

THABA STONE QUARRY
PORTION 2 AND THE REMAINING EXTENT OF THE
FARM UITKOMST NO 558, thaba 'nchu DISTRICT,
FREE STATE PROVINCE

INVASIVE PLANT SPECIES MANAGEMENT PLAN

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1. INTRODUCTION

Thaba Stone Quarry mines material from the hard rock quarry in the north-western corner of the mining area, as well as weathered dolerite from the borrow pit in the south-eastern corner (refer to EMPR for mine layout). The aggregate produced at the quarry is mainly sold to the road construction, building, and ready-mix industries.

The Right Holder implements opencast mining method where the topsoil (if any) is stripped and stockpiled separately before the excavation is expanded. Rock breaking is done initially by drilling and blasting using crawler mounted rigs and emulsion type bulk explosives. The broken rock is sorted and loaded onto articulated dump trucks that haul the material to the primary crushing plant, where various products are further conveyed to secondary-, tertiary- and quaternary crushing and screening processes to result in the desired products. The material is stockpiled until transported to clients.

At the borrow pit the gravel and weathered dolerite is removed with earthmoving equipment, loaded onto trucks and transported to the stockpile area from where it is sold to clients. No blasting is needed at the borrow pit.

The study area is situated within the Central Free State Grassland, which is characterised by undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Vachellia karroo* encroachment (Mucina & Rutherford, 2012).

Invader plant species known to occur in the disturbed areas include (but not limited to) the following:

❖ <i>Argemone mexicana</i>	Mexican Poppy	NEM:BA Category 1b
❖ <i>Cirsium vulgare</i>	Scotch Thistle	NEM:BA Category 1b
❖ <i>Datura stramonium</i>	Common Thorn Apple	NEM:BA Category 1b
❖ <i>Nicotiana glauca</i>	Wild Tobacco	NEM:BA Category 1b
❖ <i>Xanthium spinosum</i>	Spiny Cocklebur	NEM:BA Category 1b

2. OBJECTIVE

The objective of an invasive plants control plan is to provide site management with an implementation tool to control problem plant species that is present or may germinated within the mining footprint.

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3. WHAT IS ALIEN INVASIVE PLANT SPECIES?

According to the book, *Problem Plants of South Africa* (Bromilow 2001) a weed is a plant in the wrong place at the wrong time. Problem plants are described as vigorous growers that are easily adaptable and mostly exotic or foreign in origin. Weeds usually are pioneer plants that invade disturbed areas such as stockpile areas, overburden and topsoil stockpiles and firebreaks. Invasive plants are plants that have been imported and has the ability to invade the natural vegetation.

Alien invasive plants and alien invasive infestations have several repercussions, which includes environmental, social and economic. Some of the more obvious issues are:

- ❖ These plants absorb and transpire a large amount of water, which is wasted/removed for use by indigenous plants. This leads to the reduction of water flow in the vicinity of water bodies and alters aquatic ecosystems.
- ❖ When invasive species are in close proximity to watercourses, the plants may alter riverbanks and highly increase the potential for erosion that could in turn impact the integrity of the watercourse and alter flood lines. This has negative consequences on associated ecosystems and all downstream water users.
- ❖ Large stands of alien invasive species result in loss of productive land resulting in associated negative economic and social impacts.
- ❖ Large infestations reduce the availability of land to indigenous species. This has ecological implications when biodiversity is directly impacted, and social implications when natural resources become scares.
- ❖ Alien invasive species increase the dry material ratio of the veldt, thereby directly increasing the veldt fire hazards.

Therefore, the benefits of eradicating and controlling alien invasive species extends to the social-, economic- and environmental aspects of South Africa.

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Invasive species have been characterized as a “catastrophic wildfire in slow motion”. Thousands of invasive plants have infested hundreds of millions of hectares of land and water across the country causing massive disruptions in ecosystem function, reducing biodiversity and degrading ecosystem health. The health and function of forests, mountains, wetlands, and rivers have been affected by alien plant invasion which outcompete indigenous or endemic plant species and drain the water resources.

A species is considered invasive if it meets these two criteria:

- ❖ It is non-native to the ecosystem under consideration; and
- ❖ Its introduction causes or is likely to cause economic or environmental harm or harm to human health.

Appendix 1, of this document highlights, listed alien invasive species common in the Grassland Biome, including those that have been identified at the mining area, that need to be controlled. The list also indicates the control methods to be applied.

4. LEGAL FRAMEWORK

Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983)

South Africa has numerous problematic alien invader species. The Conservation of Agricultural Resources Act, 1983 was promulgated to amongst other things combat the invasion and spread of such species. The Act categorizes weeds into three categories, with varying degrees of action required for each category of weeds.

The Conservation of Agricultural Resources Act, No. 43 of 1983, (CARA) as amended in March 2001, sets out the regulations regarding the control of invasive plants and weeds under Regulations 15 and 16 and provides lists of species declared as invasive plants and indicators of bush encroachment. The Regulations classify the listed alien invasive plants into three categories. The categories can be described as follows:

Category 1: Plants that are alien invasive species and must be eradicated and controlled. These species have little economic or social value and their invasive habits outcompete indigenous species, severely alter ecosystems and threaten local biodiversity.

Section 15A of CARA states that:

1. Category 1 plants may not occur on any land or inland water surface other than in biological control reserves.

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2. A land user shall control any Category 1 plants that occur on any land or inland water surface in contravention of the provisions of sub-regulation (1) by means of the methods prescribed in regulation 15E.
3. No person shall, except in or for purposes of a biological control reserve –
 - a. establish, plant, maintain, multiply or propagate Category 1 plants;
 - b. import or sell propagating material of Category 1 plants or any Category 1 plants;
 - c. Acquire propagating material of Category 1 plants or any Category 1 plants.
4. The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with the requirements of sub-regulation (1) on such conditions as the executive officer may determine in each case.

