

ADVISORY NOTE



WEED MANAGEMENT ON MINE SITES

This advisory note outlines the steps required to effectively manage weeds on mine sites.

Introduction

Environments affected by mining are highly susceptible to invasion by weeds, as disturbances to soils caused by mining operations (creating bare ground) provide an ideal habitat where weeds can readily colonise and quickly become the dominant vegetation, often becoming a monoculture. If not controlled appropriately and/or rapidly, weed infestations on a mine site can have an increased risk of spreading to adjacent areas that may be free of weeds or have lower densities and/or less weed species.

Additionally, ecological function and aesthetic, biodiversity and Indigenous cultural values may be adversely impacted upon by weed invasion, for example providing protection for feral animals within dense weed infestations (NRETAS 2007). This can also lead to further land degradation.

Weeds pose a key risk on mine sites, not only during operational phases of mining but also during 'Rehabilitation' or 'Care and Maintenance' phases. Weed infestations can compete directly (as well as indirectly) with native or selected revegetation species and also increase the risk of fires (and fire intensity) that may damage revegetated areas.

Environmental weeds can be defined as 'those plants that adversely affect the integrity, conservation value or biodiversity of natural ecosystems' (ANZCC & ARMCANZ 1997).

Weeds have the potential to substantially change the dynamics of natural ecosystems by:

- competing with or displacing native plant species;
- affecting natural processes such as fire intensity, stream flows and water quality;
- changing habitats and therefore impacting on ecosystem health; and
- diminishing natural aesthetic values (NRETAS 2007: Smith 2002).

Mine operators have both a legislative requirement and an environmental responsibility to effectively manage weeds on their lease(s), especially declared species.

The objectives of this Advisory Note are to provide mine operators with information on their obligations from a legislative perspective and present best-practice approaches to the management and thus control of weeds on their lease(s). It is recommended that mine operators develop their weed management program in consultation with The NT Weed Advisory Committee, the Department of Natural Resources, Environment, Arts and Sports (NRETAS) Weed Management Branch, their Regional Fire Control Officer (NT Bushfires Council) and utilise information on the following website:

<http://www.nt.gov.au/nreta/natres/weeds/index.html>

Legislation

The primary legislation relating to weed management on any land in the NT (including mine sites) is the *Northern Territory of Australia Weeds Management Act 2001*. The Act applies to all owners, managers and occupiers of land, and all other land users in the NT. Some key requirements under Section 9 (within Part 3-Management of Weeds) of the Act include:

- (1) *The owner and occupier of land must –*
 - (a) *take all reasonable measures to prevent the land being infested with a declared weed;*
 - (b) *take all reasonable measures to prevent a declared weed or potential weed on the land spreading to other land; and*
 - (c) *within 14 days after first becoming aware of a declared weed that has not previously been, or known to have been, present on the land, notify an officer of the presence of the declared weed.*
- (2) *The owner and occupier of land on which a declared weed or potential weed is present must comply with a weed management plan relating to the weed.*
- (3) *The owner and occupier of land on which a potential weed is present must dispose of the weed only on the land or at a designated weed disposal area.*
- (4) *A person must not, except in accordance with a permit –*
 - (a) *bring a declared weed or take part in, or be responsible for, bringing a declared weed into the Territory;*
 - (b) *propagate or scatter a declared weed;*
 - (c) *sell or offer to sell a declared weed or any thing that contains or carries a declared weed;*
 - (d) *hire any equipment, device or thing that contains or carries a declared weed or potential weed;*
 - (e) *purchase or offer to purchase a declared weed or any thing that contains or carries a declared weed;*
 - (f) *store, grow or use a declared weed or any thing that contains or carries a declared weed; or*
 - (g) *transport or carry on his or her person a declared weed or anything that contains or carries a declared weed.*

If a weed species is declared in accordance with Section 7 of the *Weeds Management Act*, the mining operator is required to comply with the following declaration classification (NRETAS 2001).

Under the *NT Weeds Management Act*, weeds in the NT are divided into the following classes:

Class A: To be eradicated

Class B: Growth and spread to be controlled

Class C: Introduction into the Territory is to be prevented (NRETAS 2001).

Details of which weed species belong to which classes and other information regarding the Weed Management Act can be sourced from the following website:

<http://www.nt.gov.au/nreta/natres/weeds/legislation/declared.html>

General principles of weed management

Weed management implies careful use of various control methods with the aim of decreasing the harm caused by weeds on the environment and industry to a level that is economically acceptable. Where possible, an integrated approach should be implemented using the various control methods available. These are as follows:

- **Physical Removal** (including the use of machinery i.e. slashing, mowing, aerial spraying and hand pulling).
- **Land Management Techniques** (i.e. burning, cattle grazing, quarantine and hygiene control and control of feral animals).
- **Biological Control** (Biocontrol).
- **Chemical Control** (i.e. use of herbicides-selective or non-selective).
- **Use of Education Programs** (Moore 2009: NRETAS 2007).

Integrated weed management means that weeds are less adaptable to the changing systems created by the various control methods and can lead to a more effective, holistic weed management approach. In this way, integrated weed management becomes a vital component of sustainable, long term land management when used by private and government land managers.

Weed management is a component of sustainable land management by individual landholders and the community and to be effective, weed management must be long term.

There are several principles of weed management as outlined by the *Northern Territory Weeds Management Strategy (1996-2005)*:

- landholders and land users are responsible for weed management;
- weed management is an integral part of all land management;
- preventing initial introduction and spread is the best and cheapest form of weed management;
- when introduction does occur, early detection followed by swift action is the essence of successful weed management;
- weed management requires a continuous, long term commitment;
- the integration of control methods including physical, chemical, ecological and biological can achieve best weed management;
- cooperative weed management amongst landholders and land users on a catchment basis is recommended and supported; and
- co-ordination between government agencies and landholders is necessary to establish the research, educational and legislative framework required for successful weed management (Anon 1996).



Figure 1. The four components of an effective weed management program (NRETAS n.d.).

Step 1: Assess the situation – weed mapping

The first step in managing weeds is to assess the current situation. This involves gathering information on which species are present (especially declared species) and where they occur on a property. Additionally, information about neighbouring weed infestations and wind direction should be acquired, as spread from neighbouring properties is highly plausible. This will ensure that when planning is being undertaken, priority species and areas will already be identified. The best way to map weed infestations is to undertake a field survey using a Global Positioning System (GPS) to accurately record the locations of weed species present. Useful information (attribute data) that should be collected while surveying includes:

- location (GPS);
- weed species present;
- density (e.g. based on percentage cover); and
- area of infestation (e.g. hectares).

There are field computer hardware (e.g. 'palmtop') and software (e.g. Geographic Information System; GIS) packages available that allow accurate and efficient location data to be collected simultaneously with attribute data. This can then be imported into a desktop GIS to produce maps and accurate information on areas (e.g. hectares) infested with individual weed species.

A good example of a mine site weed distribution map is that produced by W. Moore (2009) through Curtin University of Technology in accordance with Newmont Pty Ltd for the Woodcutters Mine site (Figure 2).

Woodcutters Mine Weed Distribution

