected species found near the sites. Once these habitats have been physically altered, they cannot be recreated or returned to their former diversity and functionality therefore should be treated as no-go areas. Other sensitive ecological areas include dense vegetation of the riparian areas fringing the drainage channels which is essential in keeping the drainage channel intact and protects it from erosion as well as man-made wetlands on site. These areas should be avoided as far as possible, and where not possible to avoid, impacts on such sites should be minimised to reduce impacts to acceptable levels. The EIA has concluded that there are **no environmental fatal flaws** that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. The significance levels of the majority of identified negative impacts can be reduced by implementing the recommended mitigation measures. As the proposed Sannaspos solar energy infrastructure has been planned to avoid the identified environmental sensitive areas (and are illustrated in **Figure 1.3**). The project is therefore considered to meet the requirements of sustainable development. Environmental specifications for the management of potential impacts are detailed within the this draft Environmental Management Programme (EMP).

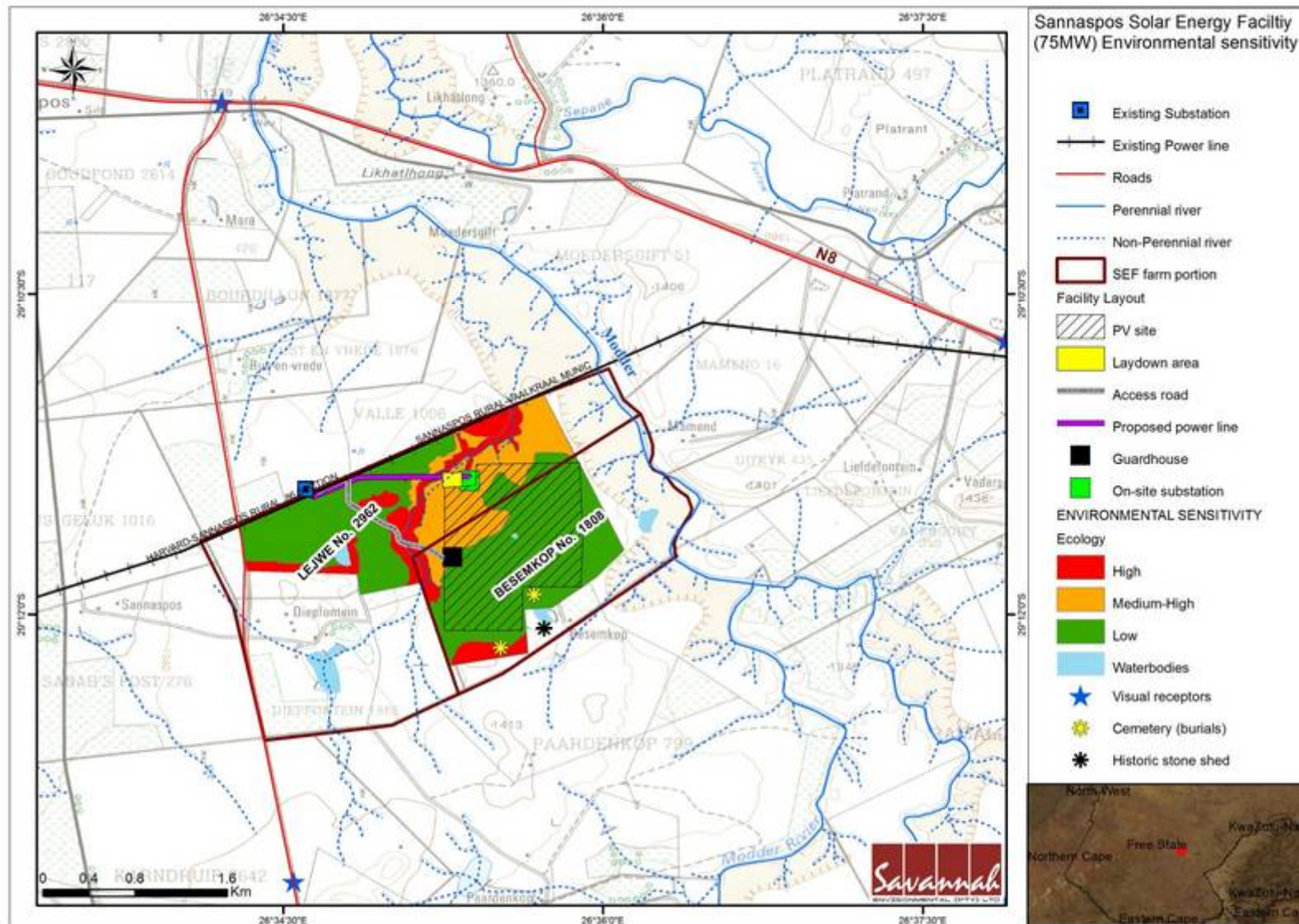


Figure 1.3: Sensitivity map for the Sannaspos SEF showing the proposed layout in relation to identified environmentally sensitive areas

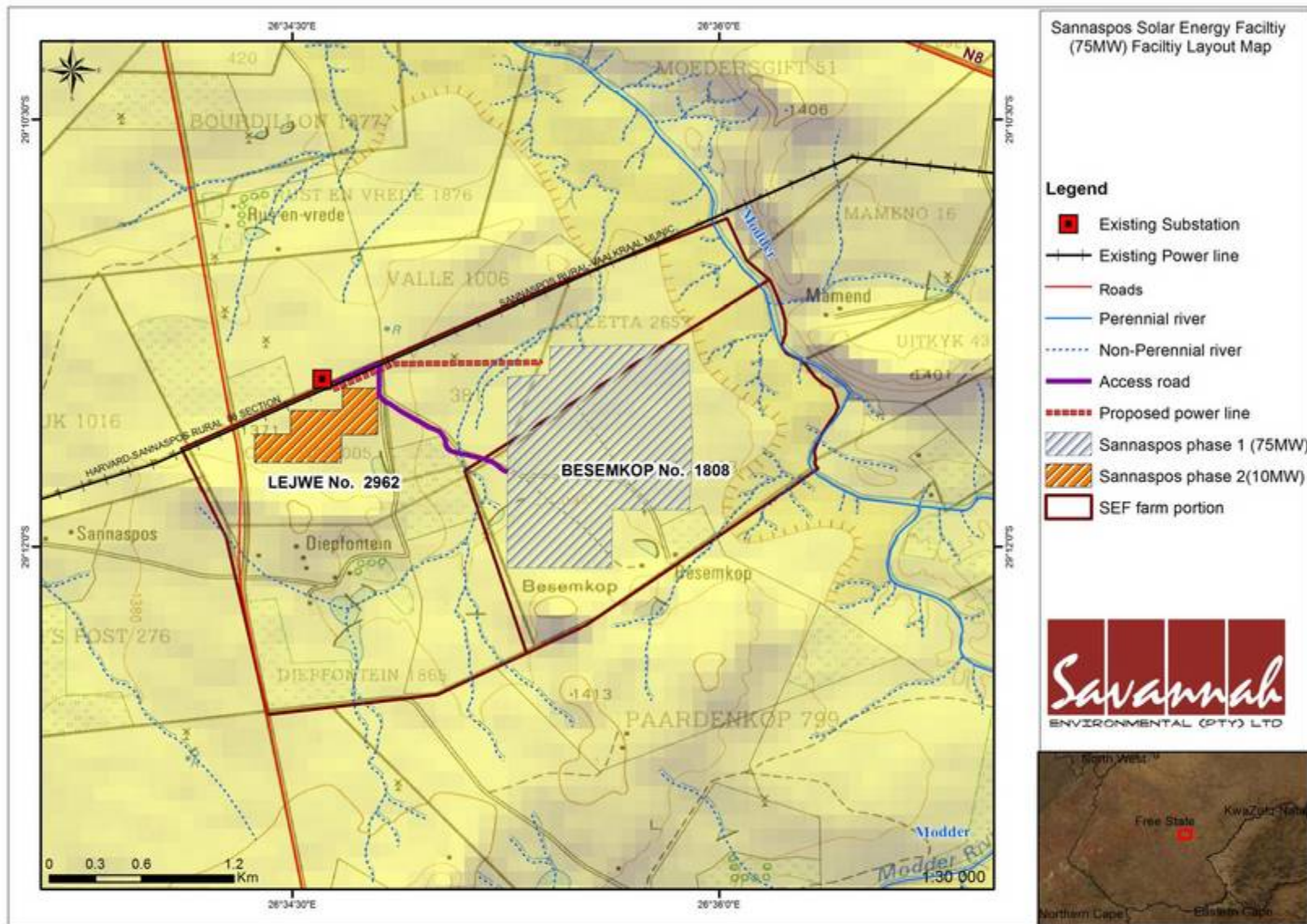


Figure 1.4: Locality map showing the Solar Energy Facility proposed adjacent to Sannaspos Solar Energy Facility-phase 1.

1.3. Benefits of the Proposed Project

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. The South African Government has set a target for renewable energy of 17 GW all new installed generating capacity (new build) being derived from renewable energy forms, to be produced mainly from biomass, wind, solar and small-scale hydro.

Through pre-feasibility assessments and research, the viability of establishing a 75MW Solar energy facility near Bloemfontein in the Free State Province has been established by **SolaireDirect Southern Africa (Pty) Ltd.**. The positive implications of establishing a solar energy facility on the demarcated sites within the Free State include:

- » The project would assist the South African government in reaching their set targets for renewable energy.
- » The potential to harness and utilise good solar energy resources would be realised.
- » The consolidation of solar facility infrastructure within an area (specifically considering the proximity to the other solar facilities to be developed).
- » The National electricity grid in the Free State would benefit from the additional generated power.
- » Promotion of clean, renewable energy in South Africa.
- » Positive impacts on the tourism economy of the area.
- » Creation of local employment and business opportunities for the area.

The proposed development represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The proposed project will not consume energy, but will instead provide a new source of clean, renewable electricity to the South African power grid. This generation of renewable power will aid in reducing the dependency on other power generation fuels and enhancing the reliability of the regional energy supply.

PURPOSE AND OBJECTIVES OF THE EMP

CHAPTER 2

An Environmental Management Programme (EMP) is defined as “an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts associated with the planning, construction, operation and decommissioning of a project are avoided or mitigated, and that the positive benefits of the projects are enhanced.”³ The objective of this EMP is to provide consistent information and guidance for implementing the management and monitoring measures established in the permitting process and help achieve environmental policy goals. The purpose of an EMP is to ensure continuous improvement of environmental performance, reducing negative impacts and enhancing positive effects during the construction and operation of the facility. An effective EMP is concerned with both the immediate outcome as well as the long-term impacts of the project.

The EMP provides specific environmental guidance for the construction and operation phases of a project, and is intended to manage and mitigate construction and operation activities so that unnecessary or preventable environmental impacts do not result. These impacts range from those incurred during start up (i.e. site clearing and site establishment), during the construction activities themselves (i.e. erosion, noise, dust, and visual impacts), during site rehabilitation (i.e. soil stabilisation, re-vegetation), during operation and during decommissioning (i.e. similar to construction phase activities).

This Construction and Operational Environmental Management Plan (CEMP and OEMP) has been compiled for the proposed Sannaspos Solar Facility-phase 1. This EMP is applicable to all employees and contractors working on the pre-construction, construction, and operation and maintenance phases of the project. The document will be adhered to, updated as relevant throughout the project life cycle.

This EMP has been compiled in accordance with Section 33 of EIA Regulations and will be further developed in terms of specific requirements listed in any authorisations issued for the proposed project. The EMP has been developed as a set of environmental specifications (i.e. principles of environmental management), which are appropriately contextualised to provide clear guidance in terms of the on-site implementation of these specifications (i.e. on-site contextualisation is provided through the inclusion of various monitoring and implementation tools).

³ Provincial Government Northern Cape, Department of Environmental Affairs and Development Planning: *Guideline for Environmental Management Plans*. 2005

This EMP has the following objectives:

- » Outline mitigation measures and environmental specifications which are required to be implemented for the planning, construction and rehabilitation, operation, and decommissioning phases of the project in order to manage and minimise the extent of potential environmental impacts associated with the facility.
- » Ensure that all the phases of the project do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- » Identify entities responsible for the implementation of the measures and outline functions and responsibilities.
- » Propose mechanisms and frequency for monitoring compliance, and preventing long-term or permanent environmental degradation.
- » Facilitate appropriate and proactive responses to unforeseen events or changes in project implementation that was not considered in the Environmental Assessment process.

The management and mitigation measures identified within the Environmental Impact Assessment (EIA) process are systematically addressed in this EMP, and ensure the minimisation of adverse environmental impacts to an acceptable level.

SolaireDirect Southern Africa (Pty) Ltd must ensure that the implementation of the project complies with the requirements of all environmental authorisations, permits, and obligations emanating from relevant environmental legislation. This obligation is partly met through the development and the implementation of this EMP and through its integration into the contract documentation. Since this EMP is part of the Environmental Impact Assessment process for the proposed Sannaspos Solar Energy Facility, it is important that this document be read in conjunction with the Final Environmental Impact Assessment Report compiled for this project (Savannah Environmental, February 2013). This will contextualise the EMP and enable a thorough understanding of its role and purpose in the integrated environmental management process. Should there be a conflict of interpretation between this EMP and the environmental authorisation, the stipulations in the environmental authorisation shall prevail over that of the EMP, unless otherwise agreed by the authorities in writing. Similarly, any provisions in legislation overrule any provisions or interpretations within this EMP.

This EMP shall be binding on all the parties involved in the construction and operational phases of the project, and shall be enforceable at all levels of contract and operational management within the project. The document will be adhered to, updated as relevant throughout the project life cycle.

STRUCTURE OF THIS EMP

CHAPTER 3

The first two chapters provide background to the EMP and the proposed project, while the chapters which follow consider the following:

- » Key legislation applicable to the development;
- » Planning and design activities;
- » Construction activities;
- » Operation activities; and
- » Decommissioning activities.

These chapters set out the procedures necessary for Sannaspos Solar Energy Facility, as the project developer, to minimise environmental impacts and achieve environmental compliance. For each of the phases of implementation, an overarching environmental **goal** is stated. In order to meet this goal, a number of **objectives** are listed. The EMP has been structured in table format in order to show the links between the goals for each phase and their associated objectives, activities/risk sources, mitigation actions, monitoring requirements and performance indicators. A specific EMP table has been established for each environmental objective. The information provided within the EMP table for each objective is illustrated below:

OBJECTIVE: Description of the objective, which is necessary to meet the overall goals; which take into account the findings of the Environmental Impact Assessment specialist studies

Project Component/s	» List of project components affecting the objective.
Potential Impact	» Description of potential environmental impact if objective is not met.
Activity/Risk Source	» Description of activities which could affect achieving objective.
Mitigation: Target/Objective	» Description of the target and/or desired outcomes of mitigation.

Mitigation: Action/Control	Responsibility	Timeframe
List specific action(s) required to meet the mitigation target/objective described above.	Who is responsible for the measures?	Periods for implementation.

Performance Indicator	Description of key indicator(s) that track progress/indicate the effectiveness of the EMP.
Monitoring	Mechanisms for monitoring compliance; the key monitoring actions required to check whether the objectives are being achieved, taking into consideration responsibility, frequency, methods, and reporting.

The objectives and EMP tables are required to be reviewed and possibly modified whenever changes, such as the following, occur:

- » Planned activities change (i.e. in terms of the components and/or layout of the facility);
- » Modification to or addition to environmental objectives and targets;
- » Relevant legal or other requirements are changed or introduced; and
- » Significant progress has been made on achieving an objective or target such that it should be re-examined to determine if it is still relevant, should be modified, etc.

3.1. Project Team

This draft EMP was compiled by:

	Name	Company
EMP Compilers:	Sheila Muniongo – Environmental Assessment Practitioner (EAP) Jo-Anne Thomas – Principle EAP	Savannah Environmental
Specialists:	Marianne Strohbach	Savannah Environmental
	Chris Viljoen	Viljoen & Associates
	Nkosinathi Tomose	Zone Land Solutions
	Jacques Louis Volschenk	Zone Land Solutions
	Job M. Kibii	Wits University Institute for Human Evolution

The Savannah Environmental team have extensive knowledge and experience in EIAs and environmental management, having been involved in Basic Assessment processes & EIAs over the past fifteen years. The team have managed and drafted EMPs for other power generation projects throughout South Africa, including numerous wind and solar energy facilities.

Curricula vitae for the Project team are included in **Appendix A**.

KEY LEGISLATION APPLICABLE TO THE DEVELOPMENT CHAPTER 4

The following legislation and guidelines have informed the scope and content of this EMP Report:

- » National Environmental Management Act (Act No 107 of 1998).
- » EIA Regulations, published under Chapter 5 of the NEMA (GNR R545, GNR 546 in Government Gazette 33306 of 18 June 2010).
- » Guidelines published in terms of the NEMA Environmental Impact Assessment Regulations, in particular:
 - * Companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010 (Draft Guideline; DEA, 2010).
 - * Public Participation in the Environmental Impact Assessment Process (DEA, 2010).
 - * Integrated Environmental Management Information Series (published by DEA).
- » International guidelines, including the Equator Principles.

Several other Acts, standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in the Environmental Impact Assessment Report. A review of legislative requirements applicable to the proposed project is provided in Table 4.1.

Table 4.1: Relevant legislative and permitting requirements applicable to the establishment of the proposed Sannaspos Solar Energy Facility

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
National Legislation			
National Environmental Management Act (Act No 107 of 1998)	<p>The Environmental Impact Assessment Regulations have been promulgated in terms of Chapter 5 of the Act. Listed activities which may not commence without an environmental authorisation are identified within these Regulations.</p> <p>In terms of S24(1) of NEMA, the potential impact on the environment associated with these listed activities must be assessed and reported on to the competent authority charged by NEMA with granting of the relevant environmental authorisation.</p> <p>In terms of GN R543, R544, R545 and R546 of 18 June 2010, an Environmental Impact Assessment Process is required to be undertaken for the proposed project.</p>	<p>Department of Environmental Affairs – competent authority</p> <p>Free State Department of Economic Development, Tourism and Environmental Affairs (FS DETEA) commenting authority</p>	<p>The listed activities triggered by the proposed solar energy facility have been identified and assessed in the Environmental Impact Assessment Process being undertaken. This Environmental Impact Assessment Report will be submitted to the competent and commenting authority in support of the application for authorisation.</p>
National Environmental Management Act (Act No 107 of 1998)	<p>In terms of the Duty of Care Provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, stopped or minimised.</p>	<p>Department of Environmental Affairs</p>	<p>While no permitting or licensing requirements arise directly by virtue of the proposed project, this section has found application during the</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<p>In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.</p>		<p>Environmental Impact Assessment Process through the consideration of potential impacts (cumulative, direct, and indirect). It will continue to apply throughout the life cycle of the project.</p>
<p>Environment Conservation Act (Act No 73 of 1989)</p>	<p>National Noise Control Regulations (GN R154 dated 10 January 1992)</p>	<p>Department of Environmental Affairs Free State Department of Economic Development, Tourism and Environmental Affairs (FS DETEA) commenting authority</p>	<p>Noise impacts are expected to be associated with the construction phase of the project and are not likely to present a significant intrusion to the local community. Therefore is no requirement for a noise permit in terms of the legislation. On-site activities should be limited to 6:00am - 6:00pm, Monday -</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			<p>Saturday (excluding public holidays).</p> <p>Should activities need to be undertaken outside of these times, the surrounding communities will need to be notified and appropriate approval will be obtained from DEA and the Local Municipality.</p>
<p>National Water Act (Act No 36 of 1998)</p>	<p>Water uses under S21 of the Act must be licensed, unless such water use falls into one of the categories listed in S22 of the Act or falls under the general authorisation (and then registration of the water use is required).</p> <p>Consumptive water uses may include the taking of water from a water resource - Sections 21a and b. Non-consumptive water uses may include impeding or diverting of flow in a water course - Section 21c; and altering of bed, banks or characteristics of a watercourse - Section 21i.</p>	<p>Department of Water Affairs</p> <p>Provincial Department of Water Affairs</p>	<p>A water use license (WUL) is required to be obtained if wetlands or drainage lines are impacted on, or if infrastructure lies within 500m of such features. Pans occur on the project site, but outside of the development footprint.</p> <p>Should water be</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			abstracted from ground water/ a borehole on site for use within the facility, a water use license may be required.
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	<p>A mining permit or mining right may be required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act.</p> <p>Requirements for Environmental Management Programmes and Environmental Management Plans are set out in S39 of the Act.</p> <p>S53 Department of Mineral Resources: Approval from the Department of Mineral Resources (DMR) may be required to use land surface contrary to the objects of the Act in terms of section 53 of the Mineral and Petroleum Resources Development Act, (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resources that might occur on site.</p>	Department of Mineral Resources	<p>As no borrow pits are expected to be required for the construction of the facility, no mining permit or right is required to be obtained.</p> <p>A Section 53 application will be submitted the Free State DMR office.</p>
National Environmental Management: Air Quality Act (Act No 39 of 2004)	Measures in respect of dust control (S32) – no regulations promulgated yet.	Department of Environmental Affairs	No permitting or licensing requirements arise from this

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	Measures to control noise (S34) - no regulations promulgated yet.		legislation. The Act provides that an air quality officer may require any person to submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with the Act.
National Heritage Resources Act (Act No 25 of 1999)	<ul style="list-style-type: none"> » Stipulates assessment criteria and categories of heritage resources according to their significance (S7). » Provides for the protection of all archaeological and palaeontological sites, and meteorites (S35). » Provides for the conservation and care of cemeteries and graves by SAHRA where this is not the responsibility of any other authority (S36). » Lists activities which require developers any person who intends to undertake to notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed 	South African Heritage Resources Agency	An HIA and PIA has been undertaken as part of the Environmental Impact Assessment Process to identify heritage sites.(See Appendix F)

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	development (S38). » Requires the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites as part of tourism attraction (S44).		
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	» Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened and protected species has been published in terms of S 56(1) - Government Gazette 29657. » Three government notices have been published, i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered, vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the	Department of Environmental Affairs	As the applicant will not carry out any restricted activity, as is defined in S1 of the Act, no permit is required to be obtained in this regard. Specialist flora and fauna studies have been undertaken as part of the Environmental Impact Assessment Process (refer to Appendix E). As such the potentially occurrence of critically endangered, endangered, vulnerable, and protected species and the potential for them to be affected has

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<p>criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GN 1002), 9 January 2011).</p> <ul style="list-style-type: none"> » This Act also regulates alien and invader species. » Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. 		<p>been considered.</p>
<p>Conservation of Agricultural Resources Act (Act No 43 of 1983)</p>	<ul style="list-style-type: none"> » Prohibition of the spreading of weeds (S5) » Classification of categories of weeds & invader plants (Regulation 15 of GN R1048) & restrictions in terms of where these species may occur. » Requirement & methods to implement control measures for alien and invasive plant species (Regulation 15E of GN R1048). 	<p>Department of Agriculture</p>	<p>This Act will find application throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented.</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			<p>The permission of agricultural authorities will be required if the Project requires the draining of vleis, marshes or water sponges on land outside urban areas.</p>
<p>National Forests Act (Act No. 84 of 1998)</p>	<p>According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.</p>	<p>National Department of Forestry</p>	<p>There are no protected trees in the study area.</p>
<p>National Veld and Forest Fire Act (Act 101 of 1998)</p>	<p>In terms of S12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material.</p> <p>In terms of S17, the applicant must have such equipment, protective clothing, and trained</p>	<p>Department of Agriculture, Forestry and Fisheries (DAFF)</p>	<p>While no permitting or licensing requirements arise from this legislation, this act will find application during the construction and operational phase of the project.</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	personnel for extinguishing fires.		
Hazardous Substances Act (Act No 15 of 1973)	<p>This Act regulates the control of substances that may cause injury, or ill health, or death due to their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products.</p> <p>Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc, nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared as Group I or Group II substance Group IV: any electronic product; and Group V: any radioactive material.</p> <p>The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.</p>	Department of Health	It is necessary to identify and list all the Group I, II, III, and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.
Development Facilitation Act (Act	Provides for the overall framework and	Local Municipality	The applicant must

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
No 67 of 1995)	administrative structures for planning throughout the Republic. S (2 - 4) provide general principles for land development and conflict resolution.		submit a land development application in the prescribed manner and form as provided for in the Act. A land development applicant who wishes to establish a land development area must comply with procedures set out in the Act.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land in the province	Department of Agriculture	Subdivision will have to be in place prior to any subdivision approval in terms of S24 and S17 of the Act.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)	The Minister may by notice in the <i>Gazette</i> publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. The Minister may amend the list by – » Adding other waste management activities to the list. » Removing waste management activities from	National Department of Water and Environmental Affairs Provincial Department of Environmental Affairs (general	As no waste disposal site is to be associated with the proposed project, no permit is required in this regard. Waste handling, storage and disposal during construction and operation is required to

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<p>the list.</p> <ul style="list-style-type: none"> » Making other changes to the particulars on the list. <p>In terms of the Regulations published in terms of this Act (GN 718), an Environmental Impact Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities.</p> <p>Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that:</p> <ul style="list-style-type: none"> » The containers in which any waste is stored, are intact and not corroded or in » any other way rendered unfit for the safe storage of waste. » Adequate measures are taken to prevent accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise; and » Pollution of the environment and harm to health are prevented. 	<p>waste)</p>	<p>be undertaken in accordance with the requirements of the Act, as detailed in the EMP (refer to Appendix K).</p> <p>The volumes of waste to be generated and stored on the site during construction and operation of the facility will not require a waste license (provided these remain below the prescribed thresholds).</p>
National Road Traffic Act (Act No	» The technical recommendations for highways	» South African	An abnormal

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
93 of 1996)	<p>(TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed.</p> <ul style="list-style-type: none"> » Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts. » The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations. 	<p>National Roads Agency Limited (national roads)</p> <ul style="list-style-type: none"> » Provincial Department of Transport 	<p>load/vehicle permit may be required to transport the various components to site for construction. These include route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads.</p> <p>Transport vehicles exceeding the dimensional limitations (length) of 22m. Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).</p>
Promotion of Access to Information Act (Act No 2 of 2000)	All requests for access to information held by state or private body are provided for in the Act under	Department of Environmental	No permitting or licensing requirements.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	S11.	Affairs	
Promotion of Administrative Justice Act (Act No 3 of 2000)	<p>In terms of S3 the government is required to act lawfully and take procedurally fair, reasonable, and rational decisions.</p> <p>Interested and affected parties have a right to be heard.</p>	Department of Environmental Affairs	No permitting or licensing requirements.
Provincial Legislation			
The Free State Nature Conservation Bill 23 of 2010 (FSNCB)	<p>According to this Bill- Chapter 10, Section 31: Except on authority of a permit issued by the MEC or under environmental authorisation no person may –Drain or mechanically disturb any wetland or portion thereof. Utilise a wetland or portion thereof in a manner that would damage the hydrological or ecological function thereof</p> <p>Engage in activities outside but adjacent to the wetland which would damage the hydrological or ecological functioning of such wetland</p> <p>Chapter 10, Section 32: No person may undertake any activity involving any species of wild animal or plant which causes or has the potential to cause a degradation in the natural state of the indigenous biodiversity of that area</p> <p>» The Act provides lists of protected species for the Province</p>	Provincial Department of Environmental Affairs	Permitting or licensing requirements arise from this legislation for the proposed activities to be undertaken for the proposed project as there are protected succulent plant species on the proposed development site. A permit is required to remove these plants.

MANAGEMENT PROGRAMME: PLANNING AND DESIGN CHAPTER 5

Overall Goal: undertake the planning and design phase in a way that:

- » Ensures that the design of the facility responds to the identified environmental constraints and opportunities.
- » Ensures that adequate regard has been taken of any landowner and community concerns and that these are appropriately addressed through design and planning (where appropriate).
- » Ensures that the best environmental options are selected for the linear components, including the access roads and power line alignments.
- » Enables the solar energy facility construction activities to be undertaken without significant disruption to other land uses and activities in the area.

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

5.1 Objectives

OBJECTIVE: Ensure the facility design responds to identified environmental constraints and opportunities

In order to minimise impacts associated with the construction and operation of the facility, the following is required to be undertaken during the final design phase:

- » Geotechnical survey – this will investigate flood potential, foundation conditions, potential for excavations, and the availability of natural construction materials. This study will serve to inform the type of foundations required to be constructed (i.e. for the substation), and the extent of earthworks and compaction required in the establishment of the internal access roads.
- » A storm-water management plan – this will detail how storm-water runoff (i.e. over engineered hard surfaces) can be managed to reduce velocities and volumes of water that could lead to erosion and potential sedimentation of drainage systems.

The implementation of the EMP within this area will minimise and/or mitigate impacts on the environment, specifically on the ecology of the project area.

Areas of high sensitivity include rocky outcrops, ridges, and small koppies which are a habitat for several protected species found near the sites (refer to Figure 1.3). Once these habitats have been physically altered, they cannot be recreated or returned to their former diversity and functionality therefore should be treated as **no-go areas**. Other sensitive ecological areas include dense vegetation of the riparian areas fringing the drainage channels which is essential in keeping the drainage channel intact and protects it from erosion as well as man-made wetlands on site. These areas should be avoided as far as possible, and where not possible to avoid, impacts on such sites should be minimised to reduce impacts to acceptable levels.

Project Component/s	<ul style="list-style-type: none"> » PV panels. » Substation. » Access roads. » Power line.
Potential Impact	» Impact on identified sensitive areas.
Activities/Risk Sources	» Positioning of all the facilities components.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » The design of the facility responds to the identified environmental constraints and opportunities. » Site sensitivities are taken into consideration and avoided as far as possible, thereby mitigating potential impacts.