Category 2: Species that have commercial or utility value and may only be grown in demarcated areas, in a controlled manner and under a permit.

Section 15B of CARA states that:

1. Category 2 plants may not occur on any land or inland water surface other than a demarcated area or a biological control reserve.
 - a. The executive officer may on application in writing demarcate an area as an area where Category 2 plants may occur, be established and be maintained.
 - b. An area in respect of which a water use license for stream flow reduction activities has been issued in terms of section 36 of the National Water Act, 1998 (Act No. 36 of 1998) shall be deemed to be a demarcated area.
2. The executive officer shall demarcate an area for the occurrence, establishment and maintenance of Category 2 plants only if –
 - a. The Category 2 plants in the area are cultivated under controlled circumstances;
 - b. The land user concerned has been authorised to use water in terms of the National Water Act, 1998 (Act No. 36 of 1998);
 - c. The Category 2 plants or products of Category 2 plants in the area are demonstrated to primarily serve a commercial purpose, use as a woodlot, shelter belt, building material, animal fodder, soil stabilisation, medicinal or other beneficial function that the executive officer may approve; and
 - d. All reasonable steps are taken to curtail the spreading of propagating material of the Category 2 plants outside the demarcated areas.
3. When an area is demarcated for the occurrence, establishment and maintenance of Category 2 plants the executive officer may impose such additional conditions as may reasonably be deemed necessary to keep the Category 2 plants in the area in check.

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4. No person shall sell propagating material of Category 2 plants or any Category 2 plants to another person unless such other person is a land user of a demarcated area or of a biological control reserve.
5. No person shall acquire propagating material of Category 2 plants or any Category 2 plants unless such material or such plants are intended for use in a demarcated area or in a biological control reserve.
6. Propagating material of Category 2 plants or Category 2 plants shall only be imported or sold in accordance with the provisions of the Plant Improvement Act, 1976 (Act No. 53 of 1976), the Agricultural Pests Act, 1983 (Act No. 36 of 1983) and the environment conservation regulations.
7. A land user shall control any Category 2 plants that occur on any land or inland water surface in contravention of the provisions of sub-regulation (1) by means of the methods prescribed in regulation 15E.
8. Unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland.
9. The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with one or more of the requirements of sub-regulations (1), (3), (5), (6), (8) and (9) on such conditions as the executive officer may determine in each case.

Category 3: Species that often have ornamental value and may be grown where they currently exist but cannot be planted, propagated or traded.

Section 15C of CARA states that:

1. Category 3 plants shall not occur on any land or inland water surface other than in a biological control reserve.
2. Subject to the provisions of sub-regulation (3), the provisions of sub-regulation (1) shall not apply in respect of Category 3 plants already in existence at the time of the commencement of these regulations.
 - a. No land user shall allow Category 3 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland.

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- b. The executive officer may impose such additional conditions as may reasonably be deemed necessary with regard to Category 3 plants already in existence at the time of the commencement of these regulations.
 - c. A land user must take all reasonable steps to curtail the spreading of propagating material of Category 3 plants.
 - d. The executive officer may, after consultation with the land user, issue a direction in terms of section 7 of the Act that Category 3 plants in existence at the time of the commencement of these regulations must be controlled by means of the measures prescribed in regulation 15F.
3. No person shall, except in or for purposes of a biological control reserve –
 - a. plant, establish, maintain, multiply or propagate Category 3 plants;
 - b. import or sell propagating material of Category 3 plants or any Category 3 plants;
 - c. acquire propagating material of Category 3 plants or any Category 3 plants.
 4. The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with one or more of the requirements of sub-regulations (1), (3) and (4) on such conditions as the executive officer may determine in each case.

The National Department of Agriculture is responsible for administering the CARA act and landowners having alien invasive species on their property may be penalised. Penalties can be in the form of fines or imprisonment. It is therefore important to have an alien invasive management plan in place that aims at primarily eradicating and secondly controlling alien invasive species. It is also important to keep records of all procedures followed and to have photographic records, as many alien invasive species are difficult to completely eradicate

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National Environmental Management: Biodiversity Act, 2004 (Act No 10 of 2004)

The National Environmental Management: Biodiversity Act, 2004 (NEM:BA) provides for the management and conservation of biological diversity and components thereof; the use of indigenous biological resources in a sustainable manner; the fair and equitable sharing of benefits arising from bio-prospecting of biological resources; and cooperative governance in biodiversity management and conservation within the framework of NEMA. The Act also gives effect to international Strategic Review of the Status of Biodiversity Management in the South African Mining Industry agreements relating to biodiversity. The Act states that the Minister of Environmental Affairs and Tourism may identify any process or activity in a listed ecosystem as a threatening process and will, thereafter, be regarded as an activity contemplated in Section 24(2)(b) of NEMA which states that:

- a. Specified activities may not be commenced without prior authorization from the Minister or MEC and specify such activities. This Act allows for any person, organization or organ of state to contribute to biodiversity management. Such a party may submit to the Minister a draft management plan for an ecosystem or species. Should the Minister approve the management plan, an agreement can be entered into regarding the implementation of the plan.
- b. The NEM:BA established the South African National Biodiversity Institute (SANBI) and gave it a mandate regarding monitoring, advising and co-coordinating biodiversity issues in South Africa.

The Alien and Invader Species (AIS) regulations was subsequently published in terms of section 97(1) of NEM:BA in August 2014 and amended in July 2016. The AIS regulations, 2014 grouped plants into four categories and prescribes the subsequent management of each category.

