

**HUMANSRUS SOLAR 4 PV FACILITY:  
ALIEN INVASIVE PLANT MANAGEMENT PLAN**



**PRODUCED FOR CAPE EAPRAC  
ON BEHALF OF HUMANSRUS SOLAR 4 (PTY) LTD  
BY**



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## **ALIEN PLANT MANAGEMENT PLAN OBJECTIVES**

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The purpose of the Humansrus Solar 4 PV Facility Alien Plant Management Plan is to provide a framework for the management of alien and invasive plant species during the construction and operation of the Humansrus Solar 4 Facility. The broad objectives of the plan includes the following:

- Ensure alien plants do not become dominant in parts or the whole site through the control and management of alien and invasive species presence, dispersal & encroachment.
- Initiate and implement a monitoring and eradication programme for alien and invasive species.
- Promote the natural re-establishment and planting of indigenous species in order to retard erosion and alien plant invasion.

The recommendations and material provided in the plan results from background research as well as personal observations resulting from inspections at existing PV facilities that have already been built.

## **PROBLEM BACKGROUND & LEGISLATIVE BACKGROUND**

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Alien plants require management because they may impact biodiversity as well as the provision of ecosystem services which contribute to human livelihoods and well-being. In recognition of these impacts, South Africa has legislation in place which requires landowners to clear or prevent the spread of certain declared weeds from their properties. Within the context of the solar energy facilities, alien plant invasion can be problematic as they may increase the risk of fire within the facilities, shade the solar panels, spread into the surrounding natural vegetation or be more costly or difficult to control than the indigenous grassland.

In terms of the legislation, the Conservation of Agricultural Resources Act (CARA, Act 43 of 1983), as amended in 2001, requires that landusers clear *Declared Weeds* from their properties and prevent the spread of *Declared Invader Plants* on their properties. Table 3 of CARA lists all declared weeds and invader plants that must be controlled. Alien plants are divided into 3 categories based on their risk and potential impact as an invader.

- Category 1 - These plants must be removed and controlled by all land users. They may no longer be planted or propagated and all trade in these species is prohibited.
- Category 2 – These plants pose a threat to the environment but nevertheless have commercial value. These species are only allowed to occur in demarcated areas and a landuser must obtain a water use licence as these plants consume large quantities of water.
- Category 3 – These plants have the potential of becoming invasive but are considered to have ornamental value. Existing plants do not have to be removed but no new plantings may occur and the plants may not be sold.

The following guide is a useful starting point for the identification of alien species:

## **ALIEN SPECIES PRESENCE & ABUNDANCE AT HUMANSRUS SOLAR 4**

The Humansrus Solar 4 Facility site is currently very lightly invaded by alien species. The density of alien species within the intact vegetation is generally very low and is restricted to disturbed areas around watering points and kraal sites. Within the intact vegetation, there are few alien species of significance; however, there are occasional *Prosopis glandulosa* trees present. Should the development go ahead, then this is likely to be one of the major alien species requiring control at the site. Within favourable areas *Prosopis glandulosa* can become extremely dense and dominant, to the extent that livestock may be excluded from heavily invaded areas due to the dense brush that develops. This species should be cleared from the invaded area around the watering point as it is likely to remain a persistent problem if seed input into the area is high. Disturbance within the site is also likely to encourage alien plant invasion following construction and a variety of species are likely to increase and may become problematic within the site. Species that typically become problematic within PV facilities include *Salsola kali*, *Datura ferox*, *Tribulis terrestris* and *Argemone ochroleuca*. Which species become problematic depends to some extent on which species are able to colonise the site and the nature of disturbance at the site.

**Table 1.** List of alien species which are likely to become established at the site following construction and which may become problematic. The list is not intended to be comprehensive and other species may also invade and become problematic.

Family	Species	English name	Afrikaans name	Category
<i>Amaranthaceae</i>	<i>Alternanthera pungens</i>	Paperthorn	Kakiebubbeltjie	Not Listed
<i>Amaranthaceae</i>	<i>Amaranthus hybridus</i>	Common Pigweed	Kaapse Misbredie	Not Listed
<i>Amaranthaceae</i>	<i>Amaranthus viridus</i>	Slender Amaranth	Skraal Misbredie	Not Listed
<i>Amaranthaceae</i>	<i>Gomphrena celosioides</i>	Globe Amaranth	Mierbossie	Not Listed
<i>Asteraceae</i>	<i>Xanthium spinosum</i>	Spiny Cocklebur	Boetebossie	1
<i>Chenopodiaceae</i>	<i>Atriplex semibaccatta</i>	Australian Saltbush	Brakbossie	Not Listed
<i>Chenopodiaceae</i>	<i>Chenopodium album</i>	White Goosefoot	Withondebossie	Not Listed
<i>Chenopodiaceae</i>	<i>Salsola kali</i>	Russian Tumbleweed	Rolbossie	Not Listed
<i>Fabaceae</i>	<i>Prosopis glandulosa</i>	Mesquite	Heuningprosopis	2
<i>Papaveraceae</i>	<i>Argemone ochroleuca</i>	Mexican Poppy	Bloudissel	1
<i>Solanaceae</i>	<i>Datura ferox</i>	Large Thorn Apple	Groot Stinkblaar	1
<i>Solanaceae</i>	<i>Nicotiana glauca</i>	Wild Tobacco	Wildetabak	1
<i>Zygophyllaceae</i>	<i>Tribulis terrestris</i>	Dubbeltjie	Dubbeltjie	Not Listed