Mitigation: Action/Control	Responsibility	Timeframe
Appoint qualified botanical and faunal specialists and ornithologist to ground-truth all power line infrastructure footprints. Their recommendations must inform the final layout.	SolaireDirect Southern Africa (Pty) Ltd / specialists	Design stage
Undertake a geotechnical pre-construction survey.	Geotechnical specialist	Design
Obtain any additional environmental permits required (e.g. water use license, permit to impact on protected plant species) prior to the commencement of construction.	SolaireDirect Southern Africa (Pty) Ltd	Project planning
Avoid identified sensitive areas within the site in the final design of the facility.	Engineering design consultant and SolaireDirect Southern Africa (Pty) Ltd	Design review
Consider and incorporate design level mitigation measures recommended by the specialists as detailed within the Environmental Impact Assessment Report and relevant appendices.	Engineering design consultant, solar component supplier, and SolaireDirect	Design review

Mitigation: Action/Control	Responsibility	Timeframe
	Southern Africa (Pty) Ltd	
External access point and internal access road to be carefully planned to maximise road user safety.	SolaireDirect Southern Africa (Pty) Ltd	Design
Compile a comprehensive storm water management plan for hard surfaces as part of the final design of the project (refer to Appendix C for principles to be considered). This must include appropriate means for the handling of storm water within the site, e.g. separate clean and dirty water streams around the plant, install stilling basins to capture large volumes of run-off, trapping sediments, and reduce flow velocities (i.e. water used when washing the panels).	SolaireDirect Southern Africa (Pty) Ltd	Design
Retain a buffer (approximately 50 - 100 m wide) of intact natural vegetation along the perimeter of each development site.	SolaireDirect Southern Africa (Pty) Ltd	Design
Retain a buffer of at least 20m around cemeteries identified on site.	SolaireDirect Southern Africa (Pty) Ltd	Design
Retain a buffer of at least 32 m from drainage lines on site.	SolaireDirect Southern Africa (Pty) Ltd	Design
Use bird-friendly power line towers and conductor designs.	SolaireDirect Southern Africa (Pty) Ltd	Design
In designing the facility, use should be made of existing road infrastructure as far as possible. Where no road infrastructure exists, new roads should be placed within existing disturbed areas or management measures must be implemented to ensure minimum damage is caused to natural habitats.	SolaireDirect Southern Africa (Pty) Ltd / Design engineer	Design phase
Roads must be designed so that changes to surface water runoff are avoided or minimised and erosion is not initiated.	SolaireDirect Southern Africa (Pty) Ltd / Design engineer	Design phase
The facility should be designed in such a manner to allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote the dissipation of storm water.	SolaireDirect Southern Africa (Pty) Ltd / Design engineer	Design phase
Obtain permits for protected plant removal and relocation prior to commencement of activity in an area	SolaireDirect Southern Africa (Pty) Ltd /	Design phase

Mitigation: Action/Control	Responsibility	Timeframe
	Design engineer	
Performance Indicator	<ul style="list-style-type: none"> » The design meets the objectives and does not degrade the environment. » Design and layouts respond to the mitigation measures and recommendations in the Environmental Impact Assessment Report. 	
Monitoring	<ul style="list-style-type: none"> » Review of the design by the Project Manager and the Environmental Control Officer (ECO) prior to the commencement of construction. 	

OBJECTIVE: Ensure the selection of the best environmental option for the alignment of the power line and access roads

- » **Access Road** - The project development site is accessible from the N8 highway towards Botsabelo linking into a secondary road S417 (gravel) and an existing access road (gravel) on the proposed farm portion, this will be upgraded and used to access the facility site. Upgrade of access roads within the site will be required and new access roads will be required. Access track construction would normally comprise of compacted rock-fill with a layer of higher quality surfacing stone on top. The strength and durability properties of the rock strata at the proposed site are not known at this stage; this will need to be assessed via a geotechnical study to be conducted by the project proponent. Depending on the results of these studies, it may be possible, in some areas, to strip off the existing vegetation and ground surface and level the exposed formation to form an access track surface. The final layout of the access roads will be determined following the identification of site related sensitivities. These roads will be approximately 4 m in width, and will be gravel based.
- » **Power line** – An 132kV overhead power line will be constructed from the new substation to connect directly into the existing Sannaspos Rural substation, which is located west of the proposed Sannaspos Solar Facility-phase 1. This power line will be approximately 1200 m in length.

Project Component/s	<ul style="list-style-type: none"> » Power line. » Access roads. 	
Potential Impact	<ul style="list-style-type: none"> » Route that degrades the environment unnecessarily, particularly with respect to visual aesthetics, loss of indigenous flora, and erosion. 	

Activities/Risk Sources	<ul style="list-style-type: none"> » Alignment of power line. » Alignment of access roads.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To ensure selection of best environmental option for alignment of linear infrastructure. » Environmental sensitivities are taken into consideration and avoided as far as possible, thereby mitigating potential impacts.

Mitigation: Action/Control	Responsibility	Timeframe
Select a power line alignment that curtails environmental impacts and enhances environmental benefits.	SolaireDirect Southern Africa (Pty) Ltd	Prior to submission of the final construction layout plan
Locate power line and access roads within disturbed corridors, as far as possible.	SolaireDirect Southern Africa (Pty) Ltd	Prior to submission of the final construction layout plan
Consider design level mitigation measures recommended by the specialists as detailed within the Environmental Impact Assessment report and relevant appendices.	SolaireDirect Southern Africa (Pty) Ltd	Design
Plan any new access roads according to contour lines to minimise cutting and filling operations.	SolaireDirect Southern Africa (Pty) Ltd	Design

Performance Indicator	<ul style="list-style-type: none"> » Power line and road alignments meet environmental objectives. » Selected linear alignments that minimise any negative environmental impacts and maximise any benefits.
Monitoring	<ul style="list-style-type: none"> » Ensure that the design implemented meets the objectives and mitigation measures in the Environmental Impact Assessment Report through review of the design by the Project Manager, and the ECO prior to the commencement of construction.

OBJECTIVE: Minimise storm water runoff (guideline for storm water management plan)

Management of storm water will be required during the construction and operational phases of the facility. A detailed storm water management plan is

required to be compiled as part of the final design to ensure compliance with applicable regulations and to prevent off-site migration of contaminated storm water or increased soil erosion. The section below provides a guideline for the management of storm water on site and will need to be supplemented with the relevant method statements during the construction and operation phases of the facility.

Project Component/s	<ul style="list-style-type: none"> » Storm water management components. » Any hard engineered surfaces (i.e. access roads).
Potential Impact	<ul style="list-style-type: none"> » Poor storm water management and alteration of the hydrological regime (i.e. drainage lines).
Activities/Risk Sources	<ul style="list-style-type: none"> » Construction of the facility (i.e. placement of hard engineered surfaces).
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Appropriate management of storm water to minimise impacts on the environment.

Mitigation: Action/Control	Responsibility	Timeframe
A Method Statement for the management of storm water which also considers the recommendations below is to be submitted to the ECO.	SolaireDirect Southern Africa (Pty) Ltd	Pre-construction
Reduce the potential increase in surface flow velocities and the resultant impact on the localised drainage system through increased sedimentation.	SolaireDirect Southern Africa (Pty) Ltd	Planning and design
Appropriately plan hard-engineered bank erosion protection structures to minimise erosion potential.	SolaireDirect Southern Africa (Pty) Ltd	Planning and design
Ensure suitable handling of storm water within the site (i.e. separate clean and dirty water streams around the plant and install stilling basins to capture large volumes of run-off, trapping sediments and reduce flow velocities) through appropriate design of the facility.	SolaireDirect Southern Africa (Pty) Ltd	Construction and operation
Design measures for storm water management need to allow for surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows.	SolaireDirect Southern Africa (Pty) Ltd	Planning and design

Performance Indicator	<ul style="list-style-type: none"> » Appropriate storm water management measures included within the facility design. » Sound water quality and quantity management during construction and operation.
Monitoring	<ul style="list-style-type: none"> » Devise a suitable surface water quality monitoring plan for implementation during construction and operation.

OBJECTIVE: Search and Rescue of All Translocatable Indigenous Plants

Prior to any earthworks (including road construction) within areas of natural vegetation, a plant Search and Rescue program should be developed and implemented (refer to Appendix F of the EMP for guidelines in this regard). The section below provides a guideline for the Search & Rescue Plan on site and will need to be supplemented with the relevant methodology depending on the final placement of infrastructure.

Project Component/s	» Any infrastructure or activity that will result in disturbance to natural areas.
Potential Impact	» Substantially increased loss of natural vegetation at construction phase and waste of on-site plant resources, and lack of locally sourced material for rehabilitation of disturbed areas. » increased cost of having to buy in material for rehabilitation.
Activities/Risk Sources	» Construction related loss and damage to remaining natural vegetation via heavy machinery, etc.
Mitigation: Target/Objective	» Rescue, maintenance and subsequent replanting of at least 40% of the natural vegetation in all development footprints within any areas of natural vegetation on site

Mitigation: Action/Control	Responsibility	Timeframe
Develop and implement an appropriate plant Search and Rescue program	SolaireDirect Southern Africa (Pty) Ltd	Planning and design
Search and Rescue (S&R) of certain translocatable, selected succulents, shrubs and bulbs occurring in long term & permanent hard surface development footprints (i.e. all buildings, new roads and tracks, laydown areas, and panel positions) should take place. All such development footprints must be surveyed and pegged out as soon as possible, and then a local horticulturist with Search and Rescue experience should be appointed to undertake the S&R. All rescued species should be bagged (and cuttings taken where appropriate) and kept in the horticulturist's or a designated on-site nursery, and should be returned to site once all construction is completed and rehabilitation of disturbed areas is required. Replanting should only occur in spring or early summer (August to January), once the first rains have fallen, in order to facilitate establishment. Plants that can be considered for rescue are all bulbs and succulents, and certain shrubs.	Specialist	Prior to construction

Performance Indicator	<ul style="list-style-type: none"> » Horticulturist to submit list of target species to botanist for approval. » Rescue of material. » Replanting in rehabilitation areas to cover 40% of these areas within 3 months of replanting.
Monitoring	<ul style="list-style-type: none"> » ECO to monitor Search and Rescue. » Horticulturist to liaise with botanist. » Botanist to review rehabilitation success after 3 months of replanting of rehabilitation areas.

OBJECTIVE: To ensure effective communication mechanisms

On-going communication with affected and surrounding landowners is important to maintain during the construction and operational phases of the solar energy facility. Any issues and concerns raised should be addressed as far as possible in as short a timeframe as possible.

Project component/s	» Solar energy facility
Potential Impact	» Impacts on affected and surrounding landowners and land uses
Activity/risk source	<ul style="list-style-type: none"> » Activities associated with solar energy facility construction » Activities associated with solar energy facility operation
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Effective communication with affected and surrounding landowners » Addressing of any issues and concerns raised as far as possible in as short a timeframe as possible

Mitigation: Action/control	Responsibility	Timeframe
Compile and implement a grievance mechanism procedure for the public (as outlined in Appendix A) to be implemented during both the construction and operational phases of the facility. This procedure should include details of the contact person who will be receiving issues raised by interested and affected parties, and the process that will be followed to address issues.	SolaireDirect Southern Africa (Pty) Ltd	Pre-construction (construction procedure) Pre-operation (operation procedure)
Develop and implement a grievance mechanism for the construction, operational and closure phases of the project for all employees, contractors, subcontractors and	SolaireDirect Southern Africa (Pty) Ltd / Contractor	Pre-construction (construction procedure) Pre-operation

Mitigation: Action/control	Responsibility	Timeframe
site personnel. This procedure should be in line with the South African Labour Law.		(operation procedure)
Liaison with landowners is to be undertaken prior to the commencement of construction in order to provide sufficient time for them to plan agricultural activities.	SolaireDirect Southern Africa (Pty) Ltd / Contractor	Pre-construction

Performance Indicator	» Effective communication procedures in place.
Monitoring	» An incident reporting system should be used to record non-conformances to the EMP.

MANAGEMENT PROGRAMME: CONSTRUCTION

CHAPTER 6

Overall Goal: Undertake the construction phase in a way that:

- » Ensures that construction activities are properly managed in respect of environmental aspects and impacts.
- » Enables construction activities to be undertaken without significant disruption to other land uses and activities in the area, in particular concerning noise impacts, farming practices, traffic and road use, and effects on local residents.
- » Minimises the impact on any remaining indigenous natural vegetation and habitats of ecological value (specifically no go areas identified through the EIA).
- » Minimises impacts on fauna using the site.
- » Minimises the impact on heritage sites should they be uncovered.

6.1 Institutional Arrangements: Roles and Responsibilities for the Construction Phase

As the proponent, SolaireDirect Southern Africa (Pty) Ltd must ensure that the implementation of the facility complies with the requirements of all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development of the EMP, and the implementation of the EMP through its integration into the contract documentation. SolaireDirect Southern Africa (Pty) Ltd will retain various key roles and responsibilities during the construction of the facility.

OBJECTIVE: Establish clear reporting, communication, and responsibilities in relation to overall implementation of the EMP

Formal responsibilities are necessary to ensure that key procedures are executed. Specific responsibilities of the Project Manager; Site Manager; Safety, Health and Environment Representative; Environmental Control Officer (ECO) and Contractor for the construction phase of this project are as detailed below.

Project Manager will:

- » Ensure all specifications and legal constraints specifically with regards to the environment are highlighted to the Contractor(s) so that they are aware of these.
- » Ensure that SolaireDirect Southern Africa (Pty) Ltd and its Contractor(s) are made aware of all stipulations within the EMP.
- » Ensure that the EMP is correctly implemented throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes.
- » Be fully conversed with the Environmental Impact Assessment for the project, the EMP, the conditions of the Environmental Authorisation (once issued), and all relevant environmental legislation.

Site Manager (SolaireDirect's on-site Representative) will:

- » Be fully knowledgeable with the contents of the Environmental Impact Assessment and risk management.
- » Be fully knowledgeable with the contents and conditions of the Environmental Authorisation (once issued).
- » Be fully knowledgeable with the contents of the EMP.
- » Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these.
- » Have overall responsibility of the EMP and its implementation.
- » Conduct audits to ensure compliance to the EMP.
- » Ensure there is communication with the Project Manager, the ECO, and relevant discipline engineers on matters concerning the environment.
- » Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
- » Confine activities to the demarcated construction site.

An independent **Environmental Control Officer** (ECO) must be appointed by SolaireDirect Southern Africa (Pty) Ltd prior to the commencement of any authorised activities. The ECO will be responsible for monitoring, reviewing and verifying compliance by the Contractor with the environmental specifications of the EMP and the conditions of the Environmental Authorisation. Accordingly, the ECO will:

- » Be fully knowledgeable with the contents with the EIA.
- » Be fully knowledgeable with the contents with the conditions of the Environmental Authorisation (once issued).
- » Be fully knowledgeable with the contents with the EMP.
- » Be fully knowledgeable with the contents with all relevant environmental legislation, and ensure compliance with them.

- » Ensure that the contents of this document are communicated to the Contractor site staff and that the Site Manager and Contractor are constantly made aware of the contents through discussion.
- » Ensure that the compliance of the EMP is monitored through regular and comprehensive inspection of the site and surrounding areas.
- » Ensure that if the EMP conditions or specifications are not followed then appropriate measures are undertaken to address this.
- » Monitoring and verification must be implemented to ensure that environmental impacts are kept to a minimum, as far as possible.
- » Ensure that the Site Manager has input into the review and acceptance of construction methods and method statements.
- » Ensure that activities on site comply with all relevant environmental legislation.
- » Ensure that appropriate measures are undertaken to address any non-compliances recorded.
- » Ensure that a removal is ordered of any person(s) and/or equipment responsible for any contravention of the specifications of the EMP.
- » Ensure that the compilation of progress reports for submission to the Project Manager, with input from the Site Manager, takes place on a regular basis, including a final post-construction audit.
- » Ensure that there is communication with the Site Manager regarding the monitoring of the site.
- » Ensure that any non-compliance or remedial measures that need to be applied are reported.
- » Independently report to DEA in terms of compliance with the specifications of the EMP and conditions of the Environmental Authorisation (once issued).
- » Keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.

As a general mitigation strategy, the Environmental Control Officer (ECO) should be present for the site preparation and initial clearing activities to ensure the correct demarcation of no-go areas, facilitate environmental induction with construction staff and supervise any flora relocation and faunal rescue activities that may need to take place during the site clearing (i.e. during site establishment, and excavation of foundations). Thereafter weekly site compliance inspections would probably be sufficient, provided that compliance with the requirements of the Environmental Authorisation, EMP and environmental legislation is maintained. In the absence of the ECO there should be a designated environmental officer present to deal with any environmental issues that may arise such as fuel or oil spills. The ECO shall remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site handed over for operation.

Contractors and Service Providers: It is important that contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMP. The contractor is responsible for informing employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The contractor's obligations in this regard include the following:

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » A copy of the EMP must be easily accessible to all on-site staff members.
- » Employees must be familiar with the requirements of this EMP and the environmental specifications as they apply to the construction of the proposed facility.
- » Prior to commencing any site works, all employees and sub-contractors must have attended an environmental awareness training course which must provide staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- » Staff will be informed of environmental issues as deemed necessary by the ECO.

All contractors (including sub-contractors and staff) and service providers are ultimately responsible for:

- » Ensuring adherence to the environmental management specifications.
- » Ensuring that Method Statements are submitted to the Site Manager (and ECO) for approval before any work is undertaken.
- » Any lack of adherence to the above will be considered as non-compliance to the specifications of the EMP.
- » Ensuring that any instructions issued by the Site Manager on the advice of the ECO are adhered to.
- » Ensuring that a report is tabled at each site meeting, which will document all incidents that have occurred during the period before the site meeting.
- » Ensuring that a register is kept in the site office, which lists all transgressions issued by the ECO.
- » Ensuring that a register of all public complaints is maintained.
- » Ensuring that all employees, including those of sub-contractors receive training before the commencement of construction in order that they can constructively contribute towards the successful implementation of the EMP (i.e. ensure their staff are appropriately trained as to the environmental obligations).

6.2 Objectives

In order to meet the overall goal for construction, the following objectives, actions, and monitoring requirements have been identified.

OBJECTIVE: Minimise impacts related to inappropriate site establishment

Project Component/s	<ul style="list-style-type: none"> » Area infrastructure (i.e. PV panels, and substation). » Linear infrastructure (i.e. power line, and access roads).
Potential Impact	<ul style="list-style-type: none"> » Hazards to landowners and public. » Damage to indigenous natural vegetation, due largely to ignorance of where such areas are located. » Loss of threatened plant species
Activities/Risk Sources	<ul style="list-style-type: none"> » Open excavations (foundations and cable trenches). » Movement of construction vehicles in the area and on-site.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To secure the site against unauthorised entry. » To protect members of the public/landowners/residents. » No loss of or damage to sensitive vegetation in areas outside the immediate development footprint.

Mitigation: Action/Control	Responsibility	Timeframe
Secure site, working areas and excavations in an appropriate manner, as agreed with the ECO.	Contractor	Site establishment, and duration of construction
Where necessary control access, fence, and secure area.	Contractor	Site establishment, and duration of construction
Adequate protective measures must be implemented to prevent unauthorised access to the working area and the internal access/haul routes.	Contractor	Site establishment, and duration of construction
Fence and secure contractor's equipment camp.	Contractor	Site establishment
Where the public could be exposed to danger by any of the works or site activities, the contractor must, as appropriate, provide suitable flagmen, barriers and/or warning signs in English, Afrikaans and any other relevant local languages, all to the approval of the Site Manager	Contractor	Site establishment Duration of construction
The construction camp used to house equipment must	Contractor	Erection:

Mitigation: Action/Control	Responsibility	Timeframe
be located in a disturbed area and must be screened as far as practical off during the entire construction phase.		during site establishment Maintenance: for duration of Contract
Establish appropriately bunded areas for storage of hazardous materials (i.e. fuel to be required during construction).	Contractor	Site establishment
All development footprints should be appropriately fenced off and clearly demarcated.	Contractor	Site establishment, and duration of construction
All unattended open excavations shall be adequately demarcated and/or fenced.	Contractor	Site establishment, and duration of construction
Establish the necessary ablution facilities with chemical toilets and provide adequate sanitation facilities and ablutions for construction workers (1 toilet per every 15 workers) at appropriate locations on site.	Contractor	Site establishment, and duration of construction
Ablution or sanitation facilities should not be located within 100 m from a 1:100 year flood line including drainage lines.	Contractor	Site establishment, and duration of construction
Supply adequate waste collection bins at site where construction is being undertaken. Separate bins should be provided for general and hazardous waste. As far as possible, provision should be made for separation of waste for recycling.	Contractor	Site establishment, and duration of construction

Performance Indicator	<ul style="list-style-type: none"> » Site is secure and there is no unauthorised entry. » No members of the public/ landowners injured. » Appropriate and adequate waste management and sanitation facilities provided at construction site.
Monitoring	<ul style="list-style-type: none"> » An incident reporting system will be used to record non-conformances to the EMP. » ECO to monitor all construction areas on a continuous basis until all construction is completed. Non-conformances will be immediately reported to the site manager.

OBJECTIVE: Appropriate management of the construction site and construction workers

The construction phase of the PV facility is expected to extend over a period of 18-24 months. Approximately 291 people are expected to be required during the construction phase. Ideally low skilled and semi-skilled positions will be filled by locals living in and around Bloemfontein. This will however be dependent on the skills availability in the area. Workers not living in the area, including those required for skilled positions will be transported to site on a daily basis and will not be housed on site. However, the security team will be required on site at all times.

Project Component/s	» Area and linear infrastructure.
Potential Impact	<ul style="list-style-type: none"> » Damage to indigenous natural vegetation and sensitive areas. » Damage to and/or loss of topsoil (i.e. pollution, compaction etc.). » Impacts on the surrounding environment due to inadequate sanitation and waste removal facilities. » Pollution/contamination of the environment.
Activities/Risk Sources	<ul style="list-style-type: none"> » Vegetation clearing and levelling of equipment storage area/s. » Access to and from the equipment storage area/s. » Ablution facilities. » Contractors not aware of the requirements of the EMP, leading to unnecessary impacts on the surrounding environment.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Limit equipment storage within demarcated designated areas. » Ensure adequate sanitation facilities and waste management practices. » Ensure appropriate management of actions by on-site personnel in order to minimise impacts to the surrounding environment.

Mitigation: Action/Control	Responsibility	Timeframe
The siting of the construction equipment camp/s must take cognisance of no go and sensitive areas identified by the EIA studies. The location of this construction equipment camp/s shall be approved by the project ECO and must be as indicated in the final layout approved by the DEA.	Contractor	Pre-construction
As far as possible, minimise vegetation clearing and levelling for equipment storage areas.	Contractor	Site establishment, and during construction
Rehabilitate all disturbed areas at the construction	Contractor	Duration of

Mitigation: Action/Control	Responsibility	Timeframe
equipment camp as soon as possible after construction is complete within an area.		Contract
Ensure waste removal facilities are maintained and emptied on a regular basis.	Contractor	Site establishment, and duration of construction
The terms of this EMP and the Environmental Authorisation (once issued) must be included in all tender documentation and Contractors contracts.	SolaireDirect Southern Africa (Pty) Ltd	Tender process
Ensure that all personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm. This can be achieved through the provision of appropriate environmental awareness training to all personnel. Records of all training undertaken must be kept.	Contractor	Duration of construction
Contractors must use chemical toilets/ablution facilities situated at designated areas of the site; no ablution activities will be permitted outside the designated areas. These facilities must be regularly serviced by appropriate contractors. A minimum of one toilet shall be provided per 15 persons at each working area such as the Contractor's camp.	Contractor and sub-contractor/s	Duration of contract
Cooking and eating of meals must take place in a designated area. No fires are allowed on site. No firewood or kindling may be gathered from the site or surrounds.	Contractor and sub-contractor/s	Duration of contract
All litter must be deposited in a clearly marked, closed, animal-proof disposal bin in the construction area. Particular attention needs to be paid to food waste.	Contractor and sub-contractor/s	Duration of contract
No one other than the ECO or personnel authorised by the ECO may disturb flora or fauna outside of the demarcated construction area/s.	Contractor and sub-contractor/s	Duration of contract
Fire fighting equipment and training must be provided before the construction phase commences.	Contractor and sub-contractor/s	Duration of contract
Draft and implement a Code of Conduct for construction workers.	Contractor and sub-contractor/s	Pre-construction
Contractors must ensure that all workers are informed at the outset of the construction phase of the conditions contained in the Code of Conduct,	Contractor and sub-contractor/s	Construction

Mitigation: Action/Control	Responsibility	Timeframe
specifically consequences of stock theft and trespassing on adjacent farms.		
On completion of the construction phase, all construction workers must leave the site within one week of their contract ending.	Contractor and sub-contractor/s	Construction
Develop and implement a grievance mechanism for the construction, operational and closure phases of the project for all employees, contractors, subcontractors and site personnel. This procedure should be in line with the South African Labour Law.	SolaireDirect Southern Africa (Pty) Ltd Contractor	Pre-construction

Performance Indicator	<ul style="list-style-type: none"> » The construction activities have avoided no go and sensitive areas, as approved by the ECO. » Ablution and waste removal facilities are in a good working order and do not pollute the environment due to mismanagement. » All areas are rehabilitated promptly after construction in an area is complete. » Excess vegetation clearing and levelling is not reported by the ECO. » No complaints regarding contractor behaviour or habits. » Appropriate training of all staff is undertaken prior to them commencing work on the construction site. » Code of Conduct drafted before commencement of construction phase.
Monitoring	<ul style="list-style-type: none"> » Regular audits of the construction camps and areas of construction on site by the ECO. » Proof of disposal of sewage at an appropriate wastewater treatment works. » An incident reporting system should be used to record non-conformances to the EMP. » Observation and supervision of Contractor practices throughout construction phase by the ECO. » Complaints will be investigated and, if appropriate, acted upon. » An incident reporting system will be used to record non-conformances to the EMP.

OBJECTIVE: Maximise local employment and business opportunities associated with the construction phase

Although limited, employment opportunities could be created during the construction phase (i.e. ~291), specifically for semi-skilled and unskilled workers. The unemployment rate in the study area is quite high and there are therefore various individuals in the area in search of employment. Employment of locals and the involvement of local SMMEs would enhance the social benefits associated with the project, even if the opportunities are only temporary. The procurement of local goods could furthermore result in positive economic spin-offs.

Project Component/s	» Construction and establishment activities associated with the establishment of the PV facility, including infrastructure etc.
Potential Impact	» The opportunities and benefits associated with the creation of local employment and business should be maximised.
Activities/Risk Sources	» The employment of outside contractors to undertake the work and who make use of their own labour will reduce the employment and business opportunities for locals. Employment of local labour will maximise local employment opportunities.
Mitigation: Target/Objective	» SolaireDirect Southern Africa (Pty) Ltd, in discussions with the GLM, should aim to employ a minimum of 80% of the low-skilled workers from the local area. This should also be made a requirement for all contractors. SolaireDirect Southern Africa (Pty) Ltd should also develop a database of local BEE service providers

Mitigation: Action/Control	Responsibility	Timeframe
Attempt to employ a majority of the low-skilled workers from the local area in line with employment and business policy document that sets out local employment targets.	SolaireDirect Southern Africa (Pty) Ltd & contractors	To be in place before construction phase commences.
Where required, implement appropriate training and skills development programmes prior to the initiation of the construction phase to ensure that local employment target is met.	SolaireDirect Southern Africa (Pty) Ltd	To be initiated prior to the initiation of the construction phase
Skills audit to be undertaken to determine training and skills development requirements.	SolaireDirect Southern Africa (Pty) Ltd	To be undertaken within 1-month of commencement of

Mitigation: Action/Control	Responsibility	Timeframe
		construction phase commences.
Develop a database of local BEE service providers and ensure that they are informed of tenders and job opportunities.	SolaireDirect Southern Africa (Pty) Ltd	Before construction phase commences.
Identify potential opportunities for local businesses.	SolaireDirect Southern Africa (Pty) Ltd	Pre-construction

Performance Indicator	<ul style="list-style-type: none"> » Employment and business policy document that sets out local employment and targets completed before construction phase commences; » Majority of semi and unskilled labour locally sourced. » Database of potential local BEE services providers in place before construction phase commences. » Skills audit to determine need for training and skills development programme undertaken within 1 month of commencement of construction phase.
Monitoring	<ul style="list-style-type: none"> » SolaireDirect Southern Africa (Pty) Ltd and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Avoid the potential impacts on family structures and social networks associated with presence of construction workers from outside the area

Even though the inflow of jobseekers is likely to occur, the probability of this issue becoming problematic and resulting in severe negative social impacts is seen to be improbable.

Other possible negative impacts due to the workforce's presence in the area and especially when jobseekers come to the area would include misconduct of workers, trespassing of workers on privately owned farms, the possible increase in crime, littering, increase in traffic, increase in noise, the development of informal vending stations, and poaching of livestock.

Project Component/s	» Construction and establishment activities associated with the establishment of the PV facility, including infrastructure etc.
Potential Impact	» The presence of construction workers who live outside the area

	and who are housed in local towns can affect family structures and social networks.
Activities/Risk Sources	» The presence of construction workers can affect negatively on family structures and social networks, especially in small, rural communities.
Mitigation: Target/Objective	» To avoid and or minimise the potential impact of construction workers on the local community. This can be achieved by maximising the number of locals employed during the construction phase and minimising the number of workers housed on the site.

Mitigation: Action/Control	Responsibility	Timeframe
Attempt to ensure that the majority of the low-skilled workers are sourced from the local area. This should be included in the tender documents. Construction workers should be recruited from the local area in and around the Bloemfontein.	SolaireDirect Southern Africa (Pty) Ltd and contractors	Construction phase.
Identify local contractors who are qualified to undertake the required work.	SolaireDirect Southern Africa (Pty) Ltd	Pre-construction
Develop and implement a Code of Conduct to cover the activities of the construction workers housed on the site	SolaireDirect Southern Africa (Pty) Ltd	Pre-construction
Ensure that construction workers attend a brief session before they commence activities. The aim of the briefing session is to inform them of the rules and regulations governing activities on the site as set out in the Code of Conduct.	SolaireDirect Southern Africa (Pty) Ltd and contractors	Pre-construction
Ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct.	SolaireDirect Southern Africa (Pty) Ltd and contractors	Pre-construction
Ensure that construction workers who are found guilty of breaching the Code of Conduct are dismissed. All dismissals must be in accordance with South African labour legislation.	Contractors	Construction phase
Provide opportunities for workers to go home over weekends.	Contractors	Construction phase
On completion of the construction phase all construction workers must be transported back to their place of origin within two days of their contract ending. The costs of transportation must be borne by the contractor.	Contractors	Construction phase

Performance Indicator	<ul style="list-style-type: none"> » Employment policy and tender documents that sets out local employment and targets completed before construction phase commences. » Majority of semi and unskilled labour locally sourced. » Local construction workers employed have proof that they have lived in the area for five years or longer. » Tender documents for contractors include recommendations for construction camp. » MF set up prior to implementation of construction phase. » Code of Conduct drafted before commencement of construction phase. » Briefing session with construction workers held at outset of construction phase.
Monitoring	<ul style="list-style-type: none"> » SolaireDirect Southern Africa (Pty) Ltd and/or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Minimise impacts related to traffic management and transportation of equipment and materials to site (Traffic Management and Transportation Plan)

The construction phase of the project will be the most significant in terms of generating traffic impacts; resulting from the transport of equipment (including turbine components) and materials and construction crews to the site and the return of the vehicles after delivery of materials. Potential impacts associated with transportation and access relate to works within the site boundary and external works outside the site boundary.

The components for the proposed facility will be transported to site by road. The study site is accessible via an existing secondary gravel road off the N8. There are a number of vehicles anticipated on site during the construction phase of the facility, with the exact number depending on the final transport plan devised by the EPC partner during the final design phase of the facility.

The section below provides a guideline for the Traffic Management and Transportation Plan on site and will need to be supplemented with the relevant final transport plan devised by the EPC partner during the final design phase of the facility.