Category 1a: Invasive plant species requiring compulsory control. These plants must be removed and destroyed and any species falling within this category is by law required to be eradicated from the environment. No permits should be sought or given to keep or propagate plant species falling within this category. Any form of trade or planting is strictly prohibited.

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Category 1b: Invasive plants requiring compulsory control as part of alien invasive plant species control programme. These plants are considered to have high invasive potential, thus require removal and eradication. Plants falling within this category qualify for governmental sponsored alien invasive plants control and management programmes. Furthermore, no permits will be issued to keep or sell plant falling within this category.

Category 2: The plants falling within this category are alien invasive plants regulated by area or locality. These alien invasive plant species requires a demarcation permit in order to import, grow, breed, sell, buy or accept as gifts. However, no permit will be issued for invasive plant species within this category existing in riparian areas or zones.

Category 3: These alien invasive plant species are regulated by activity, thus an individual plant permit is required to import, grow, breed, possess, sell, buy, or move these plants. No permit is issued for Category 3 alien invasive plant species existing in riparian areas.

In order to identify invasive plants in need of controlled/eradication from site, the plants specified in these groups must be used as a guideline.

5. ROLES AND RESPONSIBILITIES

Thaba Stone (Pty) Ltd is the responsible mining right holder accountable for the effective implementation of this plan. The alien invasive management plan is legally binding and must be implemented to fulfil the requirements of relevant legislations and recommendation.

6. CONTROL OF ALIEN INVASIVE AND PROBLEM PLANT SPECIES

Alien plant invasions cause a decline in species diversity, local extinction of indigenous species and ecological imbalance. Thus, preventing the onset of an alien invasion, management of further spreading is required as problem plants outcompete indigenous plant species and quickly establish themselves in an area. In light of this, a national strategy was compiled identifying four primary programs to address the management of alien invasive plant species as listed below:

1. Prevention: Keep the invasive species out;
2. Early detection and rapid response: Detect and eradicate invasive species to stop them from spreading;
3. Control and management: Eliminate or control the problem of invasive species; and

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4. Rehabilitation and restoration: Heal, minimize, or reverse the harmful effects from invasive species.

The occurrence of alien invasive plants not only affect the growth and distribution of natural endemic plants, they also use more water than indigenous plants, some have toxic fruits or leaves which when consumed could lead to fatalities. Therefore, alien invasive plant species need to be controlled or removed and the following section contains different methods that can be used.

The aim of an alien invasive management plan is to completely eradicate problem species from site. This is often very difficult as many of the species have seeds that remain viable for a very long time and even after physical removal of plants, the seeds germinate to form new infestations. An alien invasive management plan must therefore be an ongoing practice over many years and should follow the following phases:

1. The initial bulk eradication of alien invasive species by chemical or mechanical means, and in some instances biological control agents. This may also require rehabilitation if large stands of alien invasive species are removed. Local, indigenous species should be planted in the disturbed areas;
2. There should also be immediate follow up and all seedlings should be pulled out and removed. This should be done regularly, although the timeframes will vary from species to species depending on their growth forms and rates; and
3. Finally, monitoring of areas that appear to be under controlled must continue on at least an annual basis. Rehabilitated areas should also be monitored and action taken immediately if regeneration of problem plants occur.

Various options are available for the control of alien invasive species, including mechanical, chemical and biological control. In most instances, mechanical means are utilised and include physical removal of plants. Research on use of herbicides has been conducted on many species and can be applied in conjunction with mechanical methods. For some species, herbicides have not yet been fully researched and/or herbicides have not been registered and these need to be mechanically controlled. The Department of Water and Sanitation's Working for Water section provides guidelines to the preferred clearing methods for most problem plants. This information can be obtained from their website: <http://www.dwaf.gov.za/wfw/Control/>. The selection of appropriate methods of control shall be based on the species to be controlled, the size of the plants, the density of the stand, the accessibility of terrain and environmental safety.

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Biological control of alien invasive species is an ongoing process with some biological control agents having been released on various alien invasive species showing varying degrees of success. Biological control options need to be carried out with specialist advice from academic or research institutes involved in research of alien invasive species.

Control options must take into account the species being controlled, as well as the ecosystem in which the control options are being applied. For instance, some of the herbicides registered for control of alien invasive species may not be used in riparian areas, while some should preferably be used in areas where natural grass cover occurs. Some herbicides should only be utilised after consultation with a Working for Water technical advisor.

The control options are discussed below as individual actions, but in many cases integrated measures (more than one (1) control measure) are taken for more effective control of alien invasive species.

The Department of Water and Sanitation proposes that the following methods of control for age or size target plants:

❖ Seedlings

Hand pulling or hoeing:

- Hand pulling/hoeing should be carried out in sparse stands.
- Seedlings should be severed below the soil surface or removed from the soil. Soil disturbance should be minimized to reduce re-germination.

Herbicides:

- Herbicides can be used on dense stands.

❖ Saplings

Hand pulling or hoeing:

- Where appropriate saplings can be removed manually as described above.

Herbicides:

- Foliar sprays can be carried out depending on the density of the stand. Fan nozzles should be fitted for overall spraying and solid cone nozzles for individual plant treatment. Spraying should be restricted to plants waist high or lower. Ensure there is sufficient foliage to carry the herbicide to the root system.
- Basal stem treatments of suitable herbicides in diesel can be carried out to the bottom 250 mm of the stem. Applications should be by means of a low pressure, coarse droplet spray from a narrow angle solid cone nozzle.