Additional information on these as well as the other alien species including photographs can be found on the following website: <http://www.invasives.org.za/invasive-plants.html>

## ***ACTIVITIES LIKELY TO IMPACT ALIEN SPECIES ABUNDANCE***

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Alien species are adept at taking advantage of disturbance and many of their traits are linked to this ability. This usually includes the ability to produce large amounts of seed or being flexible in terms of their size, growth form or reproductive strategy. Alien plant control strategies therefore need to focus on these key attributes while management practices need to ensure that they do not create circumstances under which alien species are encouraged or can thrive. Perhaps the most important aspects in this regard are minimising disturbance and ensuring the retention of indigenous vegetation as far as possible. The vegetation of the site is shrub-dominated and does not pose a fire hazard, however, following disturbance the vegetation is likely to become grass and weed-dominated and this would increase the fire hazard. As a result, maintaining the natural cover at the site as much as possible would result in the lowest long-term management requirement and cost.

It is important to note that it is not possible or practical to prevent alien species from entering the facility site as seed. Any activities which result in the loss of plant cover or the disturbance of the soil surface will stimulate the invasion of alien species. This includes clearing for roads, panel arrays, building, substations and any other infrastructure.

Within the context of the site, areas which receive runoff and those areas of disturbed soil which are not rehabilitated are likely to be most vulnerable to alien invasion, in the short term as well as during the operation phase of the development. As runoff can create erosion and disturbance, it is also likely that poor runoff management at the site will promote the invasion of alien species. During construction, there will be a large number of vehicles entering and leaving the site and many of these will have come from elsewhere and may bring seed of the above or other problem species with them in mud, dirt or material carried by the vehicles. Therefore, even if a species is not currently present at the site, it is likely that it may become introduced during construction. As it is easier to control alien species while their abundance is still low, control should begin during construction to ensure that species can be combatted while their abundance is still low.

## ***RECOMMENDED MANAGEMENT PRACTICE & CLEARING METHODS***

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The following general principles and observations which underlie or impact the alien management plan can be made regarding the likely trajectories of vegetation change at PV facilities during and following construction:

- There is likely to be a progression of alien species presence and abundance at the PV sites over time. Initially, alien species are likely to be a significant and persistent problem due to the high levels of disturbance present at the sites following construction. Most alien species are poor competitors and the lack of indigenous vegetation cover will encourage the growth of alien species. Provided that alien species are controlled in a sensitive manner, a cover of perennial

grasses is likely to become well established with a couple of years. This should discourage alien species which, with additional control, should become considerably less conspicuous within 5 years of construction. Some more competitive alien species may become established at this time and alien control strategies may need to be adapted over time to address the new problem species.

- Alien species presence will vary from year to year in terms of abundance, density and the identity of species present. This can be ascribed largely to variation in rainfall timing and amount, which will favour a different suite of species each year. Therefore, occasional outbreaks of certain species is not likely to be cause for concern, whereas a persistent high or increasing abundance of a species is indicative of a species where control may be required.
- Management practices will impact indigenous as well as alien species. The dominant management practice at the PV facilities is likely to be mowing to control vegetation height and fire risk within the facility. Regular mowing encourages the growth of low and creeping forms and discourages tall growth forms. This principle is well demonstrated by garden lawns or sports fields where most alien species or weeds in the lawn can be eradicated simply through regular mowing.
- Even without management intervention the vegetation composition of the facilities will change over time. This is due to the shading effect of the panels and the uneven distribution of runoff from the panels. So even where PV sites have not been cleared, it is likely that the vegetation beneath the panels will stabilise at a relatively low level on account of the shading effect, while the runoff at the leading edge of the arrays will encourage the presence of taller or more dense vegetation, which is problematic as shading of the panels may occur and a high plant biomass poses a fire risk.