Project Component/s	» Delivery of any component required within the construction phase.
Potential Impact	<ul style="list-style-type: none"> » Impact of heavy construction vehicles on road surfaces, and possible increased risk in accidents involving people and animals. » Traffic congestion, particularly on narrow roads or on road passes where overtaking is not permitted. » Deterioration of road pavement conditions (both surfaced and gravel road) due to abnormal loads.
Activities/Risk Sources	<ul style="list-style-type: none"> » Construction vehicle movement. » Speeding on local roads. » Degradation of local road conditions. » Site preparation and earthworks. » Foundations or plant equipment installation. » Transportation of ready-mix concrete from off-site batching plant to the site. » Mobile construction equipment movement on-site. » Power line and substation construction activities.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Minimise impact of traffic associated with the construction of the facility on local traffic volume, existing infrastructure, property owners, animals, and road users. » To minimise potential for negative interaction between pedestrians or sensitive users and traffic associated with the facility construction. » To ensure all vehicles are roadworthy and all materials/equipment are transported appropriately and within any imposed permit/licence conditions.

Mitigation: Action/Control	Responsibility	Timeframe
The contractor's plans, procedures and schedules, as well as the anticipated intrusion impacts should be clarified with affected parties prior to the commencement of construction activities on site.	SolaireDirect Southern Africa (Pty) Ltd and ECO	Pre-construction
Source general construction material and goods locally where available to limit transportation over long distances.	SolaireDirect Southern Africa (Pty) Ltd and Contractor	Pre-construction and construction
Appropriate dust suppression techniques must be implemented to minimise dust from gravel roads.	Contractor and ECO	Construction
Construction vehicles and those transporting materials and goods should be inspected by the contractor or a sub-contractor to ensure that these are in good working order and not overloaded.	Contractor	Construction
Strict vehicle safety standards should be implemented and monitored.	Contractor and ECO	Construction

Mitigation: Action/Control	Responsibility	Timeframe
All relevant permits for abnormal loads must be applied for from the relevant authority.	Contractor (or appointed transportation contractor)	Pre-construction
A designated access to the proposed site must be created to ensure safe entry and exit.	Contractor	Pre-construction
No deviation from approved transportation routes must be allowed, unless roads are closed for whatever reason outside the control of the contractor.	Contractor	Duration of contract
Appropriate road management strategies must be implemented on external and internal roads with all employees and contractors required to abide by standard road and safety procedures.	Contractor (or appointed transportation contractor)	Pre-construction
Any traffic delays because of construction traffic must be co-ordinated with the appropriate authorities.	Contractor	Duration of contract
The movement of all vehicles within the site must be on designated roadways.	Contractor	Duration of contract
Signage must be established at appropriate points warning of turning traffic and the construction site (all signage to be in accordance with prescribed standards).	Contractor	Duration of contract
Appropriate maintenance of all vehicles of the contractor must be ensured.	Contractor	Duration of contract
All vehicles of the contractor travelling on public roads must adhere to the specified speed limits and all drivers must be in possession of an appropriate valid driver's license.	Contractor	Duration of contract
Keep hard road surfaces as narrow as possible.	Contractor	Duration of contract
Signs must be placed along construction roads to identify speed limits, travel restrictions and other standard traffic control information.	Contractor	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » Vehicles keeping to the speed limits. » Vehicles are in good working order and safety standards are implemented. » Local residents and road users are aware of vehicle movements and schedules. » No construction traffic related accidents are experienced. » Local road conditions and road surfaces are up to standard. » Complaints of residents are not received (e.g. concerning the speeding of heavy vehicles).
Monitoring	<ul style="list-style-type: none"> » Developer and or appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: To avoid and or minimise the potential impact of the activities during the construction on the safety of local communities and the potential loss of stock and damage to farm infrastructure

An inflow of workers could, as a worst case scenario and irrespective of the size of the workforce, pose some security risks. Criminals could also use the opportunity due to "outsiders" being in the area to undertake their criminal activities.

Project Component/s	» Construction and establishment activities associated with the establishment of the PV facility, including infrastructure etc.
Potential Impact	» Impact on safety of farmers and communities (increased crime etc.) and potential loss of livestock due to stock theft by construction workers and also damage to farm infrastructure, such as gates and fences.
Activities/Risk Sources	» The presence of construction workers on the site can pose a potential safety risk to local farmers and communities and may result in stock thefts. The activities of construction workers may also result in damage to farm infrastructure.
Mitigation: Target/Objective	» To avoid and or minimise the potential impact on local communities and their livelihoods.

Mitigation: Action/Control	Responsibility	Timeframe
Consider establishing a Monitoring Forum (MF) with the adjacent farmers and develop a Code of Conduct for construction workers.	SolaireDirect Southern Africa (Pty) Ltd and contractors	Pre-construction
Inform all workers of the conditions contained in the Code of Conduct.	SolaireDirect Southern Africa (Pty) Ltd Contractor	Pre-construction
Compensate farmers / community members at full market related replacement cost for any losses, such as livestock, damage to infrastructure etc.	Contractors	Construction phase

Performance Indicator	» Community MF in place before construction phase commences. » Code of Conduct developed and approved prior to
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	<p>commencement of construction phase.</p> <ul style="list-style-type: none"> » All construction workers made aware of Code of Conduct within first week of being employed. » Compensation claims settled within 1 month of claim being verified by Community MF.
Monitoring	<ul style="list-style-type: none"> » SolaireDirect Southern Africa (Pty) Ltd and/or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase. .

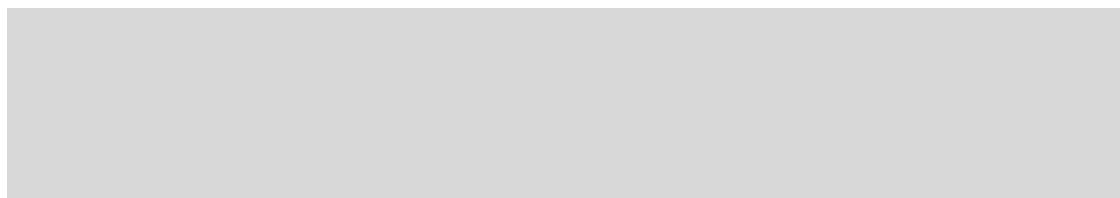
OBJECTIVE: To avoid and or minimise the potential impact on current and future farming activities during the construction phase

Construction activities of the proposed facility could lead to the loss of productive farm land.

Project component/s	<ul style="list-style-type: none"> » Construction phase activities associated with the establishment of the PV facility and associated infrastructure.
Potential Impact	<ul style="list-style-type: none"> » The footprint of the solar energy facility and associated infrastructure will result in a loss of land that will impact on farming activities on the site.
Activities/risk sources	<ul style="list-style-type: none"> » The footprint occupied by the solar energy facility and associated infrastructure.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To minimise the loss of land taken up by the PV facility and associated infrastructure and to enable farming activities to continue where possible, specifically grazing.

Mitigation: Action/control	Responsibility	Timeframe
Minimise the footprint of the PV facility and the associated infrastructure.	Contractor and SolaireDirect Southern Africa (Pty) Ltd	Pre-construction
Rehabilitate disturbed areas on completion of the construction phase. Details of the rehabilitation programme should be contained in the EMP.	Contractors	Construction

Performance Indicator	<ul style="list-style-type: none"> » Footprint of PV facility included in the Construction Phase EMP. » Meeting/s held with farmers during construction phase. .
Monitoring	<ul style="list-style-type: none"> » ECO must monitor indicators listed above to ensure that they have been met for the construction phase.



OBJECTIVE: To avoid and or minimise the potential impacts of safety, noise and dust and damage to roads caused by construction vehicles during the construction phase

During the construction phase, limited gaseous or particulate emissions are anticipated from exhaust emissions from construction vehicles and equipment on-site, as well as vehicle entrained dust from the movement of vehicles on the main and internal access roads.

Project Component/s	» Construction and establishment activities associated with the establishment of the PV facility, including infrastructure etc.
Potential Impact	» Heavy vehicles can generate noise and dust impacts. Movement of heavy vehicles can also damage roads.
Activities/Risk Sources	» The movement of heavy vehicles and their activities on the site can result in noise and dust impacts and damage roads.
Mitigation: Target/Objective	» To avoid and or minimise the potential noise and dust impacts associated with heavy vehicles, and minimise damage to roads.

Mitigation: Action/Control	Responsibility	Timeframe
Implement appropriate dust suppression measures for heavy vehicles and ensure that vehicles used to transport building materials are fitted with tarpaulins or covers.	Contractors	Duration of Construction
Ensure that all vehicles are road-worthy; drivers are qualified and are made aware of the potential noise, dust and safety issues.	Contractors	Duration of Construction
Ensure that drivers adhere to speed limits. Vehicles should be fitted with recorders to record when vehicles exceed the speed limit.	Contractors	Duration of Construction
Ensure that damage to roads is repaired before completion of construction phase.	Contractors	Duration of Construction

Performance Indicator	<ul style="list-style-type: none"> » Dust suppression measures implemented for all areas that require such measures during the construction phase commences. » Drivers made aware of the potential safety issues and enforcement of strict speed limits when they are employed. » Road worthy certificates in place for all heavy vehicles at outset of construction phase and up-dated on a monthly basis.
Monitoring	» SolaireDirect Solar Energy and/or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Minimisation of development footprint and disturbance to topsoil

In order to minimise impacts on flora, fauna, and ecological processes, the development footprint should be limited to the smallest area possible.

Project Component/s	<ul style="list-style-type: none"> » PV panels. » Power line. » Ancillary buildings. » Access roads.
Potential Impact	<ul style="list-style-type: none"> » Impacts on natural vegetation. » Impacts on soil. » Loss of topsoil.
Activity/Risk Source	<ul style="list-style-type: none"> » Site preparation and earthworks. » Excavation of foundations. » Construction of site access road. » Site preparation (e.g. compaction). » Power line construction activities. » Stockpiling of topsoil, subsoil and spoil material.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To retain natural vegetation, where possible. » To minimise footprints of disturbance of vegetation/habitats. » Remove and store all topsoil on areas that are to be excavated; and use this topsoil in subsequent rehabilitation of disturbed areas. » Minimise spoil material.

Mitigation: Action/Control	Responsibility	Timeframe
Areas to be cleared must be clearly marked on-site to eliminate the potential for unnecessary clearing.	Contractor in consultation with Specialist	Pre-construction
The extent of clearing and disturbance to the native vegetation must be kept to a minimum so that impact on flora and fauna and their habitats is restricted.	Contractor	Site establishment & duration of contract
Construction activities must be restricted to demarcated areas so that impact on flora and fauna is restricted.	Contractor	Site establishment & duration of contract
Any fill material required must be sourced from a commercial off-site suitable/permitted source, quarry or borrow pit. Where possible, material from foundation excavations must be used as fill on-site.	Contractor	Duration of contract
Excavated topsoil must be stockpiled in designated areas separate from base material and covered until replaced during rehabilitation.	Contractor	Site establishment & duration of

Mitigation: Action/Control	Responsibility	Timeframe
		contract
Topsoil must not be stripped or stockpiled when it is raining or when the soil is wet as compaction will occur.	Contractor	Site establishment Maintenance: for duration of contract
As far as possible, the maximum topsoil stockpile height must not exceed 2 m in order to preserve micro-organisms within the topsoil, which can be lost due to compaction and lack of oxygen.	Contractor	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » Minimal disturbance outside of designated work areas. » Minimise clearing of existing vegetation. » Topsoil appropriately stored.
Monitoring	<ul style="list-style-type: none"> » Observation of vegetation clearing and soil management activities by ECO throughout construction phase. » Supervision of all clearing and earthworks. » An incident reporting system will be used to record non-conformances to the EMP.

OBJECTIVE: Minimise the impacts on and loss of indigenous vegetation and faunal habitat

All development footprints within areas of natural vegetation (for roads, buildings, underground cables, laydown areas and panel foundations) should be surveyed and appropriately fenced off. Only once this has been done can any construction activity proceed. It should be made very clear to all contractors that there is to be no disturbance outside these demarcated areas, at least not without the permission of the ECO.

Project Component/s	» Any infrastructure or activity that will result in disturbance to natural areas.
Potential Impact	» Loss of indigenous natural vegetation due to construction activities, or poor behaviour on the part of the construction team.
Activity/Risk Source	<ul style="list-style-type: none"> » Vegetation clearing. » Introduction of alien invasive plant species » Construction of access roads. » Placement of power line towers. » Chemical contamination of the soil by vehicles and machinery.

	<ul style="list-style-type: none"> » Operation of construction camps. » Storage of materials required for construction.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Minimise footprints of disturbance of vegetation/habitats. » Minimise loss of indigenous vegetation. » Minimise loss of species of conservation concern.

Mitigation: Action/Control	Responsibility	Timeframe
Areas to be cleared must be clearly marked in the field to eliminate unnecessary clearing.	Contractor	Construction
Limit unnecessary impacts on surrounding natural vegetation, e.g. driving around in the veld, use access roads only.	Contractor	Construction
A site rehabilitation programme must be developed and implemented.	Contractor in consultation with Specialist	Duration of contract Pre-construction
Animals that cannot flee from the affected areas by themselves (e.g. tortoises, amphibians, small mammals) must be removed from the affected areas before the start of site clearing/construction and relocated to safe areas.	Specialist	Pre-construction

Performance Indicator	<ul style="list-style-type: none"> » Minimal disturbance outside of designated work areas. » Minimised clearing of existing/natural vegetation and faunal habitats. » Limited impacts on areas of identified and demarcated sensitive habitats/vegetation.
Monitoring	<ul style="list-style-type: none"> » Observation of vegetation clearing activities by ECO throughout construction phase. » Monitoring of vegetation clearing activities in terms of permit conditions. » Supervision of all clearing and earthworks. » An incident reporting system will be used to record non-conformances to the EMP.

OBJECTIVE: Minimise the establishment and spread of alien invasive plants (Invasive Plant Management Plan) and manage indigenous invasive plants

On-going alien and invasive plant monitoring and removal should be undertaken on all areas of natural vegetation within the project lease area on an annual basis. The section below provides a guideline for the Invasive Plant Management Plan and should be implemented together with consideration of the principles

contained in the Department of Water Affairs: Working for Water Programme (refer to Appendix B).

Project Component/s	» Any infrastructure or activity that will result in disturbance to natural areas.
Potential Impact	» Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species.
Activities/Risk Sources	» Construction, environmental management.
Mitigation: Target/Objective	» There is a target of no alien plants within project control area during the construction and operation phases, and no additional thickening of indigenous invasive shrubs.

Mitigation: Action/Control	Responsibility	Timeframe
Avoid creating conditions in which alien plants may become established: » Keep disturbance of indigenous vegetation to a minimum. » Rehabilitate disturbed areas as quickly as possible. » Do not import soil from areas with alien plants. » Remove all alien plants from areas adjacent to or on frequently traversed access routes to prevent dispersal of regenerative material onto site	Contractor	Construction and operation
Establish an on-going monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act and Biodiversity Act).	Contractor	Construction and operation
Immediately control any alien plants that become established using registered control methods.	Contractor	Construction and operation
DWA approved methodology should be employed for all invasive clearing operations. <i>Prosopis</i> , <i>Eucalyptus</i> , and <i>Opuntia</i> are the primary invasive shrub. No bulldozing or removal by any machinery except chainsaws is allowed, as this disturbs the soil and creates ideal conditions for re-invasion. All stems must be cut as close to ground level as possible, using loppers or chainsaws (depending on size). No herbicide spraying should be undertaken anywhere, due to the extensive collateral damage. All cut branches should be stacked into a pyramid (cut end up) and left to dry – where rodents will eat the available seed under the pile, reducing seed germination. Should this method not be feasible due to volumes of biomass, all cut branches	Contractor	Construction and operation

Mitigation: Action/Control	Responsibility	Timeframe
shall be shredded. Shredded material of cut branches that do not contain any seed or other regenerative material can be kept for rehabilitation. Annual follow ups are required in all areas that have been previously cleared (to be undertaken between January and April). Small seedlings may be hand pulled.		

Performance Indicator	» For each invasive or alien species: number of plants and aerial cover of plants within project area and immediate surroundings is significantly reduced and alien species are absent from site.
Monitoring	<ul style="list-style-type: none"> » On-going monitoring of area by ECO during construction. » Annual audit of project area and immediate surroundings by qualified botanist. » If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. » The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area and used in optimising the control programme. » The environmental manager should be responsible for driving this process. » Reporting frequency depends on legal compliance framework.

OBJECTIVE: Minimise soil degradation and erosion (Erosion Management Plan)

The soil on site may be impacted in terms of:

- » Soil degradation including erosion (by wind and water) and subsequent deposition elsewhere is of a concern in areas that are underlain by fine grained soil which can be mobilised when disturbed, even on relatively low slope gradients (accelerated erosion).
- » Uncontrolled run-off relating to the construction activity (excessive wetting, uncontrolled discharge, etc) will also lead to accelerated erosion and possible sedimentation along natural drainage lines or catchment areas.
- » Degradation of the natural soil profile due to excavation, removal of topsoil, stockpiling, wetting, compaction, pollution and other construction activities may affect soil forming processes and associated agricultural potential.

Management of erosion will be required during the construction phase of the facility. An erosion management plan is required to ensure compliance with applicable regulations and to prevent increased soil erosion and sedimentation of the downstream environment. The section below provides a guideline for the management of erosion on site and will need to be supplemented with the principles for erosion management contained in the Erosion Management plan included in Appendix C.

Project Component/s	<ul style="list-style-type: none"> » PV arrays and foundations to support them. » Substation. » Access roads. » Underground cabling. » Storage and maintenance facilities and foundations to support them. » Overhead power lines and substation linking the facility to the electricity grid.
Potential Impact	<ul style="list-style-type: none"> » Soil degradation including erosion, dust and siltation. » Reduction in agricultural potential.
Activities/Risk Sources	<ul style="list-style-type: none"> » Earthworks & activity on site. » Rainfall and concentrated discharge causing water erosion of disturbed areas. » Wind - erosion of disturbed areas.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Minimise soil degradation (removal, excavation, mixing, wetting, compaction, pollution, etc.). » Minimise erosion. » Minimise sediment transport downstream (siltation). » Minimise dust pollution.

Mitigation: Action/Control	Responsibility	Timeframe
Identify areas of high erosion risk (drainage lines/watercourses, existing problem areas). Only special works to be undertaken in these areas to be authorised by ECO and Engineer's representative (ER)	ECO/ER	At design stage.
Identify construction areas for general construction work and restrict construction activity to these areas.	ECO/ER/Contractor	At design stage and during construction
Prevent unnecessary destructive activity within construction areas (prevent over-excavations and double handling)	ECO/ER/Contractor	During construction
Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary degradation of soil. Special attention to be given to roads that cross drainage lines and roads	ECO/ER/Contractor	At design stage and during construction

Mitigation: Action/Control	Responsibility	Timeframe
on steep slopes (to prevent unnecessary cutting and filling operations).		
Dust control on construction site through wetting or covering of cleared areas.	Contractor	Daily during construction
Minimise removal of vegetation which aids soil stability.	ECO/Contractor	Continuously during construction
Rehabilitate disturbance areas as soon as an area is vacated.	Contractor	Continuously during and after construction
Soil conservation - stockpile topsoil for re-use in rehabilitation phase. Protect stockpile from erosion. Topsoil should be stockpiled below 1 m height and for as short a period as possible to ensure survival of the soil seed bank and other soil-borne organisms.	Contractor	Continuously during construction
Erosion control measures- run-off control and attenuation on slopes (sand bags, logs), silt fences, stormwater channels and catch-pits, shade nets, soil binding, geofabrics, hydroseeding or mulching over cleared areas.	Contractor/ECO	Erection: Before construction Maintenance: Duration of contract
Where access roads cross natural drainage lines, culverts must be designed to allow free flow. Regular maintenance must be carried out.	ECO/ER/Contractor	Before construction and maintenance over duration of contract
Control depth of excavations and stability of cut faces/sidewalls.	ECO/ER/Contractor	Before construction and maintenance over duration of contract
Identify areas of high erosion risk (drainage lines/watercourses, existing problem areas). Only special works to be undertaken in these areas to be authorised by ECO and Engineer's representative (ER).	ECO/ER	At design stage.

Performance Indicator

- » Only authorised activity outside construction areas.
- » No activity in no-go areas.
- » Acceptable level of activity within construction areas, as determined by ECO.

	<ul style="list-style-type: none"> » Acceptable level of soil erosion around site, as determined by ECO. » Acceptable level of sedimentation along drainage lines, as determined by ECO. » Acceptable level of soil degradation, as determined by ECO. » Acceptable state of excavations, as determined by ER & ECO.
Monitoring	<ul style="list-style-type: none"> » Monthly inspections of the site by the ECO. » Monthly inspections of sediment control devices by the ECO. » Monthly inspections of surroundings, including drainage lines by the ECO. » Immediate reporting of ineffective sediment control systems by the ECO. » An incident reporting system will record non-conformances.

OBJECTIVE: Minimising the impact on archaeological sites

The physical survey of the Proposed Development Area (PDA) yielded five heritage resources sites, namely: Sannas-1, Sannas-2, Sannas-3, Sannas-4 and Sannas-5 see Figure 6.2 below. The following is relevant in terms of these sites in relation to the proposed development:

- » Out of the five sites yielded, only one archaeological site was observed in the form of two MSA stone tool scatters and has been named Sannas-2. The significance of this site is low and no further actions with regards to their management are required.
- » Inscriptions were found on top of a Koppie in the Farm Besemkop. These are also considered to be of low significance and no further action is required with regards to their management.
- » The three other sites, two cemeteries and a stone shed are deemed to be of high significance.

Project Component/s	<ul style="list-style-type: none"> » Solar Array » Roads » Power line » Construction equipment camp
Potential Impact	» Destruction of archaeological sites
Activity/Risk Source	» Solar array foundations, power lines and roads
Mitigation: Target/Objective	» Conserve archaeological sites

Mitigation: Action/control

Responsibility

Timeframe

Mitigation: Action/control	Responsibility	Timeframe
Should archaeological sites or graves be exposed during construction work, work in the area must be stopped and the find must immediately be reported to a suitably qualified heritage practitioner such that an investigation and evaluation of the finds can be made.	Contractor, ECO	Duration of construction
It is proposed that the three potentially significant heritage sites identified on the site should be preserved in situ and not be disturbed or altered during the Sannaspos Solar Farm construction activities.	Contractor, ECO	Duration of construction
Should construction activities come closer to the above mentioned sites a proper fence must be built around with them with entry gates to allow visits from relatives and family friends. The fence must be placed 2 m away from the perimeter of the graves. Alternatively, the SAHRA Burial Grounds and Graves Unit requires that if the area where the burials are located fall within the development footprint, then the provisions stipulated in section 36 of the National Heritage Resource Act (Act No. 25 of 1999) are application, and relocation of these might proceed provided that a public consultation process is followed.	Contractor, ECO	Duration of construction

Performance Indicator	» No destruction of archaeological sites
Monitoring	» Monitoring of excavation activities by ECO.

OBJECTIVE: Minimising the impact on Paleontological sites

The site of the proposed Sannaspos Solar Park is underlain by sandstone and shale sediments that form the Beaufort Group, part of the Karoo Supergroup (Groenewald 1989). The Beaufort Group (Karoo Supergroup) of formations are rich in Triassic and Permian fossils (Johnson et al., 2006). Vertebrate fossils including reptiles, mammal-like reptiles (Therapsids) (*Figure 3 in Appendix G in the EIA report*), amphibians and fish remains occur in the Beaufort Group (Rubidge et al., 1995). Invertebrate fossils, invertebrate burrows and trails, well-preserved leaf impressions, silicified wood and stem impressions have also been recorded

from a number of localities in the Beaufort Group (Anderson et al., 1998; McLachlan & Anderson 1973; 1977; Riek, 1973, 1976, Rubidge et al., 1995).

Project Component/s	» Solar Array » Roads » Power line » Construction equipment camp
Potential Impact	» Destruction of paleontological sites
Activity/Risk Source	» Solar array foundations, power lines and roads
Mitigation: Target/Objective	» Conserve paleontological sites

Mitigation: Action/control	Responsibility	Timeframe
Paleontological monitoring in areas where bedrock is expected to be disturbed.	ECO	During construction phase
If any new evidence of archaeological sites or artefacts, paleontological fossils, graves or other heritage resources are found during development, construction, SAHRA and a professional archaeologist must be alerted immediately.	ECO	During construction phase

Performance Indicator	» No destruction of paleontological sites
Monitoring	» Paleontological monitoring by ECO during the construction phase where bedrock is to be affected.

OBJECTIVE: The mitigation and possible negation of the additional visual impacts associated with the construction and operation of the solar energy facility

During the construction phase heavy vehicles, components, equipment and construction crews will frequent the area and may cause, at the very least, a cumulative visual nuisance to landowners and residents in the area as well as road users. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility. Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

Project Component/s	» Construction site, various buildings, a generator, a substation, a power line, a fence and internal access roads.
Potential Impact	» Potential scarring and erosion due to the unnecessary removal of vegetation.
Activity/Risk Source	» The viewing of the above-mentioned by observers on or near the site.
Mitigation: Target/Objective	» Minimal disturbance to vegetation cover in close vicinity to the proposed solar energy facilities.

Mitigation: Action/Control	Responsibility	Timeframe
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	SolaireDirect Southern Africa (Pty) Ltd / contractors	Construction
Limit access to the construction sites to existing access roads.	SolaireDirect Southern Africa (Pty) Ltd / contractors	Construction / operation
Rehabilitate all disturbed areas to acceptable visual standards.	SolaireDirect Southern Africa (Pty) Ltd / contractors	Construction / operation
Maintain the general appearance of the facility in an aesthetically pleasing way.	SolaireDirect Southern Africa (Pty) Ltd / operator	Operation
Consider installing anti-reflective coating or glass to reduce the sunlight that is reflected and increase the amount of sunlight that is absorbed, create the shortest possible route for transmission lines between individual phases and substations to reduce its visual appearance and consider laying electrical cables underground en-route to the substation.	SolaireDirect Southern Africa (Pty) Ltd / contractors	Construction / operation

Performance Indicator	» Vegetation cover that remains intact with no erosion
Monitoring	» Monitoring of vegetation clearing during the construction phase

OBJECTIVE: Appropriate handling and management of waste

The main wastes expected to be generated by the construction of the solar energy facility will include general construction waste, hazardous waste (i.e. fuel), and liquid waste (including grey water and sewage)

In order to manage the wastes effectively, guidelines for the assessment, classification, and management of wastes, along with industry principles for minimising construction wastes must be implemented. A guideline for integrated management of construction waste is included as Appendix D of this EMP.

Project Component/s	<ul style="list-style-type: none"> » PV panels. » Power line. » Ancillary buildings. » Access roads.
Potential Impact	<ul style="list-style-type: none"> » Inefficient use of resources resulting in excessive waste generation. » Litter or contamination of the site or water through poor waste management practices.
Activity/Risk Source	<ul style="list-style-type: none"> » Packaging. » Other construction wastes. » Hydrocarbon use and storage. » Spoil material from excavation, earthworks, and site preparation.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To comply with waste management legislation. » To minimise production of waste. » To ensure appropriate waste storage and disposal. » To avoid environmental harm from waste disposal. » A waste manifests should be developed for the ablutions showing proof of disposal of sewage at appropriate water treatment works.

Mitigation: Action/Control	Responsibility	Timeframe
Construction method and materials should be carefully considered in view of waste reduction, re-use, and recycling opportunities.	Contractor	Duration of contract
Construction contractors must provide specific detailed waste management plans to deal with all waste streams.	Contractor	Duration of contract
Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap), and contaminated waste as required. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and vermin control.	Contractor	Duration of contract
Where practically possible, construction and general wastes on-site must be reused or recycled. Bins and skips must be available on-site for collection,	Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
separation, and storage of waste streams (such as wood, metals, general refuse etc.).		
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Contractor	Duration of contract
Uncontaminated waste will be removed at least weekly for disposal; other wastes will be removed for recycling/ disposal at an appropriate frequency.	Contractor	Duration of contract
Disposal of waste will be in accordance with relevant legislative requirements, including the use of licensed contractors.	Contractor	Duration of contract
Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area.	Contractor	Duration of contract
Waste must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	Contractor	Duration of contract
Documentation (waste manifest) must be maintained detailing the quantity, nature, and fate of any regulated waste. Waste disposal records must be available for review at any time.	Contractor	Duration of contract
Regularly serviced chemical toilets facilities will be used to ensure appropriate control of sewage.	Contractor	Duration of contract
Upon the completion of construction, the area must be cleared of potentially polluting materials.	Contractor	Completion of construction
Dispose of all solid waste collected at an appropriately registered waste disposal site. Waste disposal shall be in accordance with all relevant legislation and under no circumstances may waste be burnt on site.	Contractor	Duration of construction
Where a registered waste site is not available close to the construction site, provide a method statement with regard to waste management.	Contractor	Duration of construction

Performance Indicator	<ul style="list-style-type: none"> » No complaints received regarding waste on site or indiscriminate dumping. » Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately. » Provision of all appropriate waste manifests for all waste streams.
Monitoring	<ul style="list-style-type: none"> » Observation and supervision of waste management practices throughout construction phase. » Waste collection will be monitored on a regular basis. » Waste documentation completed. » A complaints register will be maintained, in which any

	<p>complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon.</p> <p>» An incident reporting system will be used to record non-conformances to the EMP.</p>
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OBJECTIVE: Appropriate handling and storage of chemicals, hazardous substances

The construction phase will involve the storage and handling of a variety of chemicals including adhesives, abrasives, oils and lubricants, paints and solvents.

Project Component/s	» Storage and handling of chemicals, hazardous substances.
Potential Impact	<p>» Release of contaminated water from contact with spilled chemicals.</p> <p>» Generation of contaminated wastes from used chemical containers.</p>
Activity/Risk Source	<p>» Vehicles associated with site preparation and earthworks.</p> <p>» Construction activities of area and linear infrastructure.</p> <p>» Hydrocarbon use and storage.</p>
Mitigation: Target/Objective	<p>» To ensure that the storage and handling of chemicals and hydrocarbons on-site does not cause pollution to the environment or harm to persons.</p> <p>» To ensure that the storage and maintenance of machinery on-site does not cause pollution of the environment or harm to persons.</p>

Mitigation: Action/Control	Responsibility	Timeframe
Develop and implement an emergency preparedness plan during the construction phase.	Contractor	Pre-construction and implement for duration of Contract
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	Contractor	Duration of contract
Corrective action must be undertaken immediately if a complaint is made, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible	Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
and implementing preventive measures.		
In the event of a major spill or leak of contaminants, the relevant administering authority must be immediately notified as per the notification of emergencies/incidents.	Contractor	Duration of contract
Spilled cement must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site.	Contractor	Duration of contract
Any contaminated/polluted soil removed from the site must be disposed of at a licensed hazardous waste disposal facility.	Contractor	Duration of contract
Routine servicing and maintenance of vehicles must not to take place on-site (except for emergencies). If repairs of vehicles must take place, an appropriate drip tray must be used to contain any fuel or oils.	Contractor	Duration of contract
All stored fuels to be maintained within a bund and on a sealed surface. The bunded area must be provided with a tap-off system through which spillages and leakages that might occur will be removed without any spillage outside the bunded area.	Contractor	Duration of contract
Fuel storage areas must be inspected regularly to ensure bund stability, integrity, and function.	Contractor	Duration of contract
Construction machinery must be stored in an appropriately sealed area.	Contractor	Duration of contract
Oily water from bunds at the substations must be removed from site by licensed contractors.	Contractor	Duration of contract
The storage of flammable and combustible liquids such as oils will be in designated areas which are appropriately bunded, and stored in compliance with Material Safety Data Sheets (MSDS) files.	Contractor	Duration of contract
Any storage and disposal permits/approvals which may be required must be obtained, and the conditions attached to such permits and approvals will be compiled with.	Contractor	Duration of contract
Transport of all hazardous substances must be in accordance with the relevant legislation and regulations	Contractor	Duration of contract
The sediment control and water quality structures used on-site must be monitored and maintained in an operational state at all times.	Contractor	Duration of contract
Upon the completion of construction, the area must be cleared of potentially polluting materials.	Contractor	Completion of construction

Performance

» No chemical spills outside of designated storage areas.