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- Cut stump treatments can be used where stems are cut as low as practical. Herbicides are applied in diesel or water as recommended for the herbicide. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.
 - The application of herbicides should only be sprayed/used on site by a registered pest control officer.
- ❖ Mature Trees (trees above shoulder height or robust bushes 12 – 1 months or older)
- Ring Barking:
- Bark must be removed from the bottom of the stem to a height of 0.75 – 1.0 m. 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 treatment should be carried out.
- Frilling or partial frilling:
- Cuts should be made through the bark into the sapwood by means of a light axe and a suitable herbicide must be applied into the cuts.
- Basal stem treatments:
- Suitable herbicides should be applied in diesel to the base of the stem and to any exposed roots. Stems with a diameter up to 50 mm should be treated to a height of 250 mm and stems above 50 mm diameter to a height of 500 mm. This method is only suitable for stems up to 100 mm in diameter.
- Cut stump treatment:
- Stumps should be cut as low as practical and the herbicide applied. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.

When herbicides are chosen as the preferred control method the guidelines of Working for Water (DWS) as stipulated in the Policy on the Use of Herbicides for the Control of Alien Vegetation must be followed:

- ❖ Herbicides selected for control shall be registered for use on that species under the conditions specified.
- ❖ Protection of the environment is of prime importance. Riparian areas must be protected and only herbicides that are approved may be used. Washing of equipment or disposal of waste spray mixture is prohibited in or near water courses where contamination of water can occur.

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- ❖ Empty herbicide containers must be disposed of as hazardous waste and may not be used for any other purpose.
- ❖ Equipment must be washed where there is no danger of contamination of a water source or natural vegetated area. It is proposed that washing be restricted to the wash bay.
- ❖ Product and spray mixtures should be stored so that it is inaccessible to the public. Site management must ensure that the Safety Data Sheet of the product is available on site.
- ❖ The application of herbicides should only be sprayed/used on site by a registered pest control officer.

7. HANDLING AND DISPOSAL OF PLANT DEBRIS OR MATERIAL

The unwanted plant material from mechanical or chemical clearing should not be kept on site as it attributes to the fire risk by providing fuel. Therefore, the following handling and disposal method could be utilized as some of the debris can offer services and some can be completely disposed of:

7.1 Stacking

- ❖ Stacking the cut material in heaps, or in windrows along slope contours to reduce erosion, facilitates easy access for follow-up. It also assists in containing the resulting fuel load and therefore the risk of uncontrolled fire;
- ❖ Keep stacks well apart to prevent fires from crossing easily; not less than five meters apart, this is naturally dependant on the size of the stack and the resulting fire intensity when they burn. Stockpile removed material into piles of 2 m high, 3 m wide windrows/stacks;
- ❖ Stack light branches separately from heavy timber (75 mm and more). Preferably remove heavy branches to reduce long burning fuel loads that can result in soil damage from intensely hot fire; and
- ❖ Do not make stacks under trees, power and telephone lines, within 30 meters of a fire belt or near watercourses, houses and other infrastructure.

7.2 Disposal

- ❖ Plant material should be used beneficially wherever possible, as opposed to disposing it at a landfill site where it takes up valuable airspace;

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- ❖ Woody and dry material, provided no seeds are present, can be chipped and used as mulch or made available to the local community for firewood;
- ❖ Wet material and aquatic weeds should be combined with other organic matter and composted. Alternatively, it may be possible to use it for basket making, animal feed or other uses.
- ❖ Material which cannot be used beneficially must be disposed of at a registered and approved disposal site.
- ❖ When removing material, take care to remove all debris, including shoots and seeds.

8. CONTROL PHASES

Alien invasive plant species removal should ideally adopt a hands on approach. The combination of two or all three control methods could prove more effective than using one control method in combating the problematic plant species. Therefore, it is advisable that landowners/operators should:

- ❖ not allow conditions to develop on their land that will contribute to the spread of a wildfire;
- ❖ remove invasive alien plants that create large fuel loads or cause fires to burn intensely; and
- ❖ take steps to fireproof their property and possessions. These apply especially to those living on the edge of open areas or in close proximity to fire prone areas.

Furthermore, any control programme for alien vegetation must include the following three phases;

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

The initial control in most cases, involves mechanical methods and in the case of heavy infestation, machinery could be used. The initial control is a drastic measure to reduce the number of adult and large invasive plants.

The follow-up control serves are measures to reduce the ability of the mechanically removed plant species for coppice or having the infestation proliferate such as to negate the efforts of initial control. Therefore, follow up control of alien seedlings and coppice re-growth is essential to achieve and sustain the progress made with initial control work.

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Maintenance control entails regular monitoring to prevent the occurrence of re-colonisation or re-infestation. The monitoring should take place timeously so to prevent infestation of the cleared area by another alien invasive plant species.

9. ALIEN INVASIVE PLANT ERADICATION TOOL

Working for Water provides the site manager with an implementation tool to control problem species and keep the site free of invasive plants:

Step 1: Conduct Site Assessment;

- ❖ Identify areas where alien invasive species need to be eradicated and controlled. Take pictures of these sites so as to have a pre-control photographic reference of the site. In this way comparisons can be made at later stages to see if control measures are adequate.

Step 2: Set objectives based on resources available and priorities:

- ❖ Prioritize management of plants according to the categories stipulated in the AIS regulations.
- ❖ Consider control options that will be applied in these areas. Consider integrated approaches and ensure approaches are not conflicting with each other. Also consider safety aspects such as trees on a slope which should not be felled but treated *in situ*.