Without being too prescriptive as the exact methods and approaches to be used, the following general management practices should be encouraged or strived for:

- Mowing excess vegetation by hand, for example with a weedeater, generates the lowest level of associated disturbance and is identified as the preferred method for vegetation control. However, this is time consuming and more mechanical means such as using a tractor with mower is also considered acceptable.
- There is a target height to which vegetation should be cut. If the vegetation is cut too low, then recovery of the grass layer will be slow and this may encourage erosion and an increase in alien invasion. On the other hand, if the vegetation is not cut low enough, then recovery will be rapid and frequent follow-up control may be required. It is recommended that the target height for vegetation after mowing should be about 10-15cm.
- The maintenance of fire-breaks around the facilities is an important safety control and the roads around the perimeter of the facility should be maintained free of vegetation. This is best achieved by manual clearing. Within the facilities themselves, some vegetation recovery along the internal roads should be considered acceptable.
- Where dense stands of alien species have established that cannot be controlled by manual means, some use of herbicides may be acceptable. However, the associated safety precautions

should be taken with regards to the appropriate application methods as well as the use of personal safety equipment (These are outlined in greater detail below). The best-practice clearing method for each species identified should be used. The preferred clearing methods for most alien species can be obtained from the DWAF Working for Water Website. <http://www.dwaf.gov.za/wfw/Control/>

- The effectiveness of vegetation control varies seasonally and this is also likely to impact alien species. Control early in the wet season will allow species to re-grow and follow-up control is likely to be required. It is tempting to leave control till late in the wet season to avoid follow-up control. However, this may allow alien species to set seed before control and hence will not contribute towards reducing alien species abundance. Therefore, vegetation control should be aimed at the middle of the wet season, with a follow-up event towards the end of the wet season. There are no exact dates that can be specified here as each season is unique and management must therefore respond according to the state and progression of the vegetation.
- Alien management is an iterative process and it may require repeated control efforts to significantly reduce the abundance of a species. This is often due to the presence of large and persistent seed banks. However, repeated control usually results in rapid decline once seed banks become depleted.
- Some alien species such as *Opuntia* (Prickly Pear) and trees such as *Prosopis* (Mesquite) are best individually pulled by hand and in the case of *Opuntia* removed from the site.
- It is expected that regular vegetation control to reduce plant biomass within the PV field will be conducted and that this will be timed so as to coincide with the critical growth phases of the most important alien species. This will significantly reduce the cost of alien management as this should contribute towards the control of the dominant alien species and additional targeted control will be required only for a limited number of species.

## **GENERAL CLEARING & GUIDING PRINCIPLES**

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- Alien control programs are long-term management projects and should include a clearing plan which includes follow up actions for rehabilitation of the cleared area.
- The lighter infested areas should be cleared first to prevent the build-up of seed banks.
- Pre-existing dense mature stands ideally should be left for last, as they probably won't increase in density or pose a greater threat than they are currently.
- Collective management and planning with neighbours may be required in the case of large woody invaders as seeds of aliens are easily dispersed across boundaries by wind or water courses.
- All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing.

## **CLEARING METHODS**

- Different species require different clearing methods such as manual, chemical or biological methods or a combination of both.
- However care should be taken that the clearing methods used do not encourage further invasion. As such, regardless of the methods used, disturbance to the soil should be kept to a minimum.
- Fire is not a natural phenomenon in the area and fire should not be used for alien control or vegetation management at the site.
- The best-practice clearing method for each species identified should be used. The preferred clearing methods for most alien species can be obtained from the DWAF Working for Water Website. <http://www.dwaf.gov.za/wfw/Control/>

## **USE OF HERBICIDES FOR ALIEN CONTROL**

Although it is usually preferable to use manual clearing methods where possible, such methods may create additional disturbance which stimulates alien invasion and may also be ineffective for many woody species which resprout. Where herbicides are to be used, the impact of the operation on the natural environment should be minimised by observing the following:

- Area contamination must be minimised by careful, accurate application with a minimum amount of herbicide to achieve good control.
- All care must be taken to prevent contamination of any water bodies. This includes due care in storage, application, cleaning equipment and disposal of containers, product and spray mixtures.
- Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed of in a suitable site.
- To avoid damage to indigenous or other desirable vegetation, products should be selected that will have the least effect on non-target vegetation.
- Coarse droplet nozzles should be fitted to avoid drift onto neighbouring vegetation.
- The appropriate health and safety procedures should also be followed regarding the storage, handling and disposal of herbicides.

For all herbicide applications, the following guidelines should be followed:

*Working for Water: Policy on the Use of Herbicides for the Control of Alien Vegetation.*



A dense infestation of Stinkblaar (*Datura ferox*) growing at a South African solar PV plant shortly after construction. A large proportion of this invasion could have been avoided if the vegetation beneath the panels had not been cleared as this vegetation would have utilised the water running off the front of the panels and limited the invasion of the *Datura*.