Indicator	<ul style="list-style-type: none"> » No unattended water or soil contamination by spills. » No complaints received regarding waste on site or indiscriminate dumping.
Monitoring	<ul style="list-style-type: none"> » Implement an effective monitoring system to detect any leakage or spillage of all hazardous substances. » Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout construction phase. » A complaints register must be maintained, in which any complaints from the community will be logged. » An incident reporting system will be used to record non-conformances to the EMP.

OBJECTIVE: To avoid and or minimise the potential risk of increased veld fires during the construction phase

The increased presence of people on the site could increase the risk of veld fires, particularly in the dry season.

Project Component/s	» Construction and establishment activities associated with the establishment of PV facility, including infrastructure etc.
Potential Impact	» Veld fires can pose a personal safety risk to local farmers and communities, and their homes, crops, livestock and farm infrastructure, such as gates and fences.
Activities/Risk Sources	» The presence of construction workers and their activities on the site can increase the risk of veld fires.
Mitigation: Target/Objective	» To avoid and or minimise the potential risk of veld fires on local communities and their livelihoods.

Mitigation: Action/Control	Responsibility	Timeframe
Ensure that open fires on the site for cooking or heating are not allowed except in designated areas.	SolaireDirect Southern Africa (Pty) Ltd and contractors	Duration of construction
Provide adequate fire fighting equipment onsite.	SolaireDirect Southern Africa (Pty) Ltd and contractors	Duration of construction
Provide fire-fighting training to selected construction staff.	Contractors	Duration of construction
Compensate farmers / community members at full market related replacement cost for any losses, such as livestock, damage to	Contractors	Duration of construction

Mitigation: Action/Control	Responsibility	Timeframe
infrastructure etc.		
Join Fire Protection Agency	SolaireDirect Southern Africa (Pty) Ltd	Pre-construction

Performance Indicator	<ul style="list-style-type: none"> » Conditions contained in the Construction EMP. » Designated areas for fires identified on site at the outset of the construction phase. » Fire fighting equipment and training provided before the construction phase commences. » Compensation claims settled within 1 month of claim being verified by Community MF. .
Monitoring	<ul style="list-style-type: none"> » SolaireDirect Southern Africa (Pty) Ltd and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

6.3 Detailing Method Statements

OBJECTIVE: Ensure all construction activities are undertaken with the appropriate level of environmental awareness to minimise environmental risk

The environmental specifications are required to be underpinned by a series of Method Statements, within which the Contractors and Service Providers are required to outline how any identified environmental risks will practically be mitigated and managed for the duration of the contract, and how specifications within this EMP will be met. That is, the Contractor will be required to describe how specified requirements will be achieved through the submission of written Method Statements to the Site Manager and ECO.

A Method Statement is defined as “a written submission by the Contractor in response to the environmental specification or a request by the Site Manager, setting out the plant, materials, labour and method the Contractor proposes using to conduct an activity, in such detail that the Site Manager is able to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications”. The Method Statement must cover applicable details with regard to:

- » Construction procedures;
- » Materials and equipment to be used;

- » Getting the equipment to and from site;
- » How the equipment/material will be moved while on-site;
- » How and where material will be stored;
- » The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur;
- » Timing and location of activities;
- » Compliance/non-compliance with the Specifications; and
- » Any other information deemed necessary by the Site Manager.

Very specific areas to be addressed in the method statement: before, during and post construction includes:

- » Site Establishment plan (which explains all activities from induction training to offloading, construction sequence for site establishment and the different amenities and to be established etc. Including a site camp plan indicating all of these).
- » Preparation of the site (i.e. clearing vegetation, compacting soils and removing existing infrastructure and waste).
- » Soil management/stockpiling and erosion control.
- » Excavations and backfilling procedure and processes.
- » Stipulate norms and standards for water supply and usage (i.e.: comply strictly to licence and legislation requirements and restrictions as applicable).
- » Stipulate the storm water management procedures recommended in the storm water management plan.
- » Ablution facilities (placement, maintenance, management and servicing).
- » Solid Waste Management:
 - * Description of the waste storage facilities (on site and accumulative).
 - * Placement of waste stored (on site and accumulative).
 - * Management and collection of waste process.
 - * Recycle, re-use and removal process and procedure.
- » Liquid waste management:
 - * The design, establish, maintain and operate suitable procedures for pollution control facilities necessary to prevent discharge of water containing polluting matter or visible suspended materials into rivers, streams or existing drainage systems.
 - * Stipulate grey water (i.e. water from basins, showers, baths, kitchen sinks etc.) that needs to be disposed of, link into an existing facilities where possible. Where no facilities are available, grey water runoff must be controlled to ensure there is no seepage into wetlands or natural watercourses.
- » Dust and noise pollution:
 - * Describe necessary measures to ensure that noise from construction activities is maintained within lawfully acceptable levels (construction

activities generating output levels of 85 dB(A) near human settlement, are to be confined to working hours (06h00 - 18h00) Mondays to Fridays).

- * Procedure to control dust at all times on the site, access roads, borrow pits and spoil sites (dust control shall be sufficient so as not to have significant impacts in terms of the biophysical and social environments). These impacts include visual pollution, decreased safety due to reduced visibility, negative effects on human health and the ecology due to dust particle accumulation.
- » Hazardous substance storage (ensure compliance with all national, regional and local legislation with regard to the storage of oils, fuels, lubricants, solvents, wood treatments, bitumen, cement, pesticides and any other harmful and hazardous substances and materials. South African National Standards apply).
 - * List of all potentially hazardous substances to be used.
 - * Appropriate handling, storage and disposal procedures.
 - * Prevention plan of accidental contamination of soil at storage and handling areas.
 - * All storage areas, (i.e.: for harmful substances appropriately bunded with a suitable collection point for accidental spills must be implemented and drip trays underneath dispensing mechanisms including leaking engines/machinery).
- » Fire prevention and management measures on site.
- » Fauna and flora protection process on and off site (i.e.: removal to reintroduction or replanting, if necessary).
- » Rehabilitation and re-vegetation process.
- » Traffic management.
- » Incident and accident reporting protocol.
- » General administration (and stipulating that all documentation and licences must be on site at all times).
- » Designate access road and the protocol on while roads are in use.
- » Requirements of gate control protocols.

The Contractor may not commence the activity covered by the Method Statement until it has been approved by the SolaireDirect Southern Africa (Pty) Ltd Construction Manager (or may be delegated to the ECO) /Project Manager, except in the case of emergency activities and then only with the consent of the Site Manager. Approval of the Method Statement will not absolve the Contractor from their obligations or responsibilities in terms of their contract. Failure to submit a method statement may result in suspension of the activity concerned until such time as a method statement has been submitted and approved.

The ECO should monitor the construction activities to ensure that these are undertaken in accordance with the approved Method Statement.

6.4 Awareness and Competence: Construction Phase of the Solar Energy Facility

OBJECTIVE: To ensure all construction personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm

To achieve effective environmental management, it is important that Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMP. The Contractor is responsible for informing employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts.

The Contractors obligations in this regard include the following:

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » Ensuring that a copy of the EMP is readily available on-site, and that all site staff are aware of the location and have access to the document.
- » Employees will be familiar with the requirements of the EMP and the environmental specifications as they apply to the construction of the facility.
- » Employees must undergo training for the operation and maintenance activities associated with a PV plant and have a basic knowledge of the potential environmental impacts that could occur and how they can be minimised and mitigated.
- » Ensuring that, prior to commencing any site works, all employees and sub-contractors have attended an Environmental Awareness Training course.
- » The course should be sufficient to provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- » Awareness of any other environmental matters, which are deemed necessary by the ECO.
- » Ensuring that employee information posters, outlining the environmental "do's" and "don'ts" (as per the environmental awareness training course) are erected at prominent locations throughout the site.

- » Ensure that construction workers have received basic training in environmental management, including the storage and handling of hazardous substances, minimisation of disturbance to sensitive areas, management of waste, and prevention of water pollution.
- » Records must be kept of those that have completed the relevant training.
- » Training should be done either in a written or verbal format but must be appropriate for the receiving audience.
- » Refresher sessions must be held to ensure the contractor staff are aware of their environmental obligations as practically possible.

Therefore, prior to the commencement of construction activities on site and before any person commences with work on site thereafter, adequate environmental awareness and responsibility are to be appropriately presented to all staff present onsite, clearly describing their obligations towards environmental controls and methodologies in terms of this EMP. This training and awareness will be achieved in the following ways:

6.4.1 Environmental Awareness Training

Environmental Awareness Training must take the form of an on-site talk and demonstration by the ECO before the commencement of site establishment and construction on site. The education/awareness programme should be aimed at all levels of management and construction workers within the contractor team. A record of attendance of this training must be maintained by the ECO on site.

6.4.2 Induction Training

Environmental induction training must be presented to all persons who are to work on the site – be it for short or long durations; Contractor's or Engineer's staff; administrative or site staff; sub-contractors or visitors to site.

This induction training should include discussing the developer's environmental policy and values, the function of the EMP and Contract Specifications and the importance and reasons for compliance to these. The induction training must highlight overall do's and don'ts on site and clarify the repercussions of not complying with these. The non-conformance reporting system must be explained during the induction as well. Opportunity for questions and clarifications must form part of this training. A record of attendance of this training must be maintained by the SHE Officer on site.

6.4.3 Toolbox Talks

Toolbox talks should be held on a scheduled and regular basis (at least twice a month) where foremen, environmental and safety representatives of different components of the Works and sub-consultants hold talks relating to environmental practices and safety awareness on site. These talks should also include discussions on possible common incidents occurring on site and the prevention of reoccurrence thereof. Records of attendance and the awareness talk subject must be kept on file.

6.5 Monitoring Programme: Construction Phase

OBJECTIVE: To monitor the performance of the control strategies employed against environmental objectives and standards

A monitoring programme must be in place not only to ensure conformance with the EMP, but also to monitor any environmental issues and impacts which have not been accounted for in the EMP that are, or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the Environmental Authorisation (once issued). Where this is not clearly dictated, SolaireDirect Southern Africa (Pty) Ltd will determine and stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Project Manager will ensure that the monitoring is conducted and reported.

The aim of the monitoring and auditing process would be to routinely monitor the implementation of the specified environmental specifications, in order to:

- » Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications.
- » Ensure adequate and appropriate interventions to address non-compliance.
- » Ensure adequate and appropriate interventions to address environmental degradation.
- » Provide a mechanism for the lodging and resolution of public complaints.
- » Ensure appropriate and adequate record keeping related to environmental compliance.
- » Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, in order to enhance the efficacy of environmental management on site.
- » Aid communication and feedback to authorities and stakeholders.

The ECO will ensure compliance with the EMP, will conduct monitoring activities, and will report any non-compliance or where corrective action is necessary to the Site Manager and/or any other monitoring body stipulated by the regulating authorities. The ECO must have the appropriate experience and qualifications to undertake the necessary tasks. The following reports will be applicable:

6.5.1 Non-Conformance Reports

All supervisory staff including Foremen, Resident Engineers, and the ECO must be provided the means to be able to submit non-conformance reports to the Site

Manager. Non-conformance reports will describe, in detail, the cause, nature and effects of any environmental non-conformance by the Contractor. Records of penalties imposed may be required by the relevant authority.

The non-conformance report will be updated on completion of the corrective measures indicated on the finding sheet. The report must indicate that the remediation measures have been implemented timeously and that the non-conformance can be closed-out to the satisfaction of the Site Manager and ECO.

6.5.2 Monitoring Reports

A monitoring report will be compiled by the ECO on a monthly basis and must be submitted to DEA for their records. This report should include details of the activities undertaken in the reporting period, any non-conformances or incidents recorded, corrective action required, and details of those non-conformances or incidents which have been closed out.

6.5.3 Final Audit Report

A final environmental audit report must be submitted to DEA upon completion of the construction and rehabilitation activities. This report must indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions and the requirements of the EMP.

MANAGEMENT PROGRAMME: REHABILITATION

CHAPTER 7

Overall Goal: Undertake the rehabilitation measures in a way that:

- » Ensures rehabilitation of disturbed areas following the execution of the works, such that residual environmental impacts are remediated or curtailed

7.1. Objectives

In order to meet this goal, the following objective, actions and monitoring requirements are relevant:

OBJECTIVE: Ensure appropriate rehabilitation of disturbed areas such that residual environmental impacts are remediated or curtailed

Areas requiring rehabilitation will include all areas disturbed during the construction phase and that are not required for regular operation and maintenance operations. Rehabilitation should be undertaken in an area as soon as possible after the completion of construction activities within that area.

Refer to Appendix B of the EMP for principles on rehabilitation. A detailed rehabilitation plan must be compiled in consultation with an appropriately qualified specialist once the construction plan has been finalised.

Project Component/s	» Area and linear infrastructure.
Potential Impact	» Environmental integrity of site undermined resulting in reduced visual aesthetics, erosion and increased runoff, and the requirement for on-going management intervention.
Activity/Risk Source	<ul style="list-style-type: none"> » Temporary construction areas. » Temporary access roads/tracks. » Power line servitudes. » Other disturbed areas/footprints.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Ensure and encourage site rehabilitation of disturbed areas. » Ensure that the site is appropriately rehabilitated following the execution of the works, such that residual environmental impacts (including erosion) are remediated or curtailed.

Mitigation: Action/Control	Responsibility	Timeframe
All temporary facilities, equipment, and waste	Contractor	Following

Mitigation: Action/Control	Responsibility	Timeframe
materials must be removed from site.		execution of the works
All temporary fencing and danger tape must be removed once the construction phase has been completed.	Contractor	Following completion of construction activities in an area
The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these should be cleaned up.	Contractor	Following completion of construction activities in an area
All hardened surfaces within the construction camp area should be ripped, all imported materials removed, and the area shall be top soiled and re-vegetated.	Contractor	Following completion of construction activities in an area
Temporary roads must be closed and access across these blocked. Compacted surfaces of temporary roads must be ripped to facilitate their rehabilitation.	Contractor	Following completion of construction activities in an area
Necessary drainage works and anti-erosion measures must be installed, where required, to minimise loss of topsoil and control erosion.	Contractor	Following completion of construction activities in an area
A rehabilitation plan that specifies the rehabilitation process should be compiled in consultation with an appropriately qualified specialist.	Contractor, SolaireDirect Southern Africa (Pty) Ltd and specialist	Pre-construction
Disturbed areas must be rehabilitated/re-vegetated with appropriate natural vegetation and/or local seed mix. Re-use of native/indigenous plant species removed from disturbance areas in the rehabilitation phase to be determined by a botanist as applicable.	Contractor in consultation with rehabilitation specialist	Following completion of construction activities in an area
Re-vegetated areas may have to be protected from wind erosion and maintained until an acceptable plant cover has been achieved.	SolaireDirect Southern Africa (Pty) Ltd in consultation with rehabilitation specialist	Post-rehabilitation

Mitigation: Action/Control	Responsibility	Timeframe
Erosion control measures should be used in sensitive areas such as steep slopes, hills, and drainage lines as necessary.	SolaireDirect Southern Africa (Pty) Ltd in consultation with rehabilitation specialist	Post-rehabilitation
On-going invasive and alien plant monitoring and removal must be undertaken on all areas of natural vegetation on an annual basis.	SolaireDirect Southern Africa (Pty) Ltd in consultation with rehabilitation specialist	Post-rehabilitation

Performance Indicator	<ul style="list-style-type: none"> » All portions of site, including construction equipment camp and working areas, cleared of equipment and temporary facilities. » Topsoil replaced on all areas and stabilised where practicable or required after construction and temporally utilised areas. » Disturbed areas rehabilitated and acceptable plant cover achieved on rehabilitated sites. » Completed site free of erosion and alien invasive plants.
Monitoring	<ul style="list-style-type: none"> » On-going inspection of rehabilitated areas in order to determine effectiveness of rehabilitation measures implemented during the operational lifespan of the facility. » On-going alien plant monitoring and removal should be undertaken on an annual basis.

MANAGEMENT PROGRAMME: OPERATION

CHAPTER 8

Overall Goal: To ensure that the operation of the solar energy facility does not have unforeseen impacts on the environment and to ensure that all impacts are monitored and the necessary corrective action taken in all cases. In order to address this goal, it is necessary to operate the facility in a way that:

- » Ensures that operation activities are properly managed in respect of environmental aspects and impacts.
- » Enables the solar energy facility operation activities to be undertaken without significant disruption to other land uses in the area, in particular with regard to farming practices, traffic and road use, and effects on local residents.
- » Minimises impacts on fauna using the site.

An environmental manager must be appointed during operation whose duty it will be to ensure the implementation of the operational EMP.

8.1. Objectives

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

OBJECTIVE: Protection of indigenous natural vegetation, fauna and maintenance of rehabilitation

Indirect impacts on vegetation and fauna during operation could result from maintenance activities and the movement of people and vehicles on site and in the surrounding area. In order to ensure the long-term environmental integrity of the site following construction, maintenance of the areas rehabilitated post-construction must be undertaken until these areas have successfully re-established.

Project component/s	<ul style="list-style-type: none"> » Areas requiring regular maintenance. » Route of the security team. » Areas disturbed during the construction phase and subsequent rehabilitation at its completion. » Areas where the natural microclimate and thus vegetation composition has changed due to structures such as PV panels erected.
Potential Impact	<ul style="list-style-type: none"> » Disturbance to or loss of vegetation and/or habitat.

	<ul style="list-style-type: none"> » Environmental integrity of site undermined resulting in reduced visual aesthetics, erosion, compromised land capability and the requirement for on-going management intervention.
Activity/Risk Source	<ul style="list-style-type: none"> » Movement of employee vehicles within and around site. » Excessive shading by PV panels. » Altered rainfall interception and resultant runoff patterns by infrastructure.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Maintain minimised footprints of disturbance of vegetation/habitats on-site. » Ensure and encourage plant regrowth in non-operational areas of post-construction rehabilitation.

Mitigation: Action/Control	Responsibility	Timeframe
Vehicle movements must be restricted to designated roadways.	SolaireDirect Southern Africa (Pty) Ltd	Operation
No disturbance of vegetation outside of the project site must occur.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Existing roads must be maintained to ensure limited erosion and impact on areas adjacent to roadways.	SolaireDirect Southern Africa (Pty) Ltd	Operation
An on-going invasive and alien plant monitoring and eradication programme must be implemented, where necessary (refer to Appendix B).	SolaireDirect Southern Africa (Pty) Ltd	Operation
A botanist familiar with the vegetation of the area should monitor the rehabilitation success and alien plant removal on an annual basis.	SolaireDirect Southern Africa (Pty) Ltd in consultation with Specialist	Annual monitoring until successful re-establishment of vegetation in an area
A botanist familiar with the vegetation of the area should monitor the vegetation composition and – density immediately adjacent to new infrastructure and decide on additional revegetation measures that may be required to maintain sufficient vegetation to prevent habitat degradation and accelerated erosion, especially underneath/around PV panels.	SolaireDirect Southern Africa (Pty) Ltd in consultation with Specialist	Annual monitoring until successful re-establishment of vegetation in an area

Performance Indicator	<ul style="list-style-type: none"> » No further disturbance to vegetation or terrestrial faunal habitats. » Continued improvement of rehabilitation efforts. » No disturbance of vegetation outside of project site. » No further thickening of invasive shrubs on site.
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	» Gradual disappearance of all alien plant species on site.
Monitoring	» Observation of vegetation on-site by facility manager and environmental manager. » Regular inspections to monitor plant regrowth/performance of rehabilitation efforts and weed infestation compared to natural/undisturbed areas.

OBJECTIVE: Protection of avifauna

During the operation of the facility, the threat of collision with the power line is the biggest potential threat to avifauna, particularly sensitive, collision prone species that may occur in the study area. The threat of electrocution while perching on the power line and associated infrastructure serves as a threat to certain sensitive species, depending on the power line structures implemented.

Project Component/s	» Power line.
Potential Impact	» Collision and electrocution events with the overhead power line.
Activities/Risk Sources	» Operation of the power line without mitigation measures.
Mitigation: Target/Objective	» Maintain a low number of collision, and electrocution events.

Mitigation: Action/Control	Responsibility	Timeframe
Ensure bird-friendly tower designs are implemented to minimise the risk of electrocutions. Fit overhead power lines with appropriate flappers in areas of sensitivity to increase the visibility thereof to avifauna.	SolaireDirect Southern Africa (Pty) Ltd	Design and Construction
Notes of electrocution and collision events must be sent to a qualified Ornithologist for the recommendation of further mitigation measures if necessary.	ECO and avifauna specialist	Operation

Performance Indicator	» Minimal collision or electrocution events.
Monitoring	» Observation of electrocution or collision events with the power line. » Monitor power line servitudes for mortalities.

OBJECTIVE: The mitigation and possible negation of the potential visual impact of lighting at the solar energy facility

The primary visual impact of the facility and its ancillary infrastructure, including the power line, is not possible to mitigate. The functional design of the structures cannot be changed in order to reduce visual impacts.

Project Component/s	Solar energy facility lighting fixtures.
Potential Impact	The potential night time visual impact of lighting fixtures on observers in proximity to the site.
Activity/Risk Source	The effects of glare and light trespass on motorists and observers.
Mitigation: Target/Objective	The containment of light emitted in order to eliminate the risk of additional night time visual impacts. Minimal usage of security and other lighting.

Mitigation: Action/Control	Responsibility	Timeframe
Ensure that proper planning is undertaken regarding the placement of lighting structures and that light fixtures only illuminate areas inside the substation sites.	SolaireDirect Southern Africa (Pty) Ltd / lighting engineer	Planning / construction
Undertake regular maintenance of light fixtures.	SolaireDirect Southern Africa (Pty) Ltd / operator	Operation

Performance Indicator	» The effective containment of the light on the site and no complaints from observers.
Monitoring	» The monitoring of the condition and functioning of the light fixtures during the operational phase of the project

OBJECTIVE: Minimise soil degradation and erosion (Erosion Management Plan)

The soil on site may be impacted in terms of:

- » Soil degradation including erosion (by wind and water) and subsequent deposition elsewhere is of a concern across the entire site which is underlain by fine grained soil which can be mobilised when disturbed, even on relatively low slope gradients (accelerated erosion).
- » Uncontrolled run-off relating to construction activity (excessive wetting, uncontrolled discharge, etc.) will also lead to accelerated erosion and possible sedimentation of drainage systems.
- » Degradation of the natural soil profile due to pollution.

Management of erosion will be required during the operation phase of the facility. An erosion management plan is required to ensure compliance with applicable regulations and to prevent increased soil erosion and sedimentation of the downstream environment. The section below provides a guideline for the management of erosion on site and will need to be supplemented with the principles for erosion management contained in the Erosion Management plan included in Appendix C of the EMP.

Project Component/s	<ul style="list-style-type: none"> » PV panels. » Power line. » Ancillary buildings. » Access roads.
Potential Impact	<ul style="list-style-type: none"> » Soil degradation. » Soil erosion. » Increased deposition of soil into drainage systems. » Increased run-off over the site.
Activities/Risk Sources	<ul style="list-style-type: none"> » Poor rehabilitation and/or revegetation of cleared areas. » Rainfall - water erosion of disturbed areas. » Wind erosion of disturbed areas. » Concentrated discharge of water from construction activity.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Ensure rehabilitation of disturbed areas is maintained. » Minimise soil degradation (i.e. wetting). » Minimise soil erosion and deposition of soil into drainage lines. » Ensure continued stability of embankments/excavations.

Mitigation: Action/Control	Responsibility	Timeframe
Rehabilitate disturbance areas should the previous attempt be unsuccessful.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Maintain erosion control measures implemented during the construction phase (i.e. run-off attenuation on slopes (logs), silt fences, storm water catch-pits, and shade nets).	SolaireDirect Southern Africa (Pty) Ltd	Operation
Develop and implement an appropriate stormwater management plan for the operational phase of the	SolaireDirect Southern Africa	Operation

Mitigation: Action/Control	Responsibility	Timeframe
facility	(Pty) Ltd	

Performance Indicator	<ul style="list-style-type: none"> » Acceptable level of soil erosion around site, as determined by the site manager. » Acceptable level of increased siltation in drainage lines, as determined by the site manager.
Monitoring	<ul style="list-style-type: none"> » Inspections of site on a bi-annual basis. » Water management plan

OBJECTIVE: Minimise dust and air emissions

During the operational phase, limited gaseous or particulate emissions are anticipated from exhaust emissions (i.e. from operational vehicles), and from the augmentation plant. Windy conditions and the movement of vehicles on site may lead to dust creation.

Project Component/s	<ul style="list-style-type: none"> » Hard engineered surfaces. » On-site vehicles.
Potential Impact	<ul style="list-style-type: none"> » Dust and particulates from vehicle movement to and on-site. » Release of minor amounts of air pollutants (for example NO₂, CO and SO₂) from vehicles and the augmentation plant.
Activities/Risk Sources	<ul style="list-style-type: none"> » Re-entrainment of deposited dust by vehicle movements. » Wind erosion from unsealed roads and surfaces. » Fuel burning vehicle and construction engines.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To ensure emissions from all vehicles are minimised, where possible. » To minimise nuisance to the community from dust emissions and to comply with workplace health and safety requirements.

Mitigation: Action/Control	Responsibility	Timeframe
Roads must be maintained to a manner that will ensure that nuisance to the community from dust is not visibly excessive.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Appropriate dust suppression must be applied to the roads as required to minimise/control airborne dust.	SolaireDirect Southern Africa (Pty) Ltd	Duration of contract
Speed of vehicles must be restricted, as defined by the Environmental Manager.	SolaireDirect Southern Africa (Pty) Ltd	Duration of contract
Vehicles and equipment must be maintained in a road-	SolaireDirect	Duration of

Mitigation: Action/Control	Responsibility	Timeframe
worthy condition at all times.	Southern Africa (Pty) Ltd	contract

Performance Indicator	<ul style="list-style-type: none"> » No complaints from affected residents or community regarding dust or vehicle emissions. » Dust suppression measures implemented for where required. » Drivers made aware of the potential safety issues and enforcement of strict speed limits when they are employed.
Monitoring	<ul style="list-style-type: none"> » Immediate reporting by personnel of any potential or actual issues with nuisance dust or emissions to the Site Manager. » A complaints register must be maintained, in which any complaints from residents/the community will be logged, and thereafter complaints will be investigated and, where appropriate, acted upon. » An incident reporting system must be used to record non-conformances to the EMP.

OBJECTIVE: Ensure the implementation of an appropriate fire management plan during the operation phase

The increased presence of people on the site could increase the risk of veld fires, particularly in the dry season.

Project Component/s	» Operation and maintenance of the solar energy facility and associated infrastructure.
Potential Impact	» Veld fires can pose a personal safety risk to local farmers and communities, and their homes, crops, livestock and farm infrastructure, such as gates and fences. In addition, fire can pose a risk to the solar energy facility infrastructure.
Activities/Risk Sources	» The presence of operation and maintenance personnel and their activities on the site can increase the risk of veld fires.
Mitigation: Target/Objective	» To avoid and or minimise the potential risk of veld fires on local communities and their livelihoods.

Mitigation: Action/Control	Responsibility	Timeframe
Join the local Fire Protection Agency.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Provide adequate fire fighting equipment on site.	SolaireDirect Southern Africa	Operation

Mitigation: Action/Control	Responsibility	Timeframe
	(Pty) Ltd	
Provide fire-fighting training to selected operation and maintenance staff.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Ensure that appropriate communication channels are established to be implemented in the event of a fire.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Fire breaks should be established where and when required. Cognisance must be taken of the relevant legislation when planning and burning firebreaks (in terms of timing, etc.).	SolaireDirect Southern Africa (Pty) Ltd	Operation
Upon completion of the construction phase, an emergency evacuation plan must be drawn up to ensure the safety of the staff and surrounding land users in the case of an emergency.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Contact details of emergency services should be prominently displayed on site.	SolaireDirect Southern Africa (Pty) Ltd	Operation

Performance Indicator	<ul style="list-style-type: none"> » Fire fighting equipment and training provided before the operational phase commences. » Appropriate fire breaks in place and maintained.
Monitoring	<ul style="list-style-type: none"> » SolaireDirect Southern Africa (Pty) Ltd must monitor indicators listed above to ensure that they have been met.

OBJECTIVE: Maximise local employment and business opportunities associated with the operational phase

The facility is expected to be operational for more than 20 years during which time approximately 60 staff members are expected to be required on-site. Therefore, long-term direct job opportunities for locals could exist, although limited. However, in an area with such high unemployment figures, these limited opportunities should still be seen as a positive impact on the quality of life of those benefiting from the employment.

Some local procurement of goods, materials and services could occur which would result in positive economic spin-offs. These opportunities for local service providers to render services to the proposed facility could include maintenance of the guardhouse, gardening at the guardhouse, cleaning services, security services and maintenance or replacement of general equipment

Project Component/s	» Day to day operational activities associated with the PV facility, including maintenance etc.
Potential Impact	» The opportunities and benefits associated with the creation of local employment and business should be maximised
Activities/Risk Sources	» The operational phase of the PV facility will create approximately 60 full time employment opportunities.
Mitigation: Target/Objective	» In the medium to long term employ as many locals as possible to fill the full time employment opportunities.

Mitigation: Action/Control	Responsibility	Timeframe
The workforce of 60 permanent staff is likely to be based in Bloemfontein. SolaireDirect Southern Africa (Pty) Ltd should commit to implementing a 5-year training and skills development and training programme to maximise employment for locals.	SolaireDirect Southern Africa (Pty) Ltd	Prior to commencement of operation
Identify local members of the community who are suitably qualified or who have the potential to be employed full time.	SolaireDirect Southern Africa (Pty) Ltd	Prior to commencement of operation

Performance Indicator	» 5 year training and skills development programme developed and designed before construction phase completed. » Potential locals identified before construction phase completed.
Monitoring	» SolaireDirect Southern Africa (Pty) Ltd must monitor indicators listed above to ensure that they have been met for the operational phase.

OBJECTIVE: Appropriate handling and management of waste

The operation of the facility will involve the storage of chemicals and hazardous substances, as well as the generation of limited waste products. The main wastes expected to be generated by the operation activities includes general solid waste, and liquid waste.

A guideline for integrated management of waste is included as Appendix D of this EMP.