Step 3: Develop and implement an action plan to achieve objectives:

- ❖ The plan must be long term and should include a clearing plan that includes follow up actions for rehabilitation of the cleared area.
- ❖ The site plan should include a map showing the areas invested with problem plants.
- ❖ Lighter invested areas should be cleared first to prevent the build-up of seed banks, while the control plan works progressively towards the areas with denser stands.
- ❖ Educate workers on the species that needs to be eradicated, as well as the specific method to be used.
- ❖ Conduct control of invasive plant species.
- ❖ Remove plant remains to a suitable disposal area.
- ❖ Prevent dispersal of seeds.

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- ❖ Strive for collective management and planning with neighbours to prevent seed dispersal of problem plants across boundaries.
- ❖ When removing alien invasive species from infested areas, always work from lower infested areas towards more infested areas and from higher-lying areas to lower areas;
- ❖ Try to remove alien invasive species when they are not seeding. If seeding, then seed heads should first be carefully removed and disposed of in a sealed bag so as not to spread the seeds;
- ❖ If soils are disturbed during the process, then these should be carefully levelled, slightly pressed down and covered with leaf litter or cut vegetation that is seed-free. Some alien invasive species release chemicals that suppress growth of other plants and these should not be utilised as leaf litter under any circumstances. The soil can also be re-seeded with indigenous vegetation;
- ❖ To reduce the risk of spread via seeds, flowers should be removed from the plants prior to seeding. To prevent further infestations, remove seeds, fruits, bulbs, corms, tubers and any other vegetative parts that may root from the site in sealed bags and dispose of safely. In some instances, these parts should be burnt on site immediately;
- ❖ Consider herbicide practices to integrate with physical removal where possible, with use of generic herbicides on alien invasive species without registered herbicides;
- ❖ Consider the uses of plants that will be removed. Options such as its potential for compost heaps (as long as it is seed free), potential as leaf litter (as long as it is seed free) and possible options for timber and cork markets. As stated earlier, some alien invasive species release chemicals that suppress growth of other plants and these should not be utilised as leaf litter under any circumstances.

Step 4: Monitor performance and change actions if necessary

- ❖ Conduct monthly inspections to enable early detection of grow back.
- ❖ Regularly follow up on areas where infestations were treated and re-apply control measures if necessary. Once again, take photographs of sites regularly and keep records of actions that were taken so that evidence is in place with regard to control measures that were successful and those that were not.

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- ❖ Consider rehabilitation of area cleared of invasive species at every stage of the control programme and consider the need to re-introduce local indigenous species to help the natural ecology stabilise within the areas.
- ❖ Consider training of employees. Courses range from introductory and awareness courses to those that qualify individuals as alien invasive control officers.

10. SITE SPECIFIC CONDITIONS

As mentioned earlier, several weeds/invader plant species were identified in the study area. The problem plants are mainly associated with the borrow pit and historic excavations but are also prominent in and around the hard rock quarry pit and stockpiles.

To prevent the dispersal of the invasive plant species to the non-infected sections of the mining area, site management must implement a vigilant invasive plant management programme and remove any invasive plants that may germinate within the mining footprint prior to and after the stripping of topsoil. A combination of the control methods, as prescribed in this plan, must be implemented throughout all the phases of the project.

The entire mining footprint area, in particular the topsoil heaps, must be monitored monthly, for the duration of the operational phase as well as the first 12 months after rehabilitation of the area, to ensure the early detection and control/management of invasive plant species germinating as a result of vegetation removal and soil disturbance.

As everyone isn't familiar with the identification of plant species, photographs of the most important species to be controlled on site were included below for ease of reference.



Mexican Prickly Poppy

Argemone mexicana



Spear Thistle

Cirsium vulgare





Thornapple

Datura stramonium



Wild Tobacco

Nicotiana glauca





Large Cocklebur

Xanthium strumarium



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11. REFERENCES

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APPENDIX 1

PROPOSED MANAGEMENT/CONTROL METHODS FOR THE MOST COMMON ALIEN INVADER PLANT SPECIES

INVASIVE PLANT SPECIES MANAGEMENT PLAN



NB: THE PROPOSED CONTROL METHODS ARE ONLY RECOMMENDATIONS BASED ON INFORMATION AVAILABLE TO THE ENVIRONMENTAL CONSULTANT AT THE TIME. THE ENVIRONMENTAL CONSULTANTS EMPLOYED AT GREENMINED ENVIRONMENTAL ARE NOT REGISTERED PEST CONTROL OPERATORS (PCO) AND IN THE CIRCUMSTANCES THE SITE SHOULD ENSURE THAT THE EXPERT ADVICE AND OPINION OF A REGISTERED PCO IS SOUGHT PRIOR TO THE COMMENCEMENT AND IMPLEMENTATION OF CONTROL METHODS PERTAINING TO INVASIVE SPECIES.

Argemone ochroleuca (White flowered Mexican poppy)



Category:	1b – Declared weed. Destroy.
Form:	Herb
General Description:	A very spiny annual herb growing up to 90cm high with stems that exude a yellow sap when cut. Grey or bluish-green spiny leaves with prominent white veins. Pale yellow or creamy white flowers appear from September to January. Spiny, oblong green fruit capsules turn .
Control Measures:	<p><u>Biological control:</u> Various insect agents are being tested.</p> <p><u>Chemical:</u> Herbicides containing picloram are affective against seedlings.</p> <p><u>Mechanical:</u> Physical removal of plants prior to seeding. Removal of seed heads prior to seeding. Light tillage can destroy seedlings.</p>
Monitoring Measures:	<p>Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation.</p> <p>Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth.</p> <p>With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.</p>
Replacement Species:	Indigenous grasses or herbs

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Argemone mexicana L. (Yellow flowered Mexican Poppy)