## **ALIEN PLANT MANAGEMENT & MONITORING PLAN**

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In order to implement the alien plant management plan, a monitoring and control schedule is required to evaluate the presence and on-going control of alien plants within the facility. This provides a guideline on the frequency with which alien plants should be monitored and what parameters are likely to be important

### **CONSTRUCTION PHASE ACTIVITIES**

The following management actions are aimed at reducing soil disturbance during the construction phase of the development, as well as reducing the likelihood that alien species will be brought onto site or otherwise encouraged.

<b>Action</b>	<b>Frequency</b>
The ECO is to provide permission prior to any vegetation being cleared for development.	Daily
Clearing of vegetation should be undertaken as the work front progresses – mass clearing should not occur unless the cleared areas are to be surfaced or prepared immediately afterwards.	Weekly
Where cleared areas will be exposed for some time, these areas should be protected with packed brush, or appropriately battered with fascine work. Alternatively, jute (Soil Saver) may be pegged over the soil to stabilise it.	Weekly
Cleared areas that have become invaded can be sprayed with appropriate herbicides	Weekly



provided that these are such that break down on contact with the soil. Residual herbicides should not be used.	
Although organic matter is frequently used to encourage regrowth of vegetation on cleared areas, no foreign material for this purpose should be brought onto site. Brush from cleared areas should be used as much as possible. The use of manure or other soil amendments is likely to encourage invasion.	Weekly
Clearing of vegetation is not allowed within 32m of any wetland, 80m of any wooded area, within 1:100 year floodlines, in conservation servitude areas or on slopes steeper than 1:3, unless permission is granted by the ECO for specifically allowed construction activities in these areas.	Weekly
Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment.) Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	Weekly
Alien vegetation regrowth on areas disturbed by construction must be controlled throughout the entire site during the construction period.	Monthly
The alien plant removal and control method guidelines should adhere to best-practice for the species involved. Such information can be obtained from the DWAF Working for Water website.	Monthly
Clearing activities must be contained within the affected zones and may not spill over into demarcated No Go areas.	Daily
Pesticides may not be used. Herbicides may be used to control listed alien weeds and invaders only.	Monthly
Wetlands and other sensitive areas should remain demarcated with appropriate fencing or hazard tape. These areas are no-go areas (this must be explained to all workers) that must be excluded from all development activities.	Daily

**MONITORING – CONSTRUCTION PHASE**

The following monitoring actions should be implemented during the construction phase of the development.

Monitoring Action	Indicator	Timeframe
Document alien species present at the site	List of alien species	Preconstruction
Document alien plant distribution	Alien plant distribution map within priority areas	3 Monthly
Document & record alien control measures implemented	Record of clearing activities	3 Monthly
Review & evaluation of control success rate	Decline in documented alien abundance over time	Biannually

**OPERATIONAL PHASE ACTIVITIES**

The following management actions are aimed at reducing the abundance of alien species within the site and maintaining non-invaded areas clear of aliens.

Action	Frequency
Surveys for alien species should be conducted regularly. Every 6 months for the first two years after construction and annually thereafter. All aliens identified should be cleared.	Every 6 months for 2 years and annually thereafter
Where areas of natural vegetation have been disturbed by construction activities, revegetation with indigenous, locally occurring species should take place where the natural vegetation is slow to recover or where repeated invasion has taken place following disturbance.	Biannually, but revegetation should take place at the start of the rainy season
Areas of natural vegetation that need to be maintained or managed to reduce plant height or biomass, should be controlled using methods that leave the soil protected, such as using a weed-eater to mow above the soil level.	When necessary
No alien species should be cultivated on-site. If vegetation is required for esthetic purposes, then non-invasive, water-wise locally-occurring species should be used.	When necessary

**MONITORING – OPERATIONAL PHASE**

The following monitoring and evaluation actions should take place during the operational phase of the development.

Monitoring Action	Indicator	Timeframe
Document alien species distribution and abundance over time at the site	Alien plant distribution map	Biannually
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate. A decline in alien distribution and cover over time at the site	Biannually
Document rehabilitation measures implemented and success achieved in problem areas	Decline in vulnerable bare areas over time	Biannually

## ***CONCLUSIONS AND RECOMMENDATIONS***

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- As there are already a number of alien species present at the site, alien invasion following disturbance at the site is likely to occur rapidly. As a result, alien control should begin during the construction phase to ensure that the density and abundance of alien species remains manageable into the operational phase.
- In the short-term, soil disturbance is likely to be the dominant driver of alien invasion at the site. While, in the long-term the distribution of runoff is likely to be a key driver as those areas which receive water will be wetter and likely to contain a higher alien abundance.
- As disturbance is the major initial driver of alien species invasion, keeping the disturbance footprint to a minimum is a key element in reducing alien abundance. Wherever possible, the indigenous vegetation should be left intact as this will significantly reduce the likelihood of alien invasion.