Project Component/s	» Substation. » Operation and maintenance staff. » Workshop.
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Potential Impact	<ul style="list-style-type: none"> » Inefficient use of resources resulting in excessive waste generation. » Litter or contamination of the site or water through poor waste management practices. » Contamination of water or soil because of poor materials management.
Activity/Risk Source	<ul style="list-style-type: none"> » Transformers and switchgear for the substations. » Ancillary buildings.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Comply with waste management legislation. » Minimise production of waste. » Ensure appropriate waste disposal. » Avoid environmental harm from waste disposal. » Ensure appropriate storage of chemicals and hazardous substances.

Mitigation: Action/Control	Responsibility	Timeframe
Hazardous substances (such as used/new transformer oils, etc.) must be stored in sealed containers within a clearly demarcated designated area.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Storage areas for hazardous substances must be appropriately sealed and banded.	SolaireDirect Southern Africa (Pty) Ltd	Operation
All structures and/or components replaced during maintenance activities must be appropriately disposed of at an appropriately licensed waste disposal site or sold to a recycling merchant for recycling.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Care must be taken to ensure that spillage of oils and other hazardous substances are limited during maintenance. Handling of these materials should take place within an appropriately sealed and banded area. Should any accidental spillage take place, it must be cleaned up according to specified standards regarding bioremediation.	SolaireDirect Southern Africa (Pty) Ltd	Operation and maintenance
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	SolaireDirect Southern Africa (Pty) Ltd	Operation and maintenance
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	SolaireDirect Southern Africa (Pty) Ltd / waste management contractor	Operation
Waste handling, collection, and disposal operations must be managed and controlled by a waste management contractor.	SolaireDirect Southern Africa (Pty) Ltd / waste	Operation

Mitigation: Action/Control	Responsibility	Timeframe
	management contractor	
Used oils and chemicals: » Appropriate disposal must be arranged with a licensed facility in consultation with the administering authority » Waste must be stored and handled according to the relevant legislation and regulations	SolaireDirect Southern Africa (Pty) Ltd	Operation
General waste must be recycled where possible or disposed of at an appropriately licensed landfill.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Hazardous waste (including hydrocarbons) and general waste must be stored and disposed of separately.	SolaireDirect Southern Africa (Pty) Ltd	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	SolaireDirect Southern Africa (Pty) Ltd	Operation

Performance Indicator	<ul style="list-style-type: none"> » No complaints received regarding waste on site or indiscriminate dumping. » Internal site audits identifying that waste segregation recycling and reuse is occurring appropriately. » Provision of all appropriate waste manifests. » No contamination of soil or water.
Monitoring	<ul style="list-style-type: none"> » Waste collection must be monitored on a regular basis. » Waste documentation must be completed and available for inspection » An incidents/complaints register must be maintained, in which any complaints from the community must be logged. » Complaints must be investigated and, if appropriate, acted upon. » Regular reports on exact quantities of all waste streams exiting the site must be compiled by the waste management contractor and monitored by the ECO. » All appropriate waste disposal certificates accompany the monthly reports.

MANAGEMENT PROGRAMME: DECOMMISSIONING

CHAPTER 9

The solar infrastructure which will be utilised for the proposed solar energy facility is expected to have a lifespan of 20 years (i.e. with maintenance). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly and replacement of the solar infrastructure with more appropriate technology/infrastructure available at that time.

The relevant mitigation measures contained under the construction section should be applied during decommissioning and therefore is not repeated in this section. It must be noted that decommissioning activities will need to be undertaken in accordance with the legislation applicable at that time, which may require this section of the EMP to be revisited and amended.

Should the activity ever cease or become redundant, the applicant shall undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

9.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required equipment, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of construction equipment.

9.2 Disassemble and Replace Infrastructure

Disassembled components will be reused, recycled, or disposed of in accordance with regulatory requirements.

OBJECTIVE: To avoid and or minimise the potential impacts associated with the decommissioning phase

Project Component/s	» Decommissioning phase of the PV facility and associated infrastructure
Potential Impact	» Decommissioning will result in job losses, which in turn can result in a number of social impacts, such as reduced quality of life, stress, depression etc. However, the number of people

	affected (60) is relatively small. Decommissioning is also similar to the construction phase in that it will also create temporary employment opportunities.
Activity/Risk Source	» Decommissioning of the PV facility
Mitigation: Target/Objective	» To avoid and or minimise the potential social impacts associated with decommissioning phase of the PV facility.

Mitigation: Action/control	Responsibility	Timeframe
Retrenchments should comply with South African Labour legislation	Operator	When PV facility is decommissioned
The developer should establish an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy to the national grid over the 25 - 30 year operational life of the facility. The rationale for the establishment of a Rehabilitation Trust Fund is linked to the experiences with the mining sector in South Africa and failure of many mining companies to allocate sufficient funds during the operational phase to cover the costs of rehabilitation and closure.	Operator	Decommissioning
Rehabilitation should start immediately after decommissioning is completed.	Operator	Straight after Decommissioning
All excavations must be rehabilitated with soil and topsoil, which should not contain invasive plant species (in compliance with the CARA, as amended), to the satisfaction of the environmental manager.	Operator	Decommissioning
Re-vegetation specifications to be developed.	Operator	Decommissioning
All building materials must be removed from the site. All compacted surfaces must be ripped and re-vegetated as per the re-vegetation specifications.	Operator	Decommissioning
The most suitable seed mix for disturbed areas to be used in rehabilitation would include indigenous species.	Operator	Decommissioning
Rehabilitation to be conducted in a progressive manner (i.e. once decommissioning in an area has been completed the area will be rehabilitated).	Operator	Decommissioning

Mitigation: Action/control	Responsibility	Timeframe
<p>The rehabilitation of the area with indigenous vegetation must coincide with the rainfall events and all alien invasive vegetation shall be removed.</p>		
<p>Rehabilitation measures for the site are to include the following:</p> <ul style="list-style-type: none"> » Re-contouring <p>Subsoil stockpiles should be used to re-contour construction affected areas. The Contractor shall restore the profile, soil condition and landform to as close as possible state to the pre-construction state.</p> » Scarification and ripping <p>All areas where rehabilitation interventions are required shall be cross-ripped before topsoil placement. Topsoil and fertile soil shall be uniformly scarified to allow for vegetation growth</p> » Fertilising <p>The Contractor shall be required to perform soil analysis tests on the top 75mm of prepared surface prior to re-vegetation/seeding to determine the required fertiliser levels for permanent cover.</p> » Seed acquisition <p>The Contractor shall purchase seed from a South African National Seed Organisation (SANSOR) accredited dealer. Seed used for rehabilitation shall not be older than one season. Purchased seed must be of the correct species and of known origin, dried and packed, conforming to all legal requirements for seed.</p> 	Operator	Decommissioning
<p>The operator shall schedule works for placing of topsoil once all infrastructure has been successfully decommissioned. Seeding can then take place after the first rains of the season and should be concluded by one month before the end of the growing season.</p>	Operator	Decommissioning
<p>The seed mix for use in rehabilitation must be an approved mix of indigenous grass species common to the area.</p>	Operator	Decommissioning

Mitigation: Action/control	Responsibility	Timeframe
The operator shall maintain rehabilitated areas free of weeds and invader plants until the end of the Defects Notification Period applicable to rehabilitation. Control of weeds and invader plants must be done in accordance with the specifications stipulated in the CARA.	Operator	Decommissioning
The operator shall be responsible for the prevention of erosion in areas impacted upon by their activities. All erosion repairs must be implemented at the first signs thereof and no erosion shall be allowed to develop on a large scale.	Operator	Decommissioning
If required, at the time of decommissioning, the operator must submit a method statement to the DWA / DEA to manage and rehabilitate the work in any wetlands. Wetlands shall be rehabilitated immediately after decommissioning has been completed as these are sensitive habitats and disturbance must be kept to a minimum. The beds of the wetlands shall be restored to a similar state, in terms of the soil profile, as well as physical and chemical properties as established in the pre-construction survey.	Operator	Decommissioning
All recyclable rubble and solid waste (e.g. scrap metal, cables, bottles, cans, and plastic residues) shall be collected and disposed of through a registered recycling company. Waste manifests will be kept by the Contractor and shown to the ECO on request. All non-recyclable rubble and solid waste shall be collected and disposed of at an approved waste disposal site. Waste manifests will be shown to the ECO on request.	Operator	Decommissioning

Performance Indicator	» South African Labour legislation relevant at the time
Monitoring	» SolaireDirect Southern Africa (Pty) Ltd and Department of Labour » Environmental Manager to monitor rehabilitation

FINALISATION OF THE EMP

CHAPTER 10

The EMP is a dynamic document, which must be updated to include any additional specifications as and when required. It is considered critical that this draft EMP be updated to include site-specific information and specifications following the final walk-through survey by specialists of the power line, and development site. This will ensure that the construction and operation activities are planned and implemented considering sensitive environmental features.

**APPENDIX A:
GRIEVANCE MECHANISM FOR PUBLIC COMPLAINTS
AND ISSUES**

GRIEVANCE MECHANISM / PROCESS

AIM

The aim of the grievance mechanism is to ensure that grievances / concerns raised by local landowners and or communities are addressed in a manner that is:

- Fair and equitable;
- Open and transparent;
- Accountable and efficient.

1 It should be noted that the grievance mechanism does not replace the right of an individual, community, group or organization to take legal action should they so wish. However, the aim should be to address grievances in a manner that does not require a potentially costly and time consuming legal process.

Proposed generic grievance process

- Local landowners, communities and authorities will be informed in writing by the proponent (the renewable energy company) of the grievance mechanism and the process by which grievances can be brought to the attention of the proponent.
- A company representative will be appointed as the contact person for grievances to be addressed to. The name and contact details of the contact person will be provided to local landowners, communities and authorities.
- Project related grievances relating to the construction, operational and or decommissioning phase must be addressed in writing to the contact person. The contact person should assist local landowners and or communities who may lack resources to submit/prepare written grievances.
- The grievance will be registered with the contact person who, within 2 working days of receipt of the grievance, will contact the Complainant to discuss the grievance and agree on suitable date and venue for a meeting. Unless otherwise agreed, the meeting will be held within 2 weeks of receipt of the grievance.
- The contact person will draft a letter to be sent to the Complainant acknowledging receipt of the grievance, the name and contact details of Complainant, the nature of the grievance, the date that the grievance was raised, and the date and venue for the meeting.
- Prior to the meeting being held the contact person will contact the Complainant to discuss and agree on who should attend the meeting. The people who will be required to attend the meeting will depend on the nature of the grievance. While the Complainant and or proponent are entitled to invite their legal representatives to attend the meeting/s, it should be made clear that to all the parties involved in the process that the grievance mechanism

process is not a legal process. It is therefore recommended that the involvement of legal representatives be limited.

- The meeting will be chaired by the company representative appointed to address grievances. The proponent will provide a person to take minutes of and record the meeting/s. The costs associated with hiring venues will be covered by the proponent. The proponent will also cover travel costs incurred by the Complainant, specifically in the case of local, resource poor communities.
- Draft copies of the minutes will be made available to the Complainant and the proponent within 4 working days of the meeting being held. Unless otherwise agreed, comments on the Draft Minutes must be forwarded to the company representative appointed to manage the grievance mechanism within 4 working days of receipt of the draft minutes.
- In the event of the grievance being resolved to the satisfaction of all the parties concerned, the outcome will be recorded and signed off by the relevant parties. The record should provide details of the date of the meeting/s, the names of the people that attended the meeting/s, the outcome of the meeting/s, and where relevant, the measures identified to address the grievance, the party responsible for implementing the required measures, and the agreed upon timeframes for the measures to be implemented.
- In the event of a dispute between the Complainant and the proponent regarding the grievance, the option of appointing an independent mediator to assist with resolving the issue should be discussed. The record of the meeting/s will note that a dispute has arisen and that the grievance has not been resolved to the satisfaction of all the parties concerned;
- In the event that the parties agree to appoint a mediator, the proponent will be required to identify three (3) mediators and forward the names and CVs to the Complainant within 2 weeks of the dispute being declared. The Complainant, in consultation with the proponent, will identify the preferred mediator and agree on a date for the next meeting. The cost of the mediator will be borne by the proponent. The proponent will provide a person to take minutes of and record the meeting/s.
- In the event of the grievance, with the assistance of the mediator, being resolved to the satisfaction of all the parties concerned, the outcome will be recorded and signed off by the relevant parties, including the mediator. The record should provide details on the date of the meeting/s, the names of the people that attended the meeting/s, the outcome of the meeting/s, and where relevant, the measures identified to address the grievance, the party responsible for implementing the required measures, and the agreed upon timeframes for the measures to be implemented.
- In the event of the dispute not being resolved, the mediator will prepare a draft report that summarizes the nature of the grievance and the dispute. The report should include a recommendation by the mediator on the proposed way forward with regard to the addressing the grievance.

- The draft report will be made available to the Complainant and the proponent for comment before being finalised and signed by all parties. Unless otherwise agreed, comments on the draft report must be forwarded to the company representative appointed to manage the grievance mechanism within 4 working days.

The way forward will be informed by the recommendations of the mediator and the nature of the grievance. As indicated above, the grievance mechanism does not replace the right of an individual, community, group or organization to take legal action should they so wish. In the event of the grievance not being resolved to the satisfaction of Complainant and or the proponent, either party may be of the opinion that legal action may be the most appropriate option.

**APPENDIX B:
DEPARTMENT OF WATER AFFAIRS: WORKING FOR
WATER PROGRAMME PRINCIPLES FOR INVASIVE
PLANT SPECIES**

METHODS FOR ALIEN SPECIES REMOVAL

The sections below are taken from the Department of water Affairs: Working for Water Programme, whose guidelines and policies on alien plant species removal should be adhered to.

In general the use of herbicide by is strongly discouraged – unless for direct stump applications in areas at least 30 m from any type of wetland. This is due to the potential for herbicide and related compounds to be distributed into the wetland areas and thus damaging indigenous vegetation all along the watercourses and beyond.

Any control programme for alien vegetation must include the following 3 phases:

- Initial control: drastic reduction of existing population
- Follow-up control: control of seedlings, root suckers, and coppice growth
- Maintenance control: sustain low alien plant numbers with annual control

2.1. Mechanical Clearing

2.1.1. ADULT PLANTS AND SAPLINGS

2.1.1.1. Felling

Consider as first option where possible, but see section 3 regarding kill standing – although this is only mandatory in pristine or near-natural environments, kill standing may have to be considered where the tree to be felled on the project area is very large or tilted and by falling it could significantly damage the surrounding habitat or other structures.

Where trees are to be felled and removed, the stem/trunk shall be cut as close to the ground as possible but not higher than 150mm, using chainsaws, bow saws, brush cutters or cane knives. Where felling is to be followed by herbicide treatment the cut shall either be made by means of a saw, so as to produce a clean, flat and generally horizontal surface or in the case of suitably small, thin barked species, the stem shall be cut with a lopper. A slasher or kapmes should preferably not be used because of the diagonal cut that is produced. This minimises the herbicide absorption and the “sharp sticks” are a Health and Safety risk.

In the case of larger trees, they shall, where possible, be felled to fall uphill in order to reduce breakage and minimise the danger to workmen.

Felled material and other dead material (brush and logs) shall not be allowed to block or impede water courses and must be removed from all water courses, either 30 m away from the river or out of the flood line itself.

Felled material (thicker than 7 cm) shall be debranched and cross cut in manageable logs of not longer than 2,4 m or in lengths as directed and then stacked in windrows (brush lines) with the contour or moved to or from identified locations as directed by Project Management.

The logs and brush shall be stacked separately, at least 3 m apart. Windrows shall be with gaps of 2 m every 15 m and be as narrow as possible but not wider than 3 m. Where windrows are impractical heap stacking may be allowed after approval by the Project Manager. Heaps shall be spaced at a minimum distance of 20 m with a maximum ground cover of 16 m² in other words heaps of maximum 4 X 4 m.

Windrows must be a minimum of 10 meters away from any indigenous forest (10 or more closely spaced indigenous trees). On a slope nothing should be packed below the indigenous forest, because burning of the windrows will cause damaged to the indigenous forest by burning up into it.

2.1.1.2. Ring barking

Where ring barking is directed, the Contractor shall remove all bark (including the inner bark or phloem) from ground level to 50 cm up or such lesser distance as may be specified. 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. Herbicide can be applied to the exposed bark except in the case of Wattle spp. In the case of smaller trees and saplings with soft, thin skinned bark (especially *Acacia* and *Hakea* species.) the stem shall be beaten with the back of a hatchet and the bark peeled off.

2.1.1.3. Frilling

Where frilling is directed, the Contractor shall, at a height of approximately 50 cm, using an axe or bush knife, make angled cuts downward into the cambium layer through the bark in a ring. Ensure to affect the cuts around the entire stem and apply herbicide into the cuts.



The Frilling Method

2.1.1.4. Bark Stripping

Where bark stripping is specified all bark shall be stripped from the trunk between ground level and 1 m above ground level.

2.1.2. SEEDLINGS

2.1.2.1. Manual clearing

Where seedlings are relatively sparse, less than 1 m high and soil suitably soft or where specified in the Project Specification (where seedlings are growing in sensitive areas where chemicals cannot be used due to the risk of contamination or effect on adjacent plant populations or for any other reason), seedlings shall be removed by hand pulling which shall be so carried out as to ensure the removal of the roots. Hand pulled plants shall be left hanging on other vegetation or deposited in a pile to reduce the possibility of re-growth.

Where seedlings are dense or are too well established to be removed by hand and the Project Management has not directed hand pulling or herbicide treatment of the undisturbed plants, the seedlings shall be cut using a lopper or brush cutter (written approval must be obtained) and the stems then treated with herbicide.

It is anticipated that after initial clearing, every year there will be a multitude of seedlings of alien species emerging. Cleared sites will thus have to be constantly monitored, and as soon as a seedling can be identified as alien invasive species, these must be pulled out by hand.

2.2. Chemical Treatment

2.2.1. Foliar spray

(Not recommended due to potential distribution of poison beyond target plants and thus killing of indigenous species)

Where foliar spray has been specified, the spray shall be applied as to the leaves of the whole plant to the point of drip-off. Spraying shall not be done when the leaves are wet or in windy conditions. The herbicide shall under all circumstances be mixed with a suitable colour dye (if the product has no built in dye) and a wetting agent if specified on the herbicide label. Where the same herbicide is used for different methods e.g. foliar and cut-stump, different colour dyes must be used to identify the different herbicide mix ratios.

Spraying shall be done using a back-pack spraying system with a solid cone nozzle which allows for consistent, thorough application of the herbicide (e.g. Spraying systems TG 0,5 (or as indicated in the herbicide policy)).

2.2.2. Cut-stump treatment



Where stumps are to be treated with herbicide the herbicide shall under all circumstances be mixed with a suitable colour dye (if the product has no built in dye) and a wetting agent if specified on the herbicide label, this shall be applied as soon as possible but not later than 15 minutes after felling, stripping or frilling. In the case of felled stumps all sawdust shall first be brushed off the cut surface.

A knapsack or handheld pressurised spray can, with a narrow angle solid cone nozzle or adjustable nozzle set to a solid spray, should be used. The pressure should be as low as possible to avoid the herbicide from bouncing off the sprayed surface and to minimise contamination; attention must be paid to achieving an even coverage only on the outer rim (Cambium area).

2.2.3. Basal bark application

(Only after written approval has been obtained, due to environmental damage caused by diesel)

Where directed and after written approval, herbicide shall be applied directly to the basal bark of trees. The herbicide shall be applied by knapsack sprayer as a coarse, low

pressure spray, using a narrow angle solid cone nozzle, all around the basal stem or trunk of the plant, from the ground up to the height as specified on the herbicide label, as well as to any exposed roots. The area to be treated shall be thoroughly wetted by the herbicide. Attention shall be paid to ensuring adequate application taking note of the condition and age of the bark.

In the case of multi-stemmed plants, each stem shall be treated.

2.3. Kill Standing vs. Felling

This section is to further explain the National Circular 18 of 2002 under the same heading.

As this National Circular contains a policy clause on the operational approach all WfW projects need to align their operations accordingly as a matter of urgency. The policy should be interpreted as follows (National policy in *Italic* font with interpretation in normal font):

All trees must be killed standing (i.e. NOT felled), except when the following applies: (where cut stump operations are underway on a property this will be allowed to be finished if negotiations for the property has already been concluded and written into the landowner's agreement, negotiations on new areas should thus be adapted accordingly as no further cut stump operations will be allowed except as indicated below):

- *Danger to lives & property and the tree must be removed* (it is the responsibility of Project Management to assess this with the assistance of the landowner. These findings must be recorded in writing and should form part of the landowner's agreement. The person collecting the data for contract generation should be informed accordingly)
- *All alien clearing within two tree lengths of roads, buildings, power lines etc* (fences should be added to the possibilities. It is the responsibility of Project Management to assess this with the assistance of the landowner. These findings must be recorded in writing and should form part of the landowner's agreement. The person collecting the data for contract generation should be informed accordingly)
- *Specific requirement of a partnership to fell* (this will be when the Programme and what it stands for will directly benefit from an operation other than frilling e.g. secondary industry operations, if this is not the case then the landowner must contribute to the price difference due to a change in the preferred operational method)
- *Where required to remove trees for specific flood-control measures* (no frilling should take place within the riparian zone that is the 1:20 year flood level or closer than 30 metres from the natural bank of a river. Trees in these areas should be removed.)
- *Where frilling is not a practical method due to tree growth form, treatment efficacy* (It is the responsibility of Project Management to assess this. If these exceptions

influence the workload then the person collecting the data for contract generation should be informed of such exceptions)

- *Where the frilling of trees increases the fire danger in the area* (where such a scenario is suspected Project Management should liaise with the landowner and also get the opinion of a reputable person, these findings should be recorded in writing and added to the landowner's agreement)

In most cases the resistance towards frilling are based on the aesthetics of the area after the operation. The most economical and effective method of eradicating invasive alien vegetation within the Programme's guidelines should remain the prime objective of efforts. It is the obligation and responsibility of people in all spheres of management to maximise the effect and efficiency of any eradication programme.

2.4. Species-specific clearing methods

Various herbicides have been registered for the control of alien invasive species. The first option though should always be felling the species as low as possible, followed by localised stump treatment and the remaining only as last-resort alternatives or where the alien is a vicious multi-stemmed scrambler, such as the bramble.

Chemicals do not only come at a cost, but will require proper storage, management, and handling. For operation details refer to the Working for Water Operational Standards spreadsheet provided separately.

Information for each invasive alien species as encountered on the project area, as well as alien invasive species that are highly likely to become established after initial clearing, is listed below.

OBJECTIVE: Optimise Operational Standards for Clearing of Invasive Alien Plants

The Contractor must take all reasonable measures to ensure the efficient use of manpower, operational equipment and chemicals for the systematic eradication of alien invasives on site.

Project component/s	<p>Project components affecting the objective:</p> <ul style="list-style-type: none"> » solar energy turbines » access roads » substation » power line
Potential Impact	<ul style="list-style-type: none"> » Hazards to landowners, workers and public » Security of materials » Substantially increased damage to adjacent sensitive vegetation and wetland areas
Activities/risk sources	<ul style="list-style-type: none"> » Operation of equipment » Use of herbicides » Use of fire » Distribution of regenerative material of invasive alien plants
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To ensure effective systematic removal of invasive alien plants » To prevent additional spreading of invasive alien plants » To maintain low numbers and eventually eradicate unwanted species from the project area » To prevent any spillage of chemicals into the surrounding environment » To prevent and reverse damage to wetlands/pans caused by invasive alien plants » To protect members of the public/landowners/residents
Timeframe	<ul style="list-style-type: none"> » Training required: training schedule and training opportunities identified and started within three months of commencement of clearing

	<ul style="list-style-type: none"> » Initial control involving planning and drastic reduction of existing population: during site establishment and construction phase » Follow-up control: control of seedlings, root suckers and coppice growth: during construction and operational phase » Maintenance control: sustain low alien plant numbers with annual control: during operational and decommissioning phase 	
Abbreviations	<ul style="list-style-type: none"> » Working for Water Programme (WfW) » Health and Safety (H&S) 	
Responsibility	RESPONSIBLE PERSON OR UNIT	
	PROJECT MANAGER	PM
	CONTRACTOR/COMMUNITY WORKER	C
	ENVIRONMENTAL CONTROL OFFICER / COMMUNITY LIASION OFFICER	ECO
	TRAINING UNIT	TU
	PLANNING UNIT	PU

Mitigation: Action/control	Responsibility
1. PROJECT OPERATIONAL PLANNING	
1.1. Creation of detailed map of the area: Provides an overview of the project and it must indicate the following:	
<ul style="list-style-type: none"> • Project boundaries 	PU
<ul style="list-style-type: none"> • Area/s where workers are sourced from 	PM
<ul style="list-style-type: none"> • Other features relevant to project wetlands, invasive thickets, grazing areas, cultivated areas 	PM, PU

Mitigation: Action/control	Responsibility
<ul style="list-style-type: none"> Clearly indicate areas that need to be cleared and divide into different Management Units according to location and most prevalent invasive 	PM, PU
1.2. Strategic plan and safety	
<ul style="list-style-type: none"> Project Management to create an Area Strategic Plan / Method Statement for clearing alien invasive vegetation 	ECO, PM
<ul style="list-style-type: none"> Project Management to be familiar with the Area Strategic Plan 	ECO, PM
<ul style="list-style-type: none"> Evidence of Rules & Regulations given and explained to Contractor or Community Workers (this should include the Operating Standards) 	PM, C
<ul style="list-style-type: none"> Emerging and potential weeds reported through agreed communication lines, ecologist can be consulted for proper identification 	PM
<ul style="list-style-type: none"> A copy of the emergency plan and telephone numbers must be on site, workers must demonstrate knowledge thereof 	PM
1.3. Management Unit Clearing Plan (MUCP)	
<ul style="list-style-type: none"> It must be up to date 	PU, PM
<ul style="list-style-type: none"> A clearing strategy must be evident and supported by the planned priorities 	PU, PM
<ul style="list-style-type: none"> Project Managers must be able to show actual work done vs. planned work, supported by fixed point photographs 	PM

2. TOOLS AND EQUIPMENT	
2.1. Hand tools in good condition and used correctly	
<ul style="list-style-type: none"> • Hand tools(e.g. lopper, pruning saw etc.) must be best suited to the work and the size of plants being cleared 	PM, C
<ul style="list-style-type: none"> • The tools must have correct and properly secured handles and must be in safe working order 	C
<ul style="list-style-type: none"> • A sharpening stone/file, with a hand grip, must be on site 	C
<ul style="list-style-type: none"> • Gloves and goggles must be worn when sharpening tools 	C
<ul style="list-style-type: none"> • The tools must be used in the correct manner; clearing must be done using the correct techniques 	C, PM
<ul style="list-style-type: none"> • Safe working distances of at least two (2) tool-reach lengths apart must be maintained 	C, PM
2.2. Chainsaws good condition and used correctly	
<ul style="list-style-type: none"> • Operators have received certified training in chainsaw operation, felling, cross-cutting and de-branching techniques and have been assessed for competence every six months. For training opportunities contact the regional WfW or otherwise qualified entity 	PM, TU
<ul style="list-style-type: none"> • The chainsaws must be best suited to the clearing work and timber size 	PM, C
<ul style="list-style-type: none"> • There must be a service maintenance schedule for all chainsaws Services (daily, weekly) are done and recorded 	PM, C
<ul style="list-style-type: none"> • Safety and operational features must be in good order as per standard checklist 	PM, C
<ul style="list-style-type: none"> • Chainsaw work is planned and executed for safe and efficient production 	PM, C
<ul style="list-style-type: none"> • Correct felling / clearing techniques are applied 	PM, C
<ul style="list-style-type: none"> • Correct cross-cutting and de-branching techniques are applied. 	PM, C

<ul style="list-style-type: none"> • Correct re-fuelling procedures are followed to prevent spillages 	C
<ul style="list-style-type: none"> • Chain sharpening is correctly done with the correct tools at each refueling 	C
2.3. In-field fuel site	
<ul style="list-style-type: none"> • A cleared area, at least six (6) metres from rest areas, demarcated with hazard tape must be used to store fuel 	C
<ul style="list-style-type: none"> • Fuel and oil containers at the in-field fuel site must be stored on an absorbent drip-mat or drip-tray 	C
<ul style="list-style-type: none"> • A 2 kg dry chemical powder (DCP) fire extinguisher must be at least 3m distant from the fuel site and easily visible 	C
3. STORES, WORKSHOPS AND OFFICES	
3.1. Stores, workshops and offices	
<ul style="list-style-type: none"> • Buildings and containers must be secure and provide safe storage space for equipment and/or supplies 	PM
<ul style="list-style-type: none"> • The office / stores area must show a high standard of housekeeping (A place for everything, everything in its place) 	PM
3.2. Herbicide stores	
<ul style="list-style-type: none"> • The building / container must meet the Herbicide Policy standards 	PM
<ul style="list-style-type: none"> • A Material Safety Data Sheet and Label must be in the store for each stock category of herbicide stored. (Each product.) 	PM
<ul style="list-style-type: none"> • Herbicides must be issued with reference to the WIMS contract number 	PM
<ul style="list-style-type: none"> • There must be stock control of empty containers. 	