Category:	1b
Form:	Herb
General Description:	A very spiny annual herb growing up to 90cm high with stems that exude a yellow sap when cut. Grey or bluish-green spiny leaves with prominent white veins. Pale yellow or creamy white flowers appear from September to January. Spiny, oblong green fruit capsules turn .
Control Measures:	<p><u>Mechanical eradication</u></p> <ul style="list-style-type: none"> ✦ Pull out during seedlings stage (before seed ripens) ✦ Disposal of eradicated plants: <ul style="list-style-type: none"> ◆ Dispose with general waste, ◆ Use in areas prone to erosions, ✦ If seeds have ripened, pull out plants while making sure seeds do not fall out. ✦ Place plants in a black plastic bag and dispose of at an incineration facility to be destroyed. ✦ File proof of delivery to the facility. ✦ Alternatively, the removed plants can be buried in a trench of at least 1m deep. Grow-back will need to be controlled in this area, preferably with herbicides. <p><u>Herbicides</u></p> <p>Apply as specified by supplier Foliar Spray: Access 240 SL <i>These plants are annual and die once seeds have ripened. Still it is very important to remove the dead plants as leaving them will result in vigorous grow-back the following season.</i></p>
Monitoring Measures:	<p>Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation.</p> <p>Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth.</p> <p>With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.</p>
Replacement Species:	Indigenous grasses or herbs

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Cestrum laevigatum (Inkberry)



Category:	CARA Category 1; NEMBA Category 1b
Form:	Herb
General Description:	<p>Inkberry is an evergreen shrub or tree growing 1-2m high, but reaching 15m or more along the coastal regions. This poisonous plant has lance-shaped leaves and greenish-yellow, tube-shaped flowers, which appear from October to May.</p> <p>Evergreen shrub or tree growing 1-2m high, but reaching 15m or more along the coast. Leaves: Lance-shaped, 150mm long and 50mm wide; releases an unpleasant smell when crushed. Flowers: Greenish-yellow in axillary clusters. Each flower is tube-shaped with five small petals and appear during summer from October to May. Fruit/seeds: Green 10mm long berries which turn purple-black.</p>
Control Measures:	<p><u>Chemical:</u> Herbicides containing picloram are affective against seedlings.</p> <p><u>Mechanical:</u> Physical removal of plants prior to seeding. Removal of seed heads prior to seeding.</p>
Monitoring Measures:	<p>Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation.</p> <p>Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth.</p> <p>With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species of the genera below.</p>
Replacement Species:	Hazel pomaderris (<i>Pomaderris aspera</i>), <i>Escalonia</i> , <i>Azalea</i> .

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Cirsium vulgare (Spear/Scotch thistle)



Category:	1b – Declared weed. Destroy.
Form:	Herb
General Description:	<p>Spiny, herbaceous biennial which forms a large, flat rosette of leaves and a deep tap root in the first year and numerous branched stems up to 1,5m high in the second year. Stems have spiny wings. Dark green leaves with stiff hairs above and white woolly beneath. Pink to mauve thistle-like flowers surrounded by spiny bracts appear from September to April. This plant invades grassland, roadsides, vlei and dam margins and river banks in cool, high rainfall areas</p> <p>General description: Branching, erect biennial growing up to 1,5m tall. Leaves: Leaves are deeply lobed and hairy - there are coarse hairs on the leaf tops and woolly hairs on the underside. Flowers: Flower heads are 'gumdrop' shaped and spines extend all around the base of the flower heads. Flowering occurs from September to April. Fruit/Seeds: Grey with longitudinal darker markings, smooth</p>
Control Measures:	<p><u>Chemical:</u> Herbicides containing picloram are affective against seedlings.</p> <p><u>Mechanical:</u> Physical removal of plants prior to seeding. Removal of seed heads prior to seeding.</p>
Monitoring Measures:	<p>Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation.</p> <p>Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth.</p> <p>With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species of the genera below.</p>
Replacement Species:	<p><i>Ceratotherca triloba</i> <i>Vernonia sp.</i></p>

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Cylindropuntia imbricata (Imbricate cactus)



Category:	1b
Form:	Succulent, branched shrub.
Control Measures:	<u>Mechanical:</u> Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic evidence should be kept, and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly to cut back any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses and/or indigenous species mentioned below.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Indigenous, local grasses.

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Datura ferox (Large thorn apple)



Category:	1b – Declared weed. Destroy.
Form:	Herbaceous shrub
General Description:	General description: An erect, sub-herbaceous annual growing up to 1,5m high. The stem is sparsely hairy and pale green in colour. Leaves: Relatively large leaves up to 200mm long with an irregular strongly toothed margin, dark green upper surface and paler underneath the surface of the leaves. Flowers: Funnel-shaped white flowers up to 65mm long appear during summer from October-March. Fruit/Seeds: Produces brown fruit capsules covered with hard spines and numerous tiny black seeds.
Control Measures:	<u>Mechanical:</u> Physical removal of the plants, including the underground parts. This should be done when not seeding. If seeding then the seed heads should be carefully removed and burnt. <u>Chemical:</u> <i>Datura ferox</i> is susceptible to glyphosate herbicides.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly to cut back any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses and/or indigenous species mentioned below.
Replacement Species:	Indigenous, local grasses.