<ul style="list-style-type: none"> • Empty containers must be stored until removal by a registered recycling company 	ECO
<ul style="list-style-type: none"> • Excess, undiluted herbicide must be returned to the stores and noted on the stock sheet. Excess, diluted herbicide must be stored in a UV-resistant container and allocated to another treatment within 2 days or returned to a suitable container in the stores 	ECO, C
<ul style="list-style-type: none"> • Burning of empty containers by Project staff or Contractor is prohibited 	PM, C
3.3. Fuel and flammable liquids stores	
<ul style="list-style-type: none"> • The building / container must be suitable for the liquids stored in them 	ECO
<ul style="list-style-type: none"> • Quantities limited to allowed maximum per class where proper storage facilities are not available: <ul style="list-style-type: none"> ○ Class I – 45L (petrol, thinners) ○ Class II – 270L (diesel, lube oils) 	
<ul style="list-style-type: none"> ○ Class I – 45L (petrol, thinners) 	PM
<ul style="list-style-type: none"> ○ Class II – 270L (diesel, lube oils) 	PM
<ul style="list-style-type: none"> • Proper housekeeping and handling procedures must be evident 	PM
<ul style="list-style-type: none"> • Adequate measures to deal with spillage and contamination e.g. spill kit 	PM
<ul style="list-style-type: none"> • Correct signage and fire-fighting equipment e.g. dry chemical powder fire extinguisher of at least 2.25kg 	PM
3.4. Storage at contractor stores / houses: Where contractors cannot make use of proper dedicated stores, the following standards apply:	
<ul style="list-style-type: none"> • All equipment, supplies, herbicides, fuel and oils must be safely and securely stored with controlled access, in a suitable lockable building, container or a lockable trailer 	C
<ul style="list-style-type: none"> • A 1kg dry chemical powder (DCP) fire extinguisher must be available outside the store / container 	C

<ul style="list-style-type: none"> PM to annually verify and keep record of inspection of compliance regarding storing facilities at contractors store / house 	PM
4. HERBICIDES	
4.1. General	
<ul style="list-style-type: none"> Workers must be specifically allocated and trained to work with herbicides and demonstrate knowledge of the risk of working with the selected chemicals and how to avoid that risk 	TU, PM
<ul style="list-style-type: none"> Only registered herbicides as detailed in the WfW herbicide policy or on the product label may be used 	PM
<ul style="list-style-type: none"> A Material Safety Data Sheet (MSDS) and Label must be in the field for each product used 	PM, C
<ul style="list-style-type: none"> Written approval must be obtained via the approved communication channels from the National Office to use an unregistered herbicide for a particular specie or situation 	PM, ECO
<ul style="list-style-type: none"> Mix water must be clean & clear (not muddy) 	C, PM
<ul style="list-style-type: none"> Spray mix adjuvants (e.g. wetters, buffers etc.) must be used according to label instructions 	PM, C
<ul style="list-style-type: none"> In the absence of a built-in colourant a suitable dye must be used in applications 	PM, C
<ul style="list-style-type: none"> Contractors and applicators must demonstrate an understanding of why herbicide applications should not be done in unsuitable weather conditions; e.g. foliar application in windy conditions 	C
<ul style="list-style-type: none"> Quality check records must show that application methods are monitored for targeting, rates and spray drift 	C, PM
<ul style="list-style-type: none"> Where there is a risk of herbicide applicators entering water, knapsacks should be filled only half full 	C, PM
<ul style="list-style-type: none"> PM must submit a Herbicide-used sheet for every completed contract, information must be captured 	PM, PU

<ul style="list-style-type: none"> • Herbicide applicators must demonstrate an understanding of spot spray patterns 	C
<ul style="list-style-type: none"> • For cut-stump / frill / ring-barking, coverage must be even and spraying must be monitored to limit excessive run-off 	C
4.2. Equipment	
<ul style="list-style-type: none"> • Equipment must be properly maintained according to regular scheduled services 	C
<ul style="list-style-type: none"> • Equipment must not leak. Faulty equipment must be serviced or decommissioned 	C
<ul style="list-style-type: none"> • Equipment appropriate to the application method and treatment must be used. 	PM, C
<ul style="list-style-type: none"> • When using knapsack sprayers the following apply: <ul style="list-style-type: none"> ○ Knapsack sprayers must be fitted with pressure regulators set to the correct pressure (1bar / 100Kpa) or fitted with a constant flow valve ○ Knapsack sprayers must be fitted with the correct nozzle in good condition, appropriate for the application method used (e.g. TG1; FL5VS; TFVS2 or equivalent) 	PM, C
<ul style="list-style-type: none"> • Lances must be secured to prevent damage when transporting. 	C
<ul style="list-style-type: none"> • Washing of equipment must take place in a designated area, using the triple-rinse method 	C
4.3. Safe storage and handling in-field	
<ul style="list-style-type: none"> • In a designated, shaded demarcated area <ul style="list-style-type: none"> ○ Away from rest / eating areas ○ At least 20m from any water body ○ Away from crops, gardens etc. 	C
	C
	C
	C

o Floor area covered suitable absorbent material	C
o Bucket & spade must be available in case of spills	C
o Clean water, washing bucket, soap & towel must be available for persons handling the herbicide & equipment	C
• Mixing containers must be UV resistant and leak proof	C
• Mixing containers must be clearly labeled, showing the brand name and concentration of the contents	C
• Refilling, mixing, washing and rinsing should only be done within the demarcated area	C
• Empty product containers must be triple-rinsed and punctured before it is returned to the store	C
• Rinsed water must be recycled for subsequent mixes	C
• Contractors must have proper records of daily herbicide mixtures and issues and actual herbicide use in the contracting teams on-site	C
5. SAFETY	
5.1. Hazard Identification and Risk Assessments (HIRA)	
• The HIRA process to be developed, recorded and available at the project / area and knowledge demonstrated by everyone.	PM,C
• Site Emergency Evacuation Plan must be drafted and communicated to all personnel.	PM,C
• Where relevant, hazards in the working area must be taped off. e.g. trenches, holes, hang-ups etc.	C
• The Written Safe Work Procedures Manual must be available, understood and adhered to by all working staff.	PM, C

5.2. First Aid kit	
<ul style="list-style-type: none"> A first aid kit, fully stocked according to the standard stock list, must be easily accessible at all work sites, and regularly inspected by the PM. 	PM, C
<ul style="list-style-type: none"> All first aid treatment and usage of stock must be recorded in the dressing book kept on site / regional office. 	C, PM
<ul style="list-style-type: none"> The First Aid kit must be under control of a trained First Aider with a current valid certificate 	C, PM
<ul style="list-style-type: none"> There must be an alternative trained First Aider of opposite gender in the team 	C
<ul style="list-style-type: none"> A list of emergency numbers must be kept in the first aid box e.g. ambulance, doctor, hospital, fire brigade, poison info centre 	C, PM
<ul style="list-style-type: none"> A copy of the competency certificate of the first-aider must be kept on-site in the H&S file. 	C, PM
5.3. Personal Protective Equipment and Clothing (PPE)	
<ul style="list-style-type: none"> PPE must meet the minimum prescribed standards of quality (EU or SABS). 	C, PM
<ul style="list-style-type: none"> PPE must be replaced when it becomes ineffective through wear & tear. 	C, PM
<ul style="list-style-type: none"> PPE must be provided with due consideration to the hazard exposure as well as the PPE requirements as per occupation 	C, PM
<ul style="list-style-type: none"> A record must be kept of all PPE issued to contractors and workers, and signed for by them, with the acknowledgement to wear the PPE. 	PM, C
<ul style="list-style-type: none"> Project must conform to acceptable H&S Guidelines 	PM, C
5.4. Substance abuse	
<ul style="list-style-type: none"> The use of any mind altering substances is not allowed on-site (e.g. alcohol, dagga). 	PM, C

<ul style="list-style-type: none"> Persons in the WfW programme must demonstrate knowledge of the potential dangers and the workplace policy of drug use 	ECO, PM, C
5.5. Extreme Weather Conditions	
<ul style="list-style-type: none"> Demonstrate knowledge that no work in / near / on water bodies may take place during rain or lightning. 	PM,C
<ul style="list-style-type: none"> No felling or spray application of herbicides may take place during high wind conditions 	PM,C
<ul style="list-style-type: none"> The contractor should be informed of any adverse weather conditions 	PM
6. METHOD OF WORK	
6.1. Appropriate clearing methods applied	
<ul style="list-style-type: none"> A process of appropriate clearing method selection must be followed and recorded - use the species guide provided 	PM
<ul style="list-style-type: none"> Handling / processing of cleared material must be kept to a minimum, but due to a potential fire hazard and the allelopathic effect of leaf litter, cleared material must not be left on site. A specific area must be designated to stack and process material to make maximum use of wood for community members, whilst regenerative material must be destroyed by controlled burning. 	PM, C
<ul style="list-style-type: none"> A copy of the Treatment Methods table must be available in the Project Office 	PM
<ul style="list-style-type: none"> No frilling / ring barking is allowed within two (2) tree lengths of roads, fences, telephone and power lines, infrastructure (e.g. buildings) or in the riparian zone of a river 	PM
6.2. Follow-up done timeously	
<ul style="list-style-type: none"> An up-to-date follow-up plan must be used to ensure treatment is done on time 	PM

<ul style="list-style-type: none"> For foliar treatment there must be sufficient newly-growing foliage and plants must not exceed hip height 	PM, C
<ul style="list-style-type: none"> When follow-up operations are not done at the most cost-efficient stage, there must be specific reasons on record including cost/person day variations between planned and actual follow-up to be recorded 	PM
6.3. Efficient team operation	
<ul style="list-style-type: none"> Operational planning for the specific site must be evident. Different tasks must be coordinated in an efficient manner for optimum productivity. If possible, every management unit mapped should have its own team allocated. 	PM, C
<ul style="list-style-type: none"> Tool use and tasks must be in line with the site-specific requirements 	C
<ul style="list-style-type: none"> Daily or weekly production tasks must be set and actual production must be measured and recorded 	C
6.4. Work methods conform to WfW standards	
<ul style="list-style-type: none"> Record of inspection of method, quantity and quality according to the contract. 	PM, C
<ul style="list-style-type: none"> All invasive alien species treated within the contract boundaries 	PM, C
7. ENVIRONMENTAL AWARENESS	
7.1. Site clean and free of litter and waste	
<ul style="list-style-type: none"> There must be no litter from clearing activities on work sites, at any time and there must be a litter bag on site at the demarcated gathering area, cleared or removed daily and disposed of in an acceptable manner. 	C

<ul style="list-style-type: none"> Existing litter not cleared in light of possible health risks, that may be associated with certain waste, reported to PM and disposal solution with relevant authority found 	PM, C
<ul style="list-style-type: none"> Project Manager and contractors to demonstrate knowledge that soil contaminated with oil must be appropriately treated and disposed of at a permitted landfill site. 	PM, C
<ul style="list-style-type: none"> When loose waste material is transported on vehicles, it must be adequately tied down / covered and contained. 	PM, C
7.2. Sanitation	
<ul style="list-style-type: none"> As far as practically possible, provide formal sanitation (chemical or water-born). Where this is not possible, a spade and toilet paper must be easily accessible on every site. 	C
<ul style="list-style-type: none"> Human waste and used toilet paper must be buried at least 20 m distant from any watercourses or bodies and at least 50 cm deep. 	C
<ul style="list-style-type: none"> In sensitive areas (urban sites, wetlands) a portable toilet must be provided on site and the waste removed and disposed of in an acceptable manner. 	C
<ul style="list-style-type: none"> Clean water and soap must be provided and used for hand washing. 	C
<ul style="list-style-type: none"> The workers should be informed of personal hygiene and demonstrate its practice 	C, PM
<ul style="list-style-type: none"> Where relevant, sufficient toilets per gender need to be available 	C, PM
7.3. Access routes	
<ul style="list-style-type: none"> Existing access routes must be used. Where new access routes or paths are required, these must be planned and made in co-operation with the landowner / manager and marked with hazard tape 	PM, C
7.4. Indigenous plants and animals	
<ul style="list-style-type: none"> Indigenous plants should not be damaged where possible and animals must not be harmed. 	C

<ul style="list-style-type: none"> • Alien trees with bird nests must be killed standing where possible. Site records must be kept. 	PM, C
<ul style="list-style-type: none"> • Collection of plant parts of alien plants for medicinal or other purposes, may only take place with the appropriate permission. Collection records must be kept. 	C
<ul style="list-style-type: none"> • Identify and protect indigenous plants and animals, especially: 	
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Red list data species (none recorded) 	C
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Protected plants (see species of conservation concern) 	C
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Sensitive communities (wetlands only, no other recorded on project area) 	C
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Wetlands 	C
<ul style="list-style-type: none"> • No species of animal may be poached, snared, hunted, captured or willfully harmed, damaged or destroyed. Snares must be reported to land owners, PM or conservation authorities and removed immediately. 	C
<ul style="list-style-type: none"> • Snakes and other reptiles that may be encountered on the treatment area must not be killed. 	C
<ul style="list-style-type: none"> • Anthills and/or termite nests that occur must not be disturbed. 	C
<ul style="list-style-type: none"> • Keep the relevant managers informed of dangerous or problem animals. Record sightings and encounters. 	PM, C
<ul style="list-style-type: none"> • Keep food and rubbish out of reach of scavengers, e.g. apes and birds. 	C
<p>7.5. Invasive alien plant identification (IAP)</p>	
<ul style="list-style-type: none"> • Alien invasive plants including aquatic alien plants must be identified, where required expert assistance must be used. 	PM, C
<ul style="list-style-type: none"> • The relevant species to be removed must be pointed out to contractors and workers on site. 	PM

<ul style="list-style-type: none"> • Damage to indigenous / desirable vegetation must be minimised. 	C
7.6. Alien invasive dispersal	
<ul style="list-style-type: none"> • Where cleared material must be moved from the site, measures must be taken to prevent dispersal of reproductive material (e.g. seeds, cuttings). 	PM, C
<ul style="list-style-type: none"> • Chipped plant material must be free of seed if used off-site (e.g. mulch). 	PM, C
<ul style="list-style-type: none"> • Plants which have been removed must not be transported across or near to rivers or dams in which the species is absent. 	PM, C
<ul style="list-style-type: none"> • Removed plants must not be stacked on top of indigenous flora. 	PM, C
<ul style="list-style-type: none"> • Method and specifications chosen with due consideration of impact on the site, natural vegetation & regeneration. 	PM
<ul style="list-style-type: none"> • Methods used must ensure that weeds are not distributed by the contractor and employees 	PM, C
7.7. Site stabilisation / anti-erosion / rehabilitation measures	
<ul style="list-style-type: none"> • Stack larger cut logs along the contour and below knee height with 2 m gaps at 10 to 15 m intervals for access, escape, animal movement and to reduce run-off and soil movement where there is an enhanced erosion risk along stream banks or steeper slopes 	PM, C
<ul style="list-style-type: none"> • Preserve indigenous plant cover and adapt treatment methods to allow indigenous plants to colonize the site. 	PM, C
<ul style="list-style-type: none"> • Identify sites requiring additional stabilisation structures / measures / re-vegetation and obtain expert advice & planning to implement. 	PM
<ul style="list-style-type: none"> • Take precautionary measures to protect stabilising plants (planted & natural) during follow-up spraying. 	C

7.8. Site stabilisation / anti-erosion / rehabilitation records	
<ul style="list-style-type: none"> Sites must be mapped and a unique Treatment Area number must be assigned. Comprehensive planting / maintenance records must be kept; including dates, species and number of plants and follow-up care. 	PM
<ul style="list-style-type: none"> A record of input costs must be kept, including: materials, plants, seeds, person-days etc. 	PM
8. FIRE FIGHTING AND PROTECTION	
8.1. Fire Precautions on work sites	
<ul style="list-style-type: none"> Smoking allowed in safe indicated areas, designated by the contractor / manager / landowner. 	PM, C
<ul style="list-style-type: none"> No fires are allowed on work sites. 	PM, C
<ul style="list-style-type: none"> Site specific reaction / evacuation rules must be applied in the case of wild fires. 	C
<ul style="list-style-type: none"> Basic appropriate fire-fighting equipment must be available at each work site; a minimum of five fire beaters and one filled knapsack fire-fighting pump, or alternative suitable equipment. 	PM, C
<ul style="list-style-type: none"> Where fuels and machines are used on site, a 2 kg dry chemical powder fire extinguisher in working condition must be available. 	PM, C
<ul style="list-style-type: none"> Fire Fighting & Extinguishing Equipment inspected and recorded. 	PM
8.2. Fire Protection	
<ul style="list-style-type: none"> The project must be a member of the Fire protection Association (FPA) and attend meetings where applicable 	ECO, PM
<ul style="list-style-type: none"> In FPA areas, the project must be on their communication network. 	ECO, PM

<ul style="list-style-type: none"> Fieldwork may not take place during red days or extreme danger rating days. (Contact Working on Fire office) 	ECO, PM
9. TRAINING	
9.1. Induction	
<ul style="list-style-type: none"> All new workers must receive orientation before starting work. 	PM
9.2. Compulsory functional training	
<ul style="list-style-type: none"> All training, including refresher courses, is compulsory. 	TU, PM
<ul style="list-style-type: none"> All training must be provided to workers and contractors within three months of commencement of work 	TU, PM
<ul style="list-style-type: none"> Project Managers must hold a valid training certificate, on file, for all the training courses required in their project. Alternatively, arrangement must be made with the WfW Programme or suitably qualified units to provide such training 	PM
<ul style="list-style-type: none"> Training must be in line with the latest WfW Training Policy 	TU, PM
<ul style="list-style-type: none"> Area / Project Managers must pass an Environmental Pest Control Course and apply for PCO Registration with the National Dept. Agric - Registrar. 	TU
<ul style="list-style-type: none"> Contractors - Limited Pest Control course. 	TU
<ul style="list-style-type: none"> Herbicide Applicators – WfW Herbicide Applicators course. 	TU
<ul style="list-style-type: none"> Other workers – Herbicide Awareness training. 	TU
<ul style="list-style-type: none"> Chain saw operators - chainsaw handling and maintenance, felling, cross-cutting and de-branching techniques. 	TU

<ul style="list-style-type: none"> Copies of all herbicide training certificates received and Pest Control Licenses must be available with the PM and contractor on-site. 	<p>PM, C</p>
<p>9.3. Training Plan & Profiles</p>	
<ul style="list-style-type: none"> The Training Annual Plan of Operations must be displayed. 	<p>PM</p>
<ul style="list-style-type: none"> The plan must be based on the WFW training matrix and policy. 	<p>TU, PM</p>
<p>9.4. Training Records</p>	
<ul style="list-style-type: none"> All training capture sheets, attendance registers, evaluation forms, and certificates must be filed in the Regional Training Manager’s office or Area office. 	<p>TU, PM</p>
<ul style="list-style-type: none"> All Department of Labour monitoring sheets, correspondence, financial records and training schedules must be filed in the Regional Training Manager’s office or Area office. 	<p>TU</p>
<p>9.5. Accreditation</p>	
<ul style="list-style-type: none"> All training must be aligned to unit standards, where possible. 	<p>TU</p>
<ul style="list-style-type: none"> All training must be provided by accredited training providers, where possible. 	<p>TU</p>
<p>Performance Indicator</p>	<ul style="list-style-type: none"> » Project area is consistently cleared of invasive alien vegetation » Remnants of alien vegetation removed from where they were cleared to make way for the proposed development and rehabilitation of natural vegetation surrounding the development » No indication of further degradation and/or pollution of the areas surrounding the development » No members of staff/ public/ landowners injured
<p>Monitoring</p>	<ul style="list-style-type: none"> » Regular visual inspection of cleared areas for signs of resprouting, alien plant seedling emergence, new alien species invasions » An incident reporting system will be used to record non-conformances to the EMP.

- » Public complaints register must be developed and maintained on site.
- » ECO to monitor all construction areas on a continuous basis until all construction is completed; immediate report backs to site manager.
- » ECO to address any infringements with responsible contractors as soon as these are recorded.

**APPENDIX C:
EROSION MANAGEMENT PLAN**

PRINCIPLES FOR EROSION MANAGEMENT

1. Purpose

An Erosion Management Plan addresses the management and mitigation of significant impacts relating to soil erosion. The objective of the plan is to provide:

- » A general framework for erosion management, which enables the contractor to identify areas where erosion can be accelerated from their action.
- » An outline of general methods to monitor, manage and rehabilitate erosion in ensuring that all erosion caused by this development is addresses.

2. Legislation and Standards

Soil conservation pertaining to erosion has been a topic within legislation form the 1930's till today in South Africa. Internationally, standards have been set by the International Finance Corporation and the World Bank to address soil erosion in construction and decommissioning of areas. Therefore this document will ensure that the developer meets the South African legislative requirements and the IFC standards with regards to monitoring, managing and rehabilitating soil erosion on the Cookhouse wind energy facility site.

Relevant legislation:

- » Conservation of Agricultural Resources Act No 43 of 1983
- » Environmental Conservation Act No 73 of 1989
- » National Forestry Act No 84 of 1998
- » National Environmental Management Act No 107 of 1998
- » The Department of Water Affairs and Forestry, February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.

3. Areas with a high soil erodability potential

The following areas are generally associated with high soil erodibility potential:

- » Any areas without vegetation cover
- » Excavated areas
- » Steep areas
- » Areas where the soil has been degraded already
- » Dispersive, duplexed soil areas
- » Areas with fine grained soil material with a low porosity
- » Areas which undergo overland flow of water.
- » Areas close to water
- » Irrigated areas

- » Compacted areas
- » Rivers
- » Drainage lines
- » And any areas where developments cause water flow to accelerate on a soil surface.
- » Coarsely gravelly covered surfaces

4. Precautionary management activities to avoid erosion

In the assessment process the ECO and the contractor must assess all:

- » Infrastructure and equipment placements and function to ensure that the infrastructure or equipment is not causing accelerating soil erosion on the site.
- » Construction activities to ensure that no erosion indicators are forming as a result of the construction activities.

5. Monitoring

7.1. General Erosion

The ECO must assess the site for erosion indicators in the monitoring process, which include:

- » Bare soil
- » Desiccation cracks
- » Terracettes
- » Sheet erosion
- » Rill erosion (small erosion features with the same properties and characteristics as gullies)
- » Hammocking (Soil build-up)
- » Pedestalling (Exposing plant roots)
- » Erosion pavements
- » Gullies
- » Evidence of Dispersive soils

In the assessment process, the ECO and the contractor must assess all:

- » Infrastructure and equipment placements and function to ensure that the infrastructure or equipment is not causing accelerated soil erosion on the site.
- » Construction activities to ensure that no erosion indicators are forming as a result of the construction activities.

If any activities or placement of equipment cause pooling on the site, degrade the vegetation, result in removal of the surface or subsurface soil horizons, create compacted surfaces with steep gradients, or minimise runoff areas, the erosion potential on the site will increase.

If any erosion features are begin forming or are present as a result of the activities mentioned above the ECO must:

- » Assess the situation.
- » Take photographs of the soil degradation.
- » Determine the cause of the soil erosion.
- » Inform and show the relevant contractors the soil degradation.
- » Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan.
- » Monitor that the contractor is taking action to stop the erosion and assist them where needed.
- » Report and monitor the progress of the rehabilitation weekly and recorded all the findings in a site diary.
- » All actions with regards to the incidents must be reported on a monthly compliance report which will be submitted to the department.

The contractor/ developer (with the ECO's consultation) must:

- » Select a system to treat the erosion
- » Design the treatment system
- » Implement the system
- » Monitor the area to see if the system functions like it should, if the system fails, the method must be adapt or adjust to ensure the accelerated erosion is controlled.
- » Monitoring must continue until the area has been stabilised

7.2. Stormwater Management

The ECO is responsible to monitor the site and the activities to ensure that no unnatural soil degradation is taking place.

The ECO must assess the site for erosion indicators such as:

- » Bare soil
- » Exposed plant roots, pedestalling
- » Sheet erosion
- » Rill erosion
- » Hammocking
- » Erosion pavements
- » Terracettes
- » Gullies

In the assessment process the ECO and the contractor must assess all:

- » Disturbed watercourse areas by the development: roads, bridges, river crossings, cabling, permanent laydown areas, crane pads and any other remaining hard surfaces.
- » Construction activity limited to specified areas. Stockpiles of aggregate and material will be positioned at least 50m away from drainage lines and wetlands.

If any erosion features are present as a result of the activities mentioned above the ECO must:

- » Assess the situation
- » Take photographs of the soil degradation.
- » Determine the cause of the erosion.
- » Inform and show the relevant contractors the soil degradation.
- » Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan.
- » Monitor that the contractor is taking action to stop the erosion and assist them where needed.
- » Monitor the rehabilitation weekly and record the findings in a site diary.
- » All actions with regards to the incidents must be reported on in the monthly compliance monitoring report.

The contractor/ developer must (with the ECO's consultation):

- » Select a system to treat the erosion
- » Design the treatment system
- » Implement the system
- » Monitor the area to ensure that the erosion has been addressed adequately.
- » Monitor the erosion until the area has been stabilised.

6. Rehabilitation

The following erosion control measures and rehabilitation specifications must be implemented to ensure that good environmental practice is conducted and environmental compliance is achieved.

6.1. General Erosion Management

In this section the equipment needed to remediate erosion, the precautionary measures which must be taken to avoid erosion and mitigation requirements for already degraded areas.

6.1.1. Equipment

The civil works contractor may use the following instruments to combat erosion when necessary:

- » Reno mattresses
- » Slope attenuation
- » Hessian material
- » Shade catch nets
- » Gabion baskets
- » Mulching Run-off control (increase the amounts of runoff areas to disperse the water)
- » Silt fences
- » Storm water channels and catch pits
- » Shade / catch nets
- » Soil bindings
- » Geofabrics
- » Hydroseeding and/or re-vegetating
- » Mulching over cleared areas
- » Stone packing
- » Tilling (roughing the surface)

6.1.2. Methods to prevent accelerated erosion

The following practises should be considered and adhered to:

- » Ensure steep slopes are stabilised.
- » Ensure that steep slopes are not stripped of vegetation and left to dry out and become water repellent (which will cause increased runoff and a decreased infiltration rate) increasing the erosion potential.
- » Ensure that all water on site (rain water or water wastage from the construction process) does not result in any surface flow (increase velocity and capacity of water) as a result of the poor drainage systems.
- » Ensure that pooling of water on site is avoided, as the site and the general area consists of dispersive soils, pooling will cause an increase of infiltration on one area, causing the subsurface to begin eroding.
- » Ensure that heavy machinery does not compact those areas which are not intended to be compacted (i.e. areas intended to be managed), as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area. where compaction does occur, the areas should be ripped.
- » Ensure that compacted areas have adequate drainage systems to avoid pooling and surface flow.
- » Prevent the concentration or flow of surface water or stormwater down cut or fill slopes, or along pipeline routes or roads, and ensure measures to prevent erosion are in place prior to construction.
- » Ensure that stormwater and any runoff generated by hard surfaces should be discharged into retention swales or areas with rock rip-rap. These areas should be grassed with indigenous vegetation. These energy dissipation structures should be placed in a manner that surface flows are managed prior to being discharged back into a natural watercourse to support the maintenance of natural

base flows within the ecological systems and prevent erosion, i.e. hydrological regime (water quantity and quality) is maintained.

- » Ensure siltation and sedimentation through the use of the erosion equipment mentioned structures.
- » Ensure that all stormwater control features have soft engineered areas that attenuate flows, allowing for water to percolate into the local ground watertable in low quantities (to reduce runoff but prevent subsurface erosion).
- » Minimise and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation.
- » Ensure that vegetation clearing is conducted in parallel with the construction progress across the site to minimise erosion and/or run-off.
- » Ensure that large tracts of bare soil which would cause dust pollution in high winds, or have high erosion susceptibility and increase sedimentation in the lower portions of the catchment are controlled through temporary surface covering.
- » Ensure no diversion of water flows in catchment occurs.
- » Ensure that dust control measures are implemented, but prevent over-wetting/saturating the area (to cause pooling) and run-off (that may cause erosion and sedimentation).
- » Watercourse (stream) crossings should not trap any run-off, thereby creating inundated areas, but allow for free flowing watercourses.

6.1.3. Mitigation for previously degraded areas

Previously degraded areas could pose a threat to construction activities in the area and must therefore be stabilised, then remediated and rehabilitated through:

- » Protecting, stabilise and isolate the degraded areas to ensure no further damage is caused by erosion due to construction activities.
- » Increase the drainage in the area but avoid pooling.
- » Prevent increasing sedimentation in areas that have been choked by soils from degraded areas.
- » Once construction has been completed, a method statement must be drafted for the rehabilitation of the previously degraded areas, using equipment mentioned above and implemented.
- » Stabilisation of steep slopes must be undertaken.
- » Ensure that bare soil is covered and hydro seeded to reduce topsoil loss.

6.2. Methodologies

The following erosion control measures and rehabilitation specifications may be required to be implemented to ensure that good environmental practice is conducted and environmental compliance is achieved.

- » Topsoil covered with a geotextile or hessian material and a grass seed mixture (see Rehabilitation Specifications).

- » Logging or stepping following the contours of the slope, to reduce surface runoff.
- » Earth or rock-pack cut-off berms.
- » Packed branches to roughen the surface and promote infiltration.
- » Benches (sand bags).
- » Stabilisation of near vertical slopes (1:1 – 1:2), if created during construction, will be required to utilise hard structures that have a natural look. The following methods may be considered:
 - Gabions (preferred method with geotextile material).
 - Retaining walls.
 - Stone pitching.
- » The slopes of all stream diversions must be protected. The following methods may be considered:
 - Reno mattresses (preferred method), ensure that the reno mattresses are buried deep into the subsurface, to avoid undercutting from the water.
 - Coarse rock (undersize rip-rap)
 - Sandbags.
 - Stone packing with geotextile
- » Where feasible use rubber dams as stream diversions when establishing water course crossings. Although (and considering that these are non-perennial watercourses) the recommendation is to construct watercourse crossings during dry periods (or no flow periods), where possible.
- » Any concentration of natural water flow caused by road works or hardstands areas will be treated as follows:
 - if water flow is sub-critical, nothing is required
 - if water flow is supercritical, the outlets will be provided with protection (either gabions or stone pitching – depending on the flows) to release water subcritical back into the watercourse at a low velocity.

6.3. Engineering Specifications

A detailed Stormwater Management Plan describing and illustrating the proposed stormwater control measures must be prepared by the Civil Engineers and this includes erosion control.

Requirements for project design:

- » Erosion control measures to be implemented before and during the construction period, including the final stormwater control measures (post construction).
- » The location, area/extent (m²/ha) and specifications of all temporary and permanent water management structures or stabilisation methods.
- » A resident Engineer to be responsible for ensuring implementation of the erosion control measures on site during the construction period.
- » The Developer holds ultimate responsibility for remedial action in the event that the approved stormwater plan is not correctly or appropriately implemented and damage to the environment is caused.

- » Concrete lined drains placed adjacent to road to transfer the water to the existing water courses.
- » Frequent gravel drains hydroseeded placed on permanent roadway edges.
- » At the point where stormwater is discharged, energy dissipaters to be constructed to reduce the flow rate of run-off.
- » All cut and fill banks will be seeded with an approved seed mix (as per the rehabilitation specifications) to ensure bank stabilisation and the elimination of potential erosion. Reno mattresses may be used to ensure that the area remains stable.

6.4. Rehabilitation Specifications

- » Employ a Horticultural Landscape Contractor to fulfil the rehabilitation of disturbed areas post-construction.
- » A detailed Rehabilitation Plan describing and illustrating the proposed rehabilitation activities on site must be prepared i.e. areas of top soiling, seeding and replanting of vegetation; species mix; requirements for fertilisation; seed sowing rates; watering etc. (i.e. bill of quantities).
- » The following document should be consulted for further support with respect to information regarding rehabilitation, namely: The Department of Water Affairs and Forestry, February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.
- » These specifications may be modified by the Horticultural Landscape Contractor on consideration of site conditions.

6.5. Post- and during construction rehabilitation activities

- » Correct and appropriate stockpile management of topsoil will be required during the construction phase.
- » Rehabilitation of disturbed areas will be implemented as these areas become available for rehabilitation.
- » Disturbed areas will include, for example: construction camp site, areas where underground cabling has been laid/buried, roadsides of new access roads.

7. Rehabilitation steps to mitigate the eroded area

- » Stockpiled topsoil must be spread over disturbed areas (150 – 200mm thick) just prior to planting/seeding.
- » Rip and scarify along the contours of the newly spread topsoil prior to watering and seeding.
- » Organic fertilizers or compost shall be used if site conditions require it and can be applied as part of hydro-seeding applications.
- » Seed should be sown into weed-free topsoil that has been stockpiled (i.e. original topsoil from the site).

- » Indigenous plants (e.g. grass species such as *Cynodon dactylon*, *Eragrostis curvula*) shall be used to rehabilitate disturbed areas.
- » Applying the seed through hydromulching (hydro-seeding) is advantageous (or organic mulching after seeding).
- » Watering is essential and rehabilitation should ideally occur during the wet season.
- » The topsoil in the area is vulnerable to erosion therefore the hydro-seeded surfaces must be covered with a shade cloth material or natural fibre (hessian material) to reduce the loss of soil while the plants establish.

7.1. 'Watering' to avoid erosion

- » Movement of livestock in newly rehabilitated areas must be restricted, where possible, while taking into consideration drinking areas/paths.
- » Watering the rehabilitated areas should be undertaken in the wet/rainy season essential but if this is not possible, an initial watering period (supplemental irrigation) will be required to ensure plant establishment (germination and established growth).
- » Generous watering during the first two weeks, or until the seeds have germinated, is required (unless adequate rainfall occurs) i.e. seed beds will need to be kept moist for germination to occur.
- » For grass to establish (once germination has occurred), rainfall or irrigation is needed at regular intervals, ideally every few days and possibly every day if weather conditions require it.
- » During dry periods, with no rainfall, 100 litres per m² (or 100mm of rain) over a month or more, may be necessary to establish plants capable of surviving dry weather (or otherwise specified by the Horticultural Landscape Contractor).

7.2. Seeding

The developer should make use of an appropriate mix of grass species for rehabilitation to be determined in consultation with a suitably qualified ecologist) and they must be mixed for sowing either in summer or in winter. Grass species application (Rutherford, 2006) is at the rate specified as kg/ha.

7.3. Steep slopes

- » Areas that have a steep gradient and require seeding for rehabilitation purposes should be adequately protected against potential run-off erosion e.g. with coir geotextile netting or other appropriate methodology.
- » Provision for wind should also be made on these slopes to ensure the fine grained soil is not removed.

7.4. Maintenance and duration

- » Rehabilitation will occur during construction, as areas for plant rehabilitation become available.
- » The rehabilitation period post construction is estimated to be over a period of 6 (minimum) to 12 months (maximum), or a time period specified by the Horticultural Landscape Contractor, particularly if planting of trees and shrubs occurs.
- » The rehabilitation phase (including post seeding maintenance) should be at least 6 months (depending on time of seeding and rainfall) to ensure establishment of plants with a minimum 80% cover achieved (excluding alien plant species).
- » If the plants have not established and the 80% is not achieved within the specified maintenance period, maintenance of these areas shall continue until at least 80% cover is achieved (excluding alien plant species).
- » Additional seeding may be necessary to achieve 80% cover.
- » Any plants that die during the maintenance period must be replaced.
- » Succession of natural plant species should be encouraged.

8. Conclusion

The Erosion Management Plan is a document to assist the contractor, the Developer and the ECO with guidelines on how to manage erosion. The implementation of management measures is not only good practice to ensure minimisation of degradation, but also necessary to ensure comply with legislative requirements. This document forms part of the EMP, and is required to be considered and adhered to during the design, construction, operation and decommissioning phases of the project.

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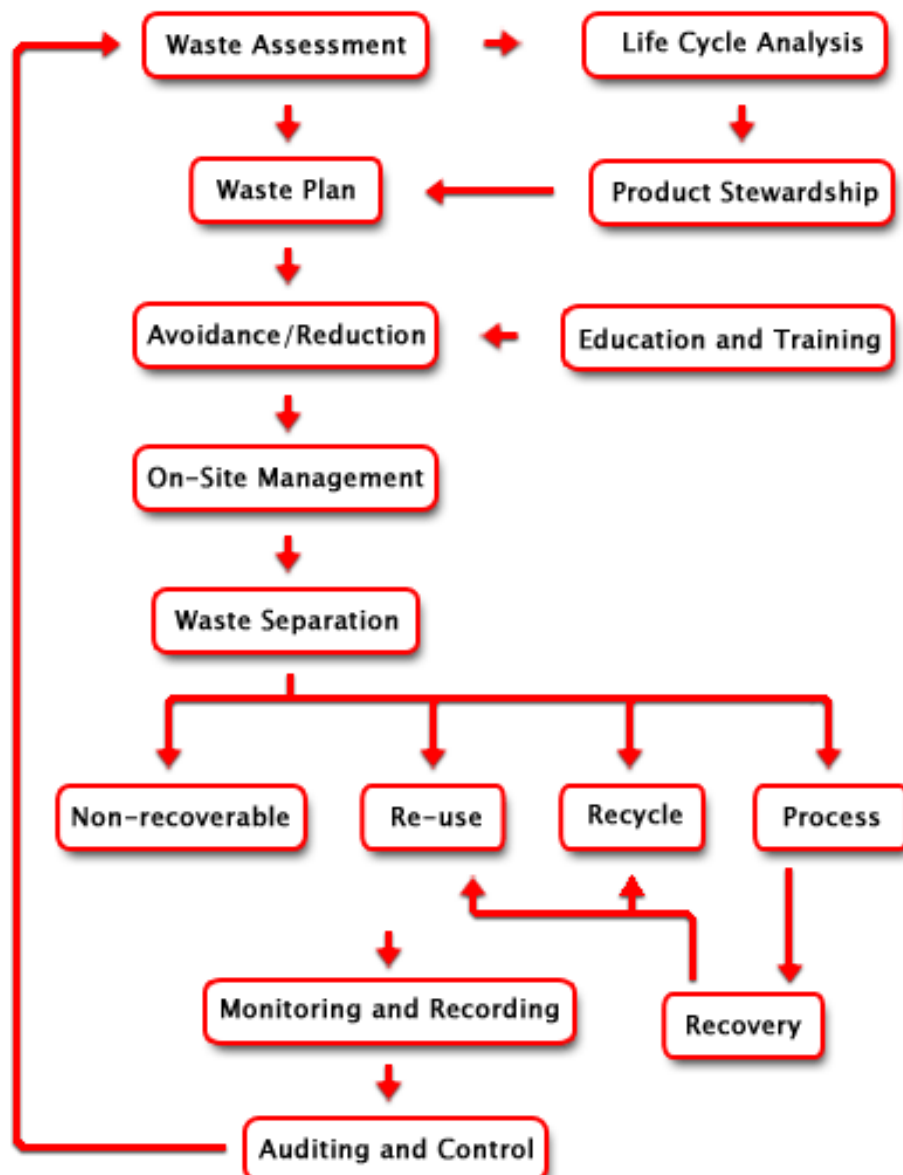
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**APPENDIX D:
GUIDELINES FOR INTEGRATED MANAGEMENT OF
CONSTRUCTION WASTE**

GUIDELINE FOR INTEGRATED MANAGEMENT OF CONSTRUCTION WASTE

Waste is broadly defined by the Department of Water Affairs in 1994 as: 'an undesirable or superfluous by-product, emission, residue or remainder of any process or activity'. An integrated approach to waste management on site is needed. Such an approach is illustrated in the figure below.

The Integrated Waste Management Approach to Waste



Source: <http://www.enviroserv.co.za/pages/content.asp?SectionId=496>

1. Waste Assessment

A detailed waste assessment is necessary to understand the waste types and volumes being produced. In order to achieve this, construction practices must be measured and analysed.

2. Waste Plan

A waste plan must be developed to provide appropriate solutions for managing the entire waste stream on site. The objective of the plan should be to reduce the volumes of waste to disposal and thereby to reduce the cost of management of the waste stream without compromising environmental standards. The plan should include recovery, re-use and recycle recommendations.

Construction Waste Management is the practice of reducing the actual waste that goes to the landfill site. Waste reduction is best met by recycling, and construction wastes offer several opportunities in this regard. In fact, 80% of the wastes found in construction waste piles are recyclable in some form or another. Wood, concrete, bricks, metals, glass and even paint offer several options for recycling.

There are three basic steps for construction waste management, i.e. Reduce, Reuse, and Recycle. **Reduce** is the prevention of the waste from arising and optimising material usage. Waste avoidance and waste reduction can be achieved through improved education and training - by improving efficiencies and by making staff environmentally aware.

Reuse is using existing materials instead of throwing these away. Reusing does not mean that it needs to be reused on the same construction site. Selling or donating waste materials to a third party is one option of construction waste management.

Recycle is somewhat limited since it only allows for those items that can be used on-site. The most important step for recycling of construction waste is on-site separation. Initially, this will take additional effort and training of construction personnel. Targets should be set for the levels of recycling. Once separation habits are established, on-site separation can be done at little or no additional cost.

3. What to Recycle

Before recycling construction waste, identify who will accept it. This is important in designating type of waste to separate, and in making arrangements for drop-off or delivery of materials. Materials that can be recycled include:

- » Cardboard and Paper
- » Wood

- » Metals
- » Plastics
- » Glass
- » Paints, Stains, Solvents and Sealants
- » Oil

4. Materials Separation

Successful recycling requires good clean uniform collections of single waste types. This is most effectively achieved by separating the waste streams close to source rather than at the landfill site. Containers for material recycling must be set up on site and clearly labelled. Construction personnel must be trained in material sorting policy, and bins must be monitored periodically to prevent waste mixing as a result of construction employees throwing rubbish into the bins.

Some materials will require bins or storage that protect these from rain. Other bins may be locked to prevent tampering.

5. Recycling and Waste Minimisation Guidelines

- » *Wood*
 - * Optimise building dimensions to correspond to standard wood dimensions in order to reduce the need for cutting.
 - * Store wood on level blocking under cover to minimize warping, twisting and waste.
- » *Metals*
 - * During construction, separate metals for recycling, including copper piping, wire, aluminium, iron and steel, nails and fasteners, galvanized roofing. It is critical to keep lead out of landfills because it could leach into groundwater.
- » *Cardboard and Paper*
 - * Avoid excessively packaged materials and supplies. However, be sure packaging is adequate to prevent damage and waste.
 - * As far as possible, use recyclable packaging.
 - * Separate cardboard waste, bundle, and store in a dry place.
 - * Minimise the number of blueprints and reproductions necessary during the design and construction process.
- » *Plastic*
 - * Avoid excessively packaged materials and supplies. However, be sure packaging is adequate to prevent damage and waste.
 - * As far as possible, use recyclable packaging.

Since more than 60 different types of plastic resins exist, the Plastics Federation of South Africa has adopted a voluntary number coding system for each category of plastics to aid in their sorting by material type for recycling (Bruyns et al, 2002). The most common resin types are itemised in Table 1.

Table 1: Identification System for Plastic

Id Number	Plastic Resin Type
1	PET (polyethylene terephthalate)
2	HDPE (high-density polyethylene)
3	PVC (polyvinyl chloride) or V (vinyl)
4	LDPE (low-density polyethylene)
5	PP (polypropylene)
6	PS (polystyrene)
7	Other (laminates, etc.)

» *Paints, Stains, Solvents and Sealants*

* Unused materials should be taken to a hazardous waste collection facility.

6. On-site Management

Good supervision of the waste management programme on site is critical to success. Management of the entire on-site program is critical to ensure smooth operations.

7. Auditing and Control

The success of the waste plan is determined by measuring criteria such as waste volumes, cost recovery from recycling, cost of disposal. Recorded data can indicate the effect of training and education, or the need for education. It will provide trends and benchmarks for setting goals and standards. It will provide clear evidence of the success or otherwise of the plan. Finally, good record keeping and control, becomes a continuous waste assessment process, allowing the waste plan to be improved and adjusted as required.

8. Useful contacts:

<http://www.transpaco.co.za/page5.htm>

Transpaco, a manufacturing and distribution company operating extensively in the plastics and packaging industries, conducts plastic reclamation and recycling.

<http://www.jclenterprises.co.za/>

JCL Enterprises for plastic sales of quality recycled plastic materials as well as the recycling of plastic.

<http://www.rosefoundation.org.za/>

The Rose Foundation specialises in the collection and recycling of used motor (engine) oil.

Information Sources:

<http://www.greenbuilder.com/sourcebook/ConstructionWaste.html#Guidelines>

<http://www.enviroserv.co.za/pages/Content.asp?SectionID=587>

<http://www.enviroserv.co.za/pages/content.asp?SectionId=496>

Programme for the Implementation of the National Waste Management Strategy. DEAT, May 2000

Residential Construction Waste Management Demonstration and Evaluation. Prepared for U.S. Environmental Protection Agency by NAHB Research Center, May 2, 1995

**APPENDIX E:
SPECIFICATIONS FOR EARTHWORKS
(ENVIRONMENTAL MEASURES)**

Standard Specifications for Earthworks: Environmental measures

Topsoil

Prior to construction, the topsoil areas to be disturbed should be stripped to a depth to be confirmed by the engineer and set aside for spreading to all areas to be reinstated after the construction. Temporary topsoil stock piles must be covered with net or shade cloth to protect them.

Once all grades have been finalised and prepared, topsoil should be spread evenly to all areas to be re-vegetated.

Erosion and sedimentation control

1. During construction the Contractor shall protect areas susceptible to erosion by installing necessary temporary and permanent drainage works as soon as possible and by taking other measures necessary to prevent the surface water from being concentrated in streams and from scouring the slopes, banks or other areas.
2. A Method statement shall be developed and submitted to the Engineer to deal with erosion issues prior to bulk earthworks operations commencing.
3. Any erosion channels developed during the construction period or during the vegetation establishment period shall be backfilled and compacted and the areas restored to a proper condition.
4. Stabilisation of cleared areas to prevent and control erosion shall be actively managed. The method of stabilisation shall determine in consultation with the ECO. Consideration and provision shall be made for the following methods (or combination):
 - a) Brush cut packing
 - b) Mulch or chip cover
 - c) Straw stabilising
 - d) Watering
 - e) Planting/sodding
 - f) Hand seed-sowing
 - g) Hydroseeding
 - h) Soil binders and anti erosion compounds
 - i) Mechanical cover or packing structures
 - i. Gabions & mattresses
 - ii. Geofabric
 - iii. Hessian cover
 - iv. Armourflex
 - v. Log/ pole fencing
 - vi. Retaining walls
5. Traffic and movement over stabilised areas shall be restricted and controlled and damage to stabilised areas shall be repaired and maintained to the satisfaction of the ECO.
6. Anti-erosion compounds shall consist of all organic or inorganic material to bind soil particles together and shall be a proven product able to suppress dust and erosion. The application rate shall conform to the manufacturer's recommendations. The material used shall be of such a quality that indigenous seeds may germinate and not prohibit growth.

Blasting

1. A current and valid authorisation shall be obtained from the relevant authorities and copied to the Engineer prior to any blasting activity.
2. A Method Statement shall be required for any blasting related activities.
3. All Laws and Regulations applicable to blasting activities shall be adhered to at all times.
4. A qualified and registered blaster shall supervise all blasting and rock splitting operations at all times.
5. The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area.)
6. The Contractor shall allow for good quality vibration monitoring equipment and record keeping on site at all times during blasting operations.
7. The Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on site.
8. The Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock. Environmental damage caused by blasting / drilling shall be repaired at the Contractor's expense to the satisfaction of the Engineer.
9. The Contractor shall ensure that adequate warning is provided immediately prior to all blasting. All signals shall also be clearly given.
10. The contractor shall use blast mats for cover material during blasting. Topsoil may not be used as blast cover.
11. During demolition the Contractor shall ensure, where possible that trees in the area are not damaged.
12. Appropriate blast shaping techniques shall be employed to aid in the landscaping of blast areas, and a Method Statement to be approved by the Engineer, shall be required in this regard.
13. At least one week prior to blasting, the relevant occupants/owners of surrounding land shall be notified by the Contractor and any concerns addressed. Buildings within the potential damaging zone of the blast shall be surveyed preferably with the owner present and any cracks or latent defects pointed out and recorded either using photographs or video. Failing to do so shall render the Contractor fully liable for any claim of whatsoever nature, which may arise. The Contractor shall indemnify the Employer in this regard.

Borrow pits and quarries

1. All borrow pit sites shall be clearly indicated on plan.
2. Prior to the onset of any quarrying or borrow pit activities the Contractor shall establish from the Engineer whether authorisation has been obtained, both in terms of the Minerals and Petroleum Resources Development Act 28 of 2002 (via the compilation of an Environmental Management Programme Report) and in terms of the National Environmental Management Act (via the Environmental Impact Assessment process). No excavation or blasting activities shall commence before the necessary authorizations are in place.
3. Borrow pits to be used must be approved by the engineer and shall at all times be operated according to the regulations promulgated in terms of the Minerals Act (No 50 of

1991): Mine Health and Safety Act (NO 29 of 1996) and Noise and Nuisance Regulations of the Environment Conservation Act (No 73 of 1989).

4. Only a single lane access for construction vehicles shall be provided at borrow pit and quarry sites. New access roads require approval by the Engineer.
5. Stormwater and groundwater controls shall be implemented.
6. Machinery, fuels and hazardous materials vulnerable to flooding shall be stored out of flood risk areas.
7. Vehicles leaving borrow pits shall not deposit/shed mud, sand and debris onto any public road.
8. All loads shall be covered with a tarpaulin or similar to prevent dangers and nuisance to other road users.
9. Borrow pits shall be fenced to prevent unauthorized persons and vehicles from entering the area. Fences shall also be stock and game proof.
10. Rehabilitation and re-vegetation of borrow pits sites shall be according to a method statement to be approved by the ECO.
11. The contractor shall ensure that blasted faces of the pit shall be shape-blasted to the approval of the Site Manager.
12. Where required, dust and fly-rock prevention methods shall be detailed in a Method Statement to be approved by the Site Manager.
13. During the rehabilitation of borrow pits, the slope or the borrow pit shall be graded to blend with the natural terrain and be stabilized to prevent erosion.

Drilling and jackhammering

1. The Contractor shall submit a Method Statement detailing his proposals to prevent pollution during drilling operations. This shall be approved by the Site Manager prior to the onset of any drilling operations.
2. The Contractor shall take all reasonable measures to limit dust generation as a result of drilling operations.
3. Noise and dust nuisances shall comply with the applicable standards.
4. The Contractor shall ensure that no pollution results from drilling operations, either as a result of oil and fuel drips, or from drilling fluid.
5. All affected parties shall be informed at least one week prior to the onset of the proposed drilling/jackhammering operations, and their concerns addressed.
6. Drill coring with water or coolant lubricants shall require a Method Statement approved by the Site Manager.
7. Any areas or structures damaged by the drilling and associated activities shall be rehabilitated by the Contractor to the satisfaction of the Site Manager.

Earthworks

1. The excavations on site shall be done in accordance with SABS 1200 D or DB, as applicable.
2. Prior to Earthworks (including site clearance) starting on site, a search and rescue operation shall be undertaken as per the requirements set out in the EMP.

2. All earthworks shall be undertaken in such a manner so as to minimise the extent of any impacts caused by such activities.
3. Defined access routes to and from the area of operations as well as around the area of operation shall be detailed in a Method Statement for approval by the Site Manager.
4. No equipment associated with the activity shall be allowed outside of these areas unless expressly permitted by the Site Manager.
5. Mechanical methods of rock breaking, including Montabert type breakers, jackhammers, have noise and dust impacts that shall be addressed.
6. Residents shall be notified at least one week prior to these activities commencing, and their concerns addressed.
7. Chemical breaking shall require a Method Statement approved by the Site Manager.

Trenching

1. Trenching for services shall be undertaken in accordance with the engineering specifications (SABS 1200DE) with the environmental amplifications contain herein, where applicable.
2. Trenching shall be kept to a minimum through the use of single trenches for multiple service provision.
3. The planning and selection of trench routes shall be undertaken in liaison with the Engineer and cognisance shall be given to minimising the potential for soil erosion.
4. Trench routes with permitted working areas shall be clearly defined and marked with painted stakes prior to excavation.
5. The stripping and separation of topsoil shall occur as stipulated by the Engineer. Soil shall be stockpiled for use as backfilling as directed by the engineer.
6. Trench lengths shall be kept as short as practically possible before backfilling and compacting.
7. Trenches shall be backfilled to the same level as (or slightly higher to allow for settlement) the surrounding land surface to minimise erosion. Excess soil shall be stockpiled in an area approved by the engineer.
8. Immediately after backfilling, trenches and associated disturbed working areas shall be planted with a suitable plant species and regularly watered. Where there is a particularly high erosion risk, a fabric such as Geojute (biodegradable) shall be used in addition to planting.

Dust

1. The Contractors shall be solely responsible for the control of dust arising from the Contractor's operations and for any costs against the Employer for damages resulting from dust.
2. The Contractor shall take all reasonable measures to minimise the generation of dust as a result of construction activities to the satisfaction of the Site Manager.
3. Removal of vegetation shall be avoided until such time as soil stripping is required and similarly exposed surfaces shall be re-vegetated or stabilised as soon as is practically possible.

4. Excavation, handling and transport of erodible materials shall be avoided under high wind conditions or when a visible dust plume is present.
5. During high wind conditions the Site Manager will evaluate the situation and make recommendations as to whether dust damping measures are adequate, or whether working will cease altogether until the wind speed drops to an acceptable level.
6. Where possible, soil stockpiles shall be located in sheltered areas where they are not exposed to the erosive effects of the wind. Where erosion of stockpiles becomes a problem, erosion control measures shall be implemented at the discretion of the Site Manager.
7. Vehicle speeds shall not exceed 40km/h along dust roads or 20km/h when traversing unconsolidated and non-vegetated areas.
8. Appropriate dust suppression measures shall be used when dust generation is unavoidable, e.g. dampening with water, particularly during prolonged periods of dry weather in summer. Such measures shall also include the use of temporary stabilising measures (e.g. chemical soil binders, straw, brush packs, clipping etc.)
9. Straw stabilisation shall be applied at a rate of one bale/ 10m² and harrowed into the top 100mm of top material for all completed earthworks.

Imported materials

1. Imported materials shall be free of weeds, litter and contaminants.
2. Sources of imported material shall be listed and approved by the Engineer or the Engineer's representative (ER) on Site.
3. The Contractor shall provide samples to the ER for approval.
4. Stockpile areas shall be approved by the ER before any stockpiling commences.

**APPENDIX F:
PLANT SEARCH & RESCUE PLAN**

METHODS FOR PLANT RESCUE AND HABITAT REHABILITATION

List of Abbreviations

CARA:	Conservation of Agricultural Resources Act 43 of 1983
DEA:	Department of Environmental Affairs
EA:	Environmental Authorisation
ECO:	Environmental Control Officer
EMP:	Environmental Management Plan
NEMA:	National Environmental Management Act 107 of 1998
LFA:	Landscape Functional Analysis (Tongway and Hindley 2004)
IAP:	Invasive Alien Plant

List of Definitions:

Accelerated soil erosion: Soil erosion induced by human activities.

Acceptable cover: An acceptable cover shall mean that not less than 75% (in an area with rainfall above 400 mm per annum), or 40% (in regions receiving less than 400 mm rain per annum), of the area planted or hydroseeded shall be covered with grass and that there shall be no bare patches of more than 500 mm in maximum dimension.

Alien: originating from another country or continent and originally different environment, commonly used to describe plants that are not indigenous to South Africa and have become problematic (spreading rapidly, threatening existing biodiversity).

Allelopathic components: one or more biochemical compound produced by a plant and released through leaf litter or roots that suppresses the growth, survival, and reproduction of other surrounding vegetation.

Bare soil: Un-vegetated soil surface, unaltered by humans.

Compacted soil surface: A soil surface that has been hardened by an outside source, causing the soil to be more compacted than the surrounding area.

Container plants: Container plants include all vegetation which are bought or supplied in acceptable containers from nurseries or vegetation lifted out of their natural position and placed in containers.

Desirable end state: the future condition or target on which the rehabilitation is designed and that will serve later as a basis for rehabilitation success evaluation. This can be based on a reference site or modelled according to available information on historic vegetation.

Ecological rehabilitation: The process of assisting the recovery of a degraded or damaged ecosystem in a trajectory that renders the ecosystem fully functional, stable, and able to develop further, but not necessarily returning to the original historic state.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed, in a trajectory that ultimately returns the ecosystem to its natural successional stage.

Ecosystem: The combination of biota within a given area, together with a suitable environment that sustains the biota and the interactions between biota. It can have a spatial unit of any size, but shows some degree homogeneity as far as structure, function and species composition is concerned. Small-scale ecosystems typically link up to larger scale ecosystems and all contribute to the ecosystem function and services at the landscape-scale.

Environmental Management Plan: an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction and operation, and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced.

Establishment of grass: All procedures necessary to produce an acceptable cover of grass on an area.

Establishment Period: The Establishment Period is defined as the period beginning from the actual planting or placing of vegetation until three months thereafter, unless otherwise specified or unless grass cover is unacceptable or unless plants have not taken.

Extinction debt: is a concept that describes the future extinction of species due to events in the past. Extinction debt occurs because of time delays between impacts on a species, such as destruction of habitat or reduction of population size, and the species' ultimate disappearance.

Geophytic: resprouting during the growing season from an underground storage organ such as bulbs, corms, tubers or rhizomes, and dying back completely during unfavourable seasons.

Hydroseeding: To apply seed in a slurry with water (plus other materials to enhance growth) by means of a spraying device.

Indigenous: refers to a plant or animal that occurs naturally in the place in which it is currently found.

Invasive plant: a kind of plant which has under section 2 (3) of CARA been declared an invader plant, and includes the seed of such plant and any vegetative part of such plant which reproduces itself asexually.

Landscape: Consists of a mosaic of two or more ecosystems that exchange organisms, energy, water, and nutrients.

Nursery conditions: These are the necessary conditions to maintain healthy growth of rescued and/or container plants. This includes protection of such plants against wind, frost, direct sunlight, pests, rodents, diseases, and drought. It also includes the provision of suitable water, fertilizer and any other measures required to maintain the container plants.

Period of Maintaining: The Period of Maintaining is defined as the period following directly after the Establishment Period until the end of the Period

of Maintenance for the whole Contract as defined in the General Conditions of Contract, unless otherwise specified.

Revegetation: The process of establishing a vegetative cover on exposed soils, regardless of species composition or structure, as long as the species are non-invasive and their presence will not impede the gradual process of ecological rehabilitation or –restoration.

Soil Erosion: is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of inter alia chemical processes and or physical transport on the land surface.

Scarifying: To roughen the surface of soil as a preparation for seeding or topsoil addition.

Trimming: To neatly round off the levels of existing or previously shaped earthworks to blend in with the levels of other earthworks, constructed works, or natural landforms.

Transformation: The conversion of an ecosystem to a different ecosystem or land use type.

Topsoil: uppermost layer of soil, in natural vegetation maximally 30 cm, in cultivated landscapes the total depth of cultivation, containing the layer with humus, seeds and nutrients. Topsoils that are applied to landscapes to be rehabilitated must be free of refuse, large roots and branches, stones, alien weeds and/or any other agents that would adversely affect the topsoils suitability for re-vegetation.

Weed: a plant that grows where it is not wanted, and can therefore be an indigenous or alien species. An unwanted plant growing in a garden is just called a weed, but the 198 listed IAPs are called “declared weeds and invaders”.

1. Purpose

The Plant Rescue and Revegetation Management Plan addresses the need to mitigate all impacts leading to disturbed vegetation, loss of species and/or agricultural potential, disturbed soil surfaces, and generally bare soils prone to erosion and further degradation on the proposed development site. The plan overlaps to some degree with the Storm Water and Erosion Management Plan, and for successful rehabilitation, it is imperative that this plan is at all times used in conjunction with other EMPs mentioned.

The objective of the plan is therefore to provide:

- » Protocols for the removal, temporary storage and replanting of plant species of conservation concern
- » Protocols for the rehabilitation of vegetative cover across the project area
- » Tools for planning the rehabilitation work and responding to unforeseen events
- » Guidelines on implementation and post-implementation tasks
- » Criteria for evaluating rehabilitation success
- » A summary of items to be included in the rehabilitation budget to ensure that there is sufficient allocation of resources on the project budget so that the scale of EMP-related activities is consistent with the significance of project impacts

2. Scope

This document is a plant rescue, rehabilitation, and revegetation plan that provides a guideline to be applied by all contractors on the development site. This plan, as part of the project EMP, is a legally binding document that must be implemented to fulfill the requirements of relevant legislation. However, the management plan is an evolving guideline that needs to be updated or adapted as progress is made with the rehabilitation and revegetation of the project area, and successes and failures of procedures identified.

The objective of rescuing plants, rehabilitation and revegetation on the project area is:

- » Preventing the loss of species either directly or through future extinction and minimising impacts of development on population dynamics of species of conservation concern.
- » Preserving the natural configuration of habitats as part of ecosystems, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist.
- » Preserving or re-creating the structural integrity of natural plant communities.
- » Actively aid the improvement of indigenous biodiversity according to a desirable end state according to a previously recorded reference state. This reference

state, if healthy, will be dynamic and able to recover after occasional disturbances without returning to a degraded state.

- » Improving the ecosystem function of natural landscapes and their associated vegetation.

3. Legislation and Standards

Relevant legislation:

- » Conservation of Agricultural Resources Act 43 of 1983
- » Environmental Conservation Act 73 of 1989
- » National Forestry Act 84 of 1998
- » National Environmental Management Act 107 of 1998
- » Northern Cape Nature Conservation Act (Act No. 9 of 2009)

4. Effect of clearing alien vegetation

Invasive and Alien Plants (IAPs) gradually displace and suppress indigenous and/or herbaceous vegetation as their stands become bigger and denser. In addition, they use more water, hence desiccate the soil more, and may alter chemical properties of the soil – partially through secondary compounds released from their litter, partially from compounds released from roots. These altered soils suppress the germination and establishment of herbaceous species, leading to bare soil underneath dense IAP canopies.

After clearing dense stands of invasive shrubs, soil surfaces are thus generally bare with topsoil exposed to erosion and often already somewhat capped and eroded.

5. Effect of removing individuals of species of conservation concern

Species of conservation concern are declining either due to overexploitation or because their range of occupancy is limited and further infringed on by development. Most plant populations require a certain minimum number of individuals within a population or metapopulation to allow for sufficient genetic transfer between individuals. This prevents genetic erosion and hence weakening of the ability of individuals to persist in their environments. Similarly, where the distance between metapopulations is significantly increased due to fragmentation and the resultant loss of some populations, populations may suffer genetic decline due to restricted movement of pollen. Pollinators or other species that depend on a particular plant species for a specific microhabitat or food source may be equally affected because of the reduction of available resources. Therefore the aim of plant rescue actions are always to maintain as many individuals of a plant population in as close proximity to the original habitat as possible to minimise loss of individuals and fragmentation of populations to prevent the creation of future extinction debts of the development.

6. General: Plant rescue and protection

Successful plant rescue can only be achieved if:

- » Species can be removed from their original habitat with minimal damage to the plant, especially the roots.
- » All plants removed are safely stored and treated according to their specific requirements prior to being transplanted again.
- » They are relocated into a suitable habitat and protected from further damage and all disturbances to aid their re-establishment.
- » Timing of planting activities is planned with the onset of the growing season.
- » Steps are taken where necessary to aid the initial establishment of vegetation, including occasional watering.