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Datura stramonium (Common thorn apple)



Category:	1b – Declared weed. Destroy.
Form:	Herbaceous shrub
General Description:	General description: Sparsely hairy, green, brown or purple, erect annual herb growing up to 1,5m in height. Leaves: Dark green or purple and paler underneath with the margins coarsely and irregularly toothed or lobed, bad-smelling. Flowers: White, mauve or purplish, narrowly funnel-shaped flowers. Fruit/Seeds: Brown, hardened capsules covered with slender spines.
Control Measures:	<p><u>Mechanical:</u> Physical hand-pulling removal of the plants. This should be done when not seeding. If seeding then the seed heads should be carefully removed and burnt. Tillage will work to some extent with seedlings.</p> <p><u>Chemical:</u> <i>Datura stramonium</i> is susceptible to a range of soil and foliar herbicides available for agricultural markets.</p>
Monitoring Measures:	<p>Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation.</p> <p>Sites will need to be revisited monthly to cut back any re-growth.</p> <p>With the removal of plants soils may become exposed and should be re-vegetated with grasses and/or indigenous species mentioned below.</p>
Replacement Species:	Indigenous, local grasses.

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Eucalyptus camaldulensis (River red gum)



Category:	1b – in riparian areas
Form:	Tree
Control Measures:	<p><u>Mechanical & Chemical</u></p> <p>Seedlings: Hand pull</p> <p>Coppice/woody growth: Foliar sprays of Brush Off at 200 g/ha and Mamba 360 SL at 3 l/ha.</p> <p>Felled trees: Cut stumps apply Chopper (1250 ml/10 l water) at 6 l/ha.</p>
Monitoring Measures:	<p>Photographic records should be kept of infested areas and should be taken at each visit.</p> <p>Re-growth should be monitored 2 and 4 months after chemical application and treated as required.</p> <p>Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.</p>
Replacement Species:	Indigenous, local grass species in low infestation. Specialists input may be required in heavily infested areas.

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Nicotiana glauca (Wild tobacco)



Category:	1b
General Description:	Closely related to commercial tobacco, it becomes a large, woody shrub. The seed capsules contain hundreds of tiny seeds, which are easily transported by water.
Form:	Woody shrub
Control Measures:	<p><u>Mechanical eradication</u></p> <ul style="list-style-type: none"> ✳ Pull out during seedlings stage (before seed ripens) ✳ Disposal of eradicated plants: <ul style="list-style-type: none"> ◆ Dispose with general waste, ◆ Use in areas prone to erosions, ✳ Place plants in a black plastic bag and dispose of at an incineration facility to be destroyed. ✳ File proof of delivery to the facility. ✳ Alternatively, the removed plants can be buried in a trench of at least 1m deep. Grow-back will need to be controlled in this area, preferably with herbicides. <p><u>Herbicides</u></p> <p>Apply as specified by supplier</p> <p>Foliar Spray: Access 240 SL, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)</p>
Monitoring Measures:	<p>Photographic records should be kept of infested areas and should be taken at each visit.</p> <p>Re-growth should be monitored 2 and 4 months after chemical application and treated as required.</p> <p>Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.</p>
Replacement Species:	<p><i>Themeda triandra</i></p> <p><i>Melinis repens</i></p>

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Opuntia ficus indica (Sweet Prickly Pear) & *Opuntia humifusa* (Large-flowered prickly pear)



Category:	1b
General Description:	Succulent, branched shrub or tree up to 3m high which forms a sturdy trunk with age. Leaves: Minute leaves. Flowers: Bright yellow or orange showy flowers appearing from October to December. Fruit/seeds: Yellowish turning reddish edible fruit covered with minute spines.
Form:	Succulent
Control Measures:	<u>Mechanical:</u> Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	<i>Euphorbia</i> spp. and <i>Aloe</i> spp

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Pennisetum clandestinum (Kikuyu grass)



Category:	a. 1b in protected areas and wetlands in which it does not already occur b. Not listed elsewhere
Form:	Grass
Control Measures:	<u>Chemical:</u> Taskforce at 0.56 and 0.75 kg/ha for mature grass <u>Mechanical:</u> Physical removal of the plants, including the underground parts. This should be done when not seeding. If seeding, then the seed heads should be carefully removed and burnt.
Monitoring Measures:	Photographic records should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited, monthly to cut back and re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species, mentioned below.
Replacement Species:	<i>Themeda triandra</i> <i>Melinis repens</i>

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Pennisetum setaceum (Fountain grass)



Category:	a. 1b b. Sterile cultivars or hybrids are not listed
Form:	Grass
Control Measures:	<u>Chemical:</u> The species can be controlled by the usual industrial herbicides used on road sides such as Roundup <u>Mechanical:</u> Physical removal of the plants, including the underground parts. This should be done when not seeding. If seeding, then the seed heads should be carefully removed and burnt.
Monitoring Measures:	Photographic records should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited, monthly to cut back and re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species, mentioned below.
Replacement Species:	<i>Themeda triandra</i> <i>Melinis repens</i> <i>Eragrostis curvula</i>

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Ricinus communis (Castor-oil plant)



Category:	2
General Description:	A very distinctive plant with green, spreading star-shaped leaves and tall, spiky fruit capsules. Leaves: Shiny, star-shaped dark green or reddish leaves that are paler below with serrated margins. Flowers: Upper flowers are reddish and lower flowers cream. Fruit/seeds: Green, brown or reddish, three-lobed capsules covered with soft spines protruding from the top of the plant.
Form:	Shrub
Control Measures:	<u>Mechanical:</u> Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Robinia pseudoacacia (Black locust)