6.1. Time of planting

- » All planting shall be carried out as far as is practicable during the period most likely to produce beneficial results (i.e. during the peak growing season), but as soon as possible after completion of a section of earthworks.
- » Drainage line rehabilitation preparation must be done during autumn, and planting of appropriate species in these areas should commence during early spring after the first rains.

7. General: IAP removal

Removal of invasive plants should at all time follow the specifications and guidelines of the Working for Water Programme (refer also to invasive plant management plan).

Information can be obtained from the relevant website:

<http://www.dwaf.gov.za/wfw>

Detailed information on clearing methods is available on the above websites "Alien Invasive Plants" menu (clearing methods, operational standards and species-specific treatment methods).

8. General: Rehabilitation and re-vegetation

Successful rehabilitation can only be achieved with:

- » A long-term commitment
- » Practical, adaptive management
- » Viable goals of desired outcomes

Prior to vegetation rehabilitation, all stakeholders involved should be consulted to determine:

- » What the rehabilitation is ultimately aiming for– rehabilitation of cropping/grazing lands or rehabilitation of indigenous vegetation, after soil erosion and storm water management is in place and IAPs have been cleared?
- » A clear definition of incompatible and compatible vegetation on and in the immediate surroundings of the development must be defined and maintained as such. No tree or shrubs shall be allowed to grow to a height in excess of the horizontal distance of that tree or shrub from the nearest newly developed structure or to grow in such a manner as to endanger the development or its operation
- » Who will take long-term ownership and hence responsibility for the rehabilitation and its subsequent monitoring and management? Continued monitoring of vegetation establishment and composition, as well as erosion detection will have to be coupled with continued follow-up maintenance of rehabilitation and erosion control from commencement of activity up to the decommissioning phase.

The ultimate objective for rehabilitation should focus on the stabilisation of soil erosion, retaining agricultural potential of transformed areas and /or the establishment of a dense and protective plant cover and the maintenance of habitats to enable vegetation to persist and flourish on rehabilitated areas indefinitely, ultimately relying only on environmental resources.

8.1. Map and create management areas

The entire project area must be mapped and divided into management areas indicating:

- » Current land cover
 - Roads and residential
 - Areas with IAPs, subdivided further in sparse or dense infestations where applicable
 - Transformed areas
 - Untransformed indigenous vegetation

For every one of the management areas, the project proponent, in consultation with the land users, will have to decide what intervention will be necessary, desirable, and feasible to enable the development of the project and long-term sustainable maintenance of infrastructure. Thus for every management area there must be an operational outline on:

- » what will happen there
- » what needs to be mitigated – including storm water- and erosion management
- » which management units need priority intervention/mitigation
- » how will this mitigation / intervention be done (method statements) including schedule of work
- » realistic and desirable end states including list of species that should be established to initiate rehabilitation after initial revegetation

- » approximate timeframes
- » monitoring protocol to evaluate success or failures of interventions
 - establish permanently marked transects and monitor with fixed-point photography
- » who will be responsible for doing what
- » how will different actions be integrated to achieve and maintain or improve the desirable end state of the environment of that management unit

Special attention will have to be given to drainage zones, as these not only have very active morphodynamics, but are also distributors of seeds – both indigenous and of IAPs. Thus clearing a downstream invasion of aliens to enable maintenance of the development will be futile if the upstream IAPs are not cleared or at least aggressively controlled.

8.2. Setting realistic rehabilitation goals

Rehabilitation efforts typically aim at improving ecosystem function that consists of a series of processes, which can in the end be evaluated against a desired outcome or reference state of the vegetation and environment.

Attainable goals of rehabilitation on the project area should be possible and viable for at least the following:

- » Stabilisation of soils
- » Stabilisation of riparian areas
- » Storm water reduction through management and wetland integrity
- » Clearing of IAPs
 - The degree to which IAPs can be cleared from the project area needs to be determined according to desirability, available project funding, personnel and project requirements
- » Restoring and/or rehabilitating vegetative cover on non-transformed areas to obtain an acceptable vegetation cover that can be maintained or persists on its own indefinitely

8.3. Remove or ameliorate the cause of degradation

This will include:

- » Physical rehabilitation of topsoil where it has been removed.
- » Topsoil on areas that have not been cultivated are considered as the upper 20 - 30 cm only. These contain the most important nutrients, micro flora and –fauna essential for nutrient cycling processes. Topsoils are also an important source of seeds.
- » Subsoils and overburden substrata lack the above elements and will first have to be used for physical rehabilitation of landscapes as and where necessary, and then overlain with topsoils

- » Stabilisation of topsoils and prevention of erosion – refer to the Erosion management plan
- » Removal of all invasive vegetation – refer to the Invasive Management Plan
 - Where it is desirable to use brush or logs of the cleared vegetation for soil stabilisation, such material must be free of regenerative material – e.g. seeds or root suckers

8.4. Initial revegetation

Immediately after clearing of vegetation, the soil surface must be inspected for signs of erosion and stabilised as soon as possible. After completion of construction, such erosion stabilisation should preferably be with a cover of vegetation. A dense initial grass or other perennial cover will be desirable. The appropriate seed mix should be determined in consultation with an ecologist familiar with the area. The aim of the first vegetation cover is to form a protective, relatively dense indigenous layer to slow runoff, increase moisture infiltration into the soil, and gradually change the soil nutrient status in order for it to be more favourable for other desirable indigenous vegetation to become established.

8.5. Plant Search and Rescue

Prior to construction, once all the areas where topsoil will be removed or areas will be transformed have been demarcated, the ECO and contractor will be responsible to remove all bulbous species from the topsoil, as well as succulents and small indigenous shrubs that can be transplanted. These are to be kept in a raised, protected position in a designated area until they can be replanted again as part of the rehabilitation process. Further details are listed in the operation standards.

8.6. Natural seed banks and improvement of plant structural and compositional diversity

It is expected that soil seed banks of indigenous vegetation will be present to initiate initial vegetation cover, but may not be sufficient to establish an acceptable cover of desirable species. After deciding which indigenous species should be re-introduced, seed should be ideally collected from site or an environmentally-matched site nearby.

Seed collection may be done throughout the year as seed ripens, but can also be restricted to summer, when a large amount of the perennial seed should have ripened. Seeds should be stored in paper or canvas bags dusted with insecticide, and sown at the onset of the rainy season.

Alternatively, slower-growing perennials may be raised from seed or cuttings in a nursery and then transplanted once established. It will be beneficial to investigate if community members would be able to create and maintain such a nursery, or if there are nurseries in the area, that raise indigenous flora from the area.

The final vegetation cover should resemble the original (non-encroached) vegetation composition and structure as far as practicable possible or permissible within each management unit.

For drainage areas:

- » First restore drainage line morphology following the guidelines of the Erosion management plan – without that ecological recovery cannot be initiated
- » Determine if natural seed sources may be present further upstream
- » If such upstream seed sources are still present, rehabilitation of riparian vegetation after soil erosion management will most likely occur naturally, PROVIDED that follow-up monitoring of the establishment of vegetation is carried out, and all invasive species eradicated as they emerge. This can only be achieved with a long-term commitment (> 5 years minimum)
- » Should no upstream seed resources be available, suitable species (as determined in consultation with an ecologist) should be sown or planted.

8.7. Monitoring and follow-up action

Throughout the lifecycle of the development, regular monitoring and adaptive management must be in place to detect any new degradation of ecosystems affected by the development, and remedy these as soon as detected.

During the construction phase, the ECO and contractor will be responsible for initiating and maintaining a suitable monitoring system. Once the development is operational, the project proponent will have to identify a suitable entity that will be able to take over and maintain the monitoring cycle and initiate adaptive management as soon as it is required. Monitoring personnel must be adequately trained.

The following are the minimum criteria that should be monitored:

- » Composition and density of replanted vegetation, distinguishing between species introduced for initial revegetation only and species that are part of the pre-determined desirable end state
- » Associated nature and stability of surface soils
 - It is recommended that permanent transects are marked and surveyed annually according to the LFA technique (Tongway and Hindley 2004), adapted to integrate both surface soil characteristics and the vegetation to be monitored
- » Re-emergence of IAPs
 - If noted, remedial action must be taken immediately according to Working for Water specifications
- » Nature and dynamics of riparian zones
 - Stability of riparian vegetation
 - Any form of bank erosion, slumping or undercutting

- Stability of channel form and width of streams – if this increases, it shows that vegetation on plains and/or riparian areas and upper drainage lines are not yet in a stable enough state to be fully functional in reducing excess runoff and the ecosystem overall is losing valuable resources

8.8. Timeframes and duration

- » Rehabilitation will occur during construction, as areas for the re-application of topsoil and revegetation become available or where revegetation can be initiated after clearing of invasives or to stabilise erosion.
- » The initial revegetation period post construction is estimated to be over a period of 6 (minimum) to 12 months (maximum), or a time period specified by the Horticultural Landscape Contractor, particularly if planting of trees and shrubs occurs.
- » The rehabilitation phase (including post seeding maintenance) should be at least 12 months (depending on time of seeding and rainfall) to ensure establishment of an acceptable plant cover is achieved (excluding invasive plant species or weeds).
- » If the plants have not established and the acceptable plant cover is not achieved within the specified maintenance period, maintenance of these areas shall continue until at acceptable plant cover is achieved (excluding alien plant species or weeds).
- » Additional seeding or planting may be necessary to achieve acceptable plant cover. Hydroseeding may have to be considered as an option in this case.
- » Any plants that die, during the maintenance period, shall be replaced by the Horticultural Landscape Contractor (at the Horticultural Landscape Contractor's cost if it was due to insufficient maintenance).
- » Succession of natural plant species should be encouraged
- » Monitoring of rehabilitation success and follow-up adaptive management, together with clearing of emerging invasives shall be carried on until the decommissioning phase has been completed.

9. Conclusion

The Plant Rescue and Revegetation Management Plan is a document to assist the contractor, the developer, and the ECO with guidelines on how to plan and implement the required work, and understand the concepts behind successful rehabilitation. This plan will have to be implemented in conjunction with erosion-, storm water- and IAP management plans. The exact details of the rehabilitation plan will depend on the determined extent of rehabilitation that will have to be undertaken, available funding, and desirable end state of the vegetation after rehabilitation.

10. References and further reading

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A. APPENDIX: RECOMMENDED OPERATIONAL STANDARDS

OBJECTIVE: Revegetate and Rehabilitate disturbed areas

The Contractor must take all reasonable measures to ensure that plant species of conservation concern are rescued and survive indefinitely. Landscaped topsoils as well as areas cleared of IAPs must be adequately rehabilitated and /or revegetated to ensure that the ecosystems affected by the development regain and/or retain their functionality indefinitely.

Throughout the lifecycle of the development, regular monitoring and adaptive management must be in place to detect any new degradation of ecosystems affected by the development and remedy these as soon as detected.

Mitigation measures relating to the vegetative cover as part of a healthy ecosystem must be implemented in order to effectively limit and gradually reverse the impact on the environment. The focus of the mitigation measures laid out below relate to project-related disturbances. Where such disturbances are exacerbated by farming-related disturbances or vice versa, mitigation measures must be carried out in consultation with the land-user responsible.

Project component/s	<p>Project components affecting the objective:</p> <ul style="list-style-type: none"> » Turbines » Access roads and cabling between and to turbine units » Power line » Sealed surfaces (e.g. roofs, concrete surfaces, compacted road surfaces, paved roads / areas) » Substation » All other infrastructure
Potential Impact	<ul style="list-style-type: none"> » Loss of suitable substrate for a stable vegetation cover » De-stabilisation and/or alteration of substrate and hence degradation of vegetation cover, significant change in species composition or loss of agricultural potential » Loss of suitable habitat for flora and fauna » Leaky ecosystem due to loss of nutrients and moisture from the system, leading to a less resilient vegetation cover and loss of ecosystem function and -services » Degradation and/or loss of riparian areas and wetlands on and beyond the project boundaries » A loss of indigenous vegetation cover and possibly endangered species » Disturbance of fauna species
Activities/risk sources	<ul style="list-style-type: none"> » Rainfall and wind erosion of disturbed areas » Excavation, stockpiling and compaction of soil » Existing IAPs as well as clearing thereof » Concentrated discharge of water from construction activity or new

	<p>infrastructure</p> <ul style="list-style-type: none"> » Storm water run-off from sealed, altered or bare surfaces » Mobile construction equipment movement on site » Cabling and access roads construction activities » Power line construction activities » River/stream/drainage line road crossings » Roadside drainage ditches » Project related infrastructure » Premature abandonment of follow-up monitoring and adaptive management of rehabilitation
Mitigation: Target/ Objective	<ul style="list-style-type: none"> » To minimise loss of plant species of conservation concern » To minimise unfavourable runoff conditions and loss of resources from the ecosystems » To minimise erosion of soil from site during and after construction » To minimise and mitigate unfavourable alteration to drainage lines, especially incision » To minimise damage to indigenous vegetation during and after construction » No accelerated overland flow related surface erosion as a result of project infrastructure » No reduction in the surface area or general nature and functionality of wetlands (drainage lines and other wetland areas) as a result of the establishment of infrastructure on the project areas and beyond its boundaries » A clear reduction of IAPs on the project area and replacement thereof by indigenous vegetation according to a pre-determined desirable end state

Mitigation: Action/control	Responsibility	Timeframe
Planning		
Classify the entire project area into management units according to current land cover and state of the environment and map accordingly	Developer / Contractor	Prior to construction
<p>For each management unit</p> <ul style="list-style-type: none"> » establish what interventions will be necessary relating to IAPs, soil erosion management, topsoil handling, landscape rehabilitation and revegetation » where rehabilitation and revegetation will be necessary, decide on the desired end state of vegetation for that management unit and create a list of species to be established on specific sites » outline the management of construction activities, including topsoils, excavated materials and felled biomass in a manner that will optimise the rehabilitation goals as fast and as effective as possible for that management unit 	Developer / Contractor in collaboration with ECO and land-users	Prior to construction
Plant Rescue and indigenous plant materials		
<p>All harvested plant materials shall be labelled with</p> <ul style="list-style-type: none"> » Genus as minimum, species if known » Habitat from which materials were collected 	ECO	Prior to construction

Mitigation: Action/control	Responsibility	Timeframe
<p>Indigenous plant materials for re-vegetation:</p> <ul style="list-style-type: none"> » All plant material shall be obtained from the search-and-rescue operation on the site prior to clearing or from local nurseries or reputable seed providers » Indigenous materials shall only be removed from their habitat with the necessary permits whenever applicable » Each plant removed shall be handled, packed and stored in a manner suitable for that species » Removed plants shall be protected from windburn or other damage during transportation » No plants or plants with exposed roots shall be subjected to excessive exposure to drying winds and sun, or subjected to water logging » All plants shall be kept free from plant diseases and pests and protected from rodents or other damaging agents » All indigenous plants that have been removed prior to clearing shall be returned to conditions resembling their original habitat as close as practically possible 	Contractor in collaboration with ECO	Before, during and after construction
<p>Seed stocks for rehabilitation</p> <ul style="list-style-type: none"> » Seed can be used for cultivation of desirable species for revegetation » Seed shall be utilised for direct sowing or hydroseeding » Seed collected from the site must be dried and stored in a suitable facility under cool (7-10°C), dry, insect free conditions until required for cultivation or seeding. Only viable, ripe seed shall be used » Seed harvested shall be insect- and pathogen free » Seed harvested shall not contain materials of any invasive species » Prior to clearing, seed should be collected from the site on a regular basis as species start to seed to maximise the amount of fully developed seed secured » From sites that will be cleared, 100% of all seeds available may be collected » From sites adjacent to the development, 25% of seeds can be collected for rehabilitation 	Contractor and ECO	Before, during and after construction
<p>Site-specific nursery</p> <ul style="list-style-type: none"> » On-site nursery facilities shall be erected for the holding of rescued plant material and the propagation of appropriate species for re-vegetation » Where nursery facilities can only cater for rescued plants, a suitable (local) nursery shall be identified that will be willing to receive seeds collected and propagate the necessary species for later revegetation » Soil or other propagation media, were used, shall be weed- and pathogen free » Argentine ants shall be controlled at all times » The area where plants are stored shall be kept free of 	Contractor, ECO to control	Prior to construction

Mitigation: Action/control	Responsibility	Timeframe
weeds <ul style="list-style-type: none"> » Plants stored in the designated area shall be protected from rodents, excessive sun and wind, and inspected regularly until being planted for pathogens and pests, and then treated accordingly » The nursery shall be adequately secured to prevent loss or theft of species 		
Protected flora <ul style="list-style-type: none"> » Ensure that no indigenous protected flora is removed from its original habitat in the project area without legal documents from the relevant authorities 	ECO	Before, during and after construction
Topsoil		
Avoid <ul style="list-style-type: none"> » Management units that will not be developed or selected elements – trees, rocky outcrops on site shall be maintained in situ and demarcated clearly to prevent any disturbance during construction » These units will be considered as NO-GO areas during construction 	Contractor and ECO	Before, during and immediately after construction
Invasives <ul style="list-style-type: none"> » Remove all invasive shrubs as per the Working for Water specifications 	Contractor, ECO to control	Before, during and after construction
Mulch <ul style="list-style-type: none"> » all trees felled shall be debranched and the logs used in controlling erosion from re-landscaped topsoils and/or adding surface roughness and organic matter to topsoils to be rehabilitated » all cut branches from trees, as well as all shrubs cleared from the construction site shall be shredded to mulch, either by a chipper or by hand to sticks no longer than 10 cm » preparation of mulch shall be done at source » mulched material shall be free of seed-bearing invasive plant material » the mulch shall be suitably stored – bagged if necessary - and will be used in rehabilitation and soil erosion management on the site » should additional mulch be used for rehabilitation, this should be obtained from invasive shrubs of areas not cleared » mulch shall be stored for as short a period as possible 	Contractor, ECO to control	Before, during and immediately after construction
Storage of topsoil and subsoil: <ul style="list-style-type: none"> » topsoils constitute the upper 20 – 30 cm of soil only, lower layers of soil are regarded as subsoil » stockpiling of topsoils and subsoils shall only be done on previously transformed areas, and be kept at least 50 m from any remaining natural vegetation » care shall be taken during stockpiling to prevent the 	Contractor, ECO to control	During and immediately after construction

Mitigation: Action/control	Responsibility	Timeframe
<p>mixing of topsoil with subsoil and/or any other material</p> <ul style="list-style-type: none"> » topsoils shall be stored in heaps no higher than 100 cm, and shall be re-applied as soon as possible » care shall be exercised during stockpiling of topsoils to prevent compaction thereof » topsoils shall be adequately protected from erosion by preventing concentration of surface water and scouring of slopes » erosion of topsoils has to be contained and repaired as soon as it occurs, before large scale erosion and loss of topsoil develops » any logs obtained during clearing operations can be used in continuous rows to curtail erosion where necessary. Geojute (geotextile) shall be used additionally if the logs are not sufficient to remedy any erosion – for details refer to the erosion management plan » where topsoils need to be stored longer than 6 months, such stockpiles shall be revegetated, even if this has to include re-seeding to achieve an acceptable cover of vegetation 		
<p>Boulders and rocks</p> <ul style="list-style-type: none"> » where removed during clearing, should be stored separately and used in the rehabilitation program » boulders and rocks must be partially buried within the topsoil layer wherever practical to provide greater soil-holding stability and reduce water erosion » placement of rocks and boulders shall mimic the natural occurrence of rocks and boulders in the area 	Contractor, ECO to control	During and after construction
Rehabilitation of surface		
<p>Prior to the application of topsoil</p> <ul style="list-style-type: none"> » subsoil shall be shaped and trimmed to blend in with the surrounding landscape or used for erosion mitigation measures » ground surface or shaped subsoil shall be ripped or scarified with a mechanical ripper or by hand to a depth of 15 – 20 cm, » compacted soil shall be ripped to a depth greater than 25 cm and the trimmed by hand to prevent re-compacting the soil » any rubbish, concrete remnants, steel remnants or other objects introduced to the site during the construction process shall be cleared before ripping, or shaping and trimming of any landscapes to be rehabilitated takes place » shaping will be to roughly round off cuts and fills and any other earthworks to stable forms, sympathetic to the natural surrounding landscapes 	Contractor, ECO to control	During and after construction

Mitigation: Action/control	Responsibility	Timeframe
<p>Application of topsoil</p> <ul style="list-style-type: none"> » topsoils shall be spread evenly over the ripped or trimmed surface, if possible not deeper than the topsoil originally removed » the final prepared surface shall not be smooth but furrowed to follow the natural contours of the land » the final prepared surface shall be free of any pollution or any kind of contamination » care shall be taken to prevent the compaction of topsoil » where applicable, the final prepared surface will also contain scattered rocks and/or logs to mimic the natural condition of the original habitat or area and to aid in soil stabilisation and erosion control 	Contractor, ECO to control	During and after construction
<p>Soil stabilisation</p> <ul style="list-style-type: none"> » mulch from brush shall be applied by hand to achieve a layer of uniform thickness » mulch shall be rotovated into the upper 10 cm layer of soil <ul style="list-style-type: none"> ○ this operation shall not be attempted if the wind strength is such as to remove the mulch before it can be incorporated into the topsoil » in very rocky areas a layer of mulch shall be applied prior to adding the topsoil » measures shall be taken to protect all areas susceptible to erosion by installing temporary and permanent drainage work as soon as possible <ul style="list-style-type: none"> ○ where natural water flow-paths can be identified, subsurface drains or suitable surface drains and chutes need to be installed » additional measures shall be taken to prevent surface water from being concentrated in streams and from scouring slopes, banks or other areas <ul style="list-style-type: none"> ○ if mulch is limited, available mulch, together with harvested seeds, should be concentrated in these hollows to promote rapid re-vegetation in them » runnels or erosion channels developing shall be back-filled and restored to a proper condition <ul style="list-style-type: none"> ○ such measures shall be effected immediately before erosion develops at a large scale » where erosion cannot be remedied with available mulch, logs or rocks, geojute shall be used to curtail erosion 	Contractor, ECO to control	During and after construction
<p>Borrow-pits</p> <ul style="list-style-type: none"> » shall be shaped to have undulating, low-gradient slopes and surfaces that are rough and irregular, suitable for trapping sediments and facilitation of plant growth » upon completion of rehabilitation these reshaped and revegetated areas shall blend into the natural terrain 	Contractor, ECO to control	After construction

Mitigation: Action/control	Responsibility	Timeframe
Revegetation		
<p>Recreate a non-invasive, acceptable vegetation cover that will facilitate the establishment of desirable and/or indigenous species</p> <ul style="list-style-type: none"> » revegetation of the final prepared area is expected to occur spontaneously to some degree where topsoils could be re-applied within 6 months » revegetation will be done according to an approved planting/landscaping plan according to the management units initially delineated and their respective desirable end states and permissible vegetation 	Contractor, ECO to control	Successively during construction , as construction of individual components is completed, then followed up until desired end state is reached
<p>Re-seeding</p> <ul style="list-style-type: none"> » revegetation can be increased where necessary by hand- seeding indigenous species <ul style="list-style-type: none"> ○ previously collected and stored seeds shall be sown evenly over the designated areas, and be covered by means of rakes or other hand tools » re-seeding shall occur at the recommended time to take advantage of the growing season » in the absence of sufficient follow-up rains after seeds started germinating, watering of the new vegetation cover until it is established shall become necessary to avoid loss of this vegetative cover and the associated seedbank » where, after initial re-seeding, the no acceptable vegetation cover has established within 12 months, hydroseeding should be considered as an option for follow-up revegetation work » sowing rates of seeds used during hydro-seeding should be obtained from the relevant supplier and in accordance with the existing environment 	Contractor, ECO to control	Successively during construction , as construction of individual components is completed, then followed up until desired end state is reached
<p>Planting of species</p> <ul style="list-style-type: none"> » species to be planted include all rescued species » the size of planting holes shall be sufficiently large to ensure that the entire root system is well covered with topsoil » soil around the roots of container plants shall not be disturbed » bulbous plants shall be planted in groups or as features in selected areas » before placement of larger plant specimens into prepared holes, the holes shall be watered if not sufficiently moist » during transplanting care shall be taken to limit or 	Contractor, ECO to control	Successively during construction , as construction of individual components is completed, then followed up until desired end state is

Mitigation: Action/control	Responsibility	Timeframe
prevent damage to roots » plants should be watered immediately after transplanting to help bind soil particles to the roots (or soil-ball around rooted plants) and so facilitate the new growth and functioning of roots		reached
Traffic on revegetated areas » designated tracks shall be created for pedestrian of vehicle traffic where necessary » Disturbance of vegetation and topsoil must be kept to a practical minimum, no unauthorised off road driving will be allowed » All livestock shall be excluded from revegetated areas	Contractor	Before, during and after construction
Establishment » The establishment and new growth of revegetated and replanted species shall be closely monitored » Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created	Contractor	Successively during construction , as construction of individual components is completed, then followed up until desired end state is reached
Monitoring and follow-up treatments		
Monitor success of rehabilitation and revegetation and take remedial actions as needed according to the respective plan » Erosion shall be monitored at all times and measures taken as soon as detected » Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created	ECO during construction, suitable designated person/institution after that	During and after construction , during operational and decommissioning phase
Weeding » It can be anticipated that invasive species and weeds will germinate on rehabilitated soils <ul style="list-style-type: none"> ○ These need to be hand-pulled before they are fully established and/or reaching a mature stage where they can regenerate ○ Where invasive shrubs re-grow, they will have to be eradicated according to the Working for Water specifications 		
Performance Indicator	» No activity in identified no-go areas » Acceptable level of activity within disturbance areas, as	

	<p>determined by ECO</p> <ul style="list-style-type: none">» Natural configuration of habitats as part of ecosystems or cultivated land is retained or recreated, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist» The structural integrity and diversity of natural plant communities is recreated or maintained» Indigenous biodiversity continually improves according to the pre-determined desirable end state<ul style="list-style-type: none">○ This end state, if healthy, will be dynamic and able to recover by itself after occasional natural disturbances without returning to a degraded state» Ecosystem function of natural landscapes and their associated vegetation is improved or maintained
Monitoring	<ul style="list-style-type: none">» Fortnightly inspections of the site by ECO during construction» An incident reporting system must record non-conformances to the EMP.» Quarterly inspections and monitoring of the site by the ECO or personnel designated to the rehabilitation process until 80% of the desired plant species have become established<ul style="list-style-type: none">○ These inspections should be according to the monitoring protocol set out in the rehabilitation plan» Thereafter annual inspections according to the minimal monitoring protocol

B. APPENDIX: CHECKLIST OF ACTIONS FOR REHABILITATION PLANNING

<p>Conceptual Planning</p>	<ul style="list-style-type: none"> » Identify rehabilitation site locations and its boundaries » Identify ownership of rehabilitation program » Describe improvements that are anticipated following rehabilitation » Identify the kind of ecosystem to be rehabilitated at each site » Identify rehabilitation goals and desirable end state » Identify physical site conditions in need of repair » Identify stressors in need of regulation or re-initiation to maintain the integrity of the ecosystem, such as aliens, erosion, fire-regime » Identify the list and kinds of interventions of abiotic and biotic interventions that are and will be needed » Identify landscape restrictions and whether or not its integrity is dependent on a functioning ecosystem outside the project area » Determine project funding and sources » Identify labour sources and equipment needs » Identify biotic resource needs and sources, e.g. suitable topsoil, seeds » Identify any permit requirements or other legal issues » Determine project duration » Outline adaptable strategies for long-term protection and management
<p>Preliminary Tasks</p>	<ul style="list-style-type: none"> » Appoint a rehabilitation practitioner who is in charge of all the technical aspects of rehabilitation » Appoint a restoration team and train where necessary to ensure effective implementation » Prepare a budget to accommodate the completion of preliminary tasks » Document existing site conditions, also describing biota » Conduct pre-project monitoring as needed, including soil chemistry, that may affect the success of the rehabilitation program » Establish a reference site or past reference that represents the desired end state of the site » Gather information on key species to be re-introduced » Conduct investigations as needed to assess the effectiveness of restoration methods and strategies used in similar habitats up to date » Decide if rehabilitation goals are realistic or need modification » Prepare a list of objectives that need to be reached to achieve restoration goals » Ensure liaison with affected stakeholders, especially as far as rehabilitation goals are concerned » Investigate available accedes and infrastructure needed to facilitate implementation of rehabilitation
<p>Implementation phase</p>	<ul style="list-style-type: none"> » Describe the interventions that will be implemented to attain each set objective » Acknowledge potential for passive restoration where viable » Prepare performance standards and monitoring protocols to measure the attainment of each objective » Schedule tasks needed to fulfil each objective

	<ul style="list-style-type: none">» Obtain equipment, supplies and biotic resources as needed» Prepare an appropriate budget
Implementation tasks	<ul style="list-style-type: none">» Mark boundaries and work areas» Install permanent monitoring fixtures» Implement restoration tasks
Post-implementation tasks	<ul style="list-style-type: none">» Protect the rehabilitation site against initial disturbance, including herbivores» Perform post-implementation maintenance, especially continued monitoring and eradication of emerging IAPs» Monitor site at least once per year, using the LFA technique, and identify needs for adaptive management
Evaluation	<ul style="list-style-type: none">» Assess monitoring data to determine whether performance standards are met and rehabilitation objectives reached and maintained» Conduct an ecological evaluation of the newly completed rehabilitation

C. APPENDIX: TRANSPLANTING GUIDELINES FOR PLANTS WITH UNDERGROUND STORAGE ORGANS

Many of the plants in harsh environments have underground storage organs from which they resprout every year after sufficient rains, flower and then die back soon after fruiting and remain dormant, out of sight until the next growing season. All species of the families Amaryllidaceae, Iridaceae, Orchidaceae are protected provincially, nationally and/or internationally, as are many species of other monocot species.

Root system: underground storage organs are variable in size, but usually between 15 and 40 cm deep in the soil

Transplanting: success of transplanting is usually very high IF handled correctly

Rescue 101: Plants should be lifted and transplanted after flowering and fruiting, preferably as the leaves start to die back. For lifting, loosen the soil or wedge apart rocks working from a circle of about 20 cm away from the base of the plant, working inwards but not closer than about 5 cm of the plant with a sharp narrow object such as a koevoet. Once the soil is loosened, gently feel by hand where the bulb, corm, or other storage organ is, and wedge out by hand, taking care not to damage it. Remove loose soil, gently cleanse off most of remaining soil, or rinse off the storage organ. Group these according to species and label clearly, keep records of labels to include name if that is known, or a brief description or photo, also the average depth of the organs when they were removed, and the habitat they were removed from. Spread these plants so that the storage organ can dry completely, and then loosely pack into newspaper or paper bag and then store in a shaded, dry position for maximally 3 months. Transplant into soil that is as similar as possible to the original habitat, TAKING CARE that the growing point of the organ points to the top, else the plant will die. Make sure the storage organs are positioned according to the records kept about original depth of the storage organ.

Aftercare: Firm down soil around the base of the plant once it is in a new position. Allow plant to resprout naturally after sufficient rains, do not water. As these plants may not be visible for a while, clearly demarcate the area where these have been planted to avoid disturbing and potentially destroying them later on.