Category:	1b
General Description:	A deciduous tree reaching up to 25m high, but often smaller with dark brown and deeply furrowed bark. Leaves: Small, bright green leaves above and paler beneath which become yellow in autumn and rounded at the tips. Flowers: White, fragrant flowers in drooping clusters appear from September to November. Fruit/seeds: Reddish-brown pods.
Form:	Tree
Control Measures:	<p><u>Biological control:</u></p> <p>Acacia seed weevils</p> <p><u>Mechanical and Chemical:</u></p> <p>Seedlings & Saplings: Hand pull or hoe.</p> <p>Foliar sprays of Mamba 360 SL (150 ml/10l water) for saplings up to 1 m at 3 l/ha; Garlon 480 EC or Viroaxe (25-75 ml/10l water) for saplings up to 1.5 m at 0.5 to 1.5 l/ha; or Touchdown Forte for saplings up to 2 m at 3 l/ha.</p> <p>Young trees: Foliar sprays with Garlon 480 EC or Viroaxe (75 ml/10l water) at 3 l/ha.</p> <p>For mature plants: Cut or frill and apply Timbrel 360 SL (300 ml/10l water) at 1.5 l/ha to freshly cut areas.</p> <p>Cut and apply mycoherbicide (Stumpout[®]) to freshly cut stumps.</p> <p>Use triclopyr butoxyethyl ester (Garlon 480 EC or Viroaxe) in areas where grasses occur.</p>
Monitoring Measures:	<p>Photographic records should be kept of infested areas and should be taken at each visit.</p> <p>Re-growth should be monitored 2 and 4 months after chemical application and treated as required.</p> <p>Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.</p>
Replacement Species:	Ankle thorn (<i>Acacia robusta</i>), hook thorn (<i>Acacia caffra</i>), weeping wattle (<i>Peltophorum africanum</i>)

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Sesbania punicea (Red sesbania)



Category:	1b
General Description:	A deciduous shrub or small tree growing up to 4m in height and has numerous slender branches. Leaves: Dark green, drooping, 100-200mm long, paired leaflets. Flowers: Red or orange flowers appear in dense sprays up to 25cm long from September to March. Fruit/seeds: Distinctive four-winged oblong brown pods 60-80mm long.
Form:	Tree/Shrub
Control Measures:	<p><u>Mechanical eradication</u></p> <ul style="list-style-type: none"> ✳ Pull out during seedlings stage (before seed ripens) ✳ Disposal of eradicated plants: <ul style="list-style-type: none"> ◆ Dispose with general waste, ◆ Use in areas prone to erosions, ◆ Dispose of plant material into quarry pit. ✳ If seeds have ripened, pull out plants while making sure seeds do not fall out. ✳ Place plants in a black plastic bag and dispose of at an incineration facility to be destroyed. ✳ File proof of delivery to the facility. ✳ Alternatively, the removed plants can be buried in a trench of at least 1m deep. Grow-back will need to be controlled in this area, preferably with herbicides. <p><u>Herbicides</u></p> <p>Apply as specified by supplier</p> <p>Foliar Spray (Seedlings <1m): Roundup 360 SL, Roundup Max 680 WG, Glyph 360 SL, Mamba 360 SL, Mamba Max 480 SL, Springbok 360</p> <p>Foliar Spray (Seedlings 1 – 2 m): Roundup Max 680 WG, Glyph 360 SL, Mamba 360 SL, Roundup 360 SL; Garlon 4 EC</p> <p>Foliar Spray (Adult): Roundup Max 680 WG, Chopper 100 SL, Hatchet 100 SL</p>
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Ankle thorn (<i>Acacia robusta</i>), hook thorn (<i>Acacia caffra</i>), weeping wattle (<i>Peltophorum africanum</i>)

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Tamarix ramosissima (Pink tamarisk)



Category:	1b
General Description:	Evergreen shrub or tree 3-6m high with reddish-brown bark and feathery branches. Deep green, greyish or bluish-green leaves are minute and scale-like. Flowers are pale to purplish-pink in clusters 15-70mm long at the end of thin, long twigs. Fruits are papery capsules 3-4mm long. General description: Evergreen tree growing up to 6m with reddish-brown bark. Leaves: Deep green, greyish or bluish-green leaves are minute and scale-like. Flowers: Flowers are pale to purplish-pink in clusters 15-70mm long. Fruit/seeds: Fruits are papery capsules 3-4mm long.
Form:	Tree/Shrub
Control Measures:	Being deep germinators, these weeds are not adequately controlled by many pre-emergence herbicides. In annual crops, it is best to delay treatment as long as possible in order to catch late germinating individuals. Eradicate before the plants form flowers and seed.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	<i>Tamarix usneoides</i>

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Xanthium strumarium (Large cocklebur)



Category:	1b – Declared weed. Destroy.
Form:	Herbaceous shrub
Control Measures:	<p><u>Mechanical:</u> Hand pull. Remove underground parts preferably when not seeding. Remove seed heads carefully and dispose of.</p> <p><u>Chemical:</u> Susceptible to a range of soil and foliar herbicides available for agricultural markets.</p>
Monitoring Measures:	<p>Photographic records should be kept of infested areas and should be taken at each visit.</p> <p>Re-growth should be monitored 2 and 4 months after treatment.</p> <p>Heavily infested areas should be revisited and treated if and as necessary every 6 months.</p>
Replacement Species:	Indigenous, local grass species.

INVASIVE PLANT SPECIES MANAGEMENT PLAN



Xanthium spinosum (Spiny Cocklebur)



Category:	1b – Declared weed. Destroy.
Form:	Herbaceous shrub
Control Measures:	<u>Mechanical:</u> Hand pull. Remove underground parts preferably when not seeding. Remove seed heads carefully and dispose of. <u>Chemical:</u> Susceptible to a range of soil and foliar herbicides available for agricultural markets.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after treatment. Heavily infested areas should be revisited and treated if and as necessary every 6 months.
Replacement Species:	Indigenous, local grass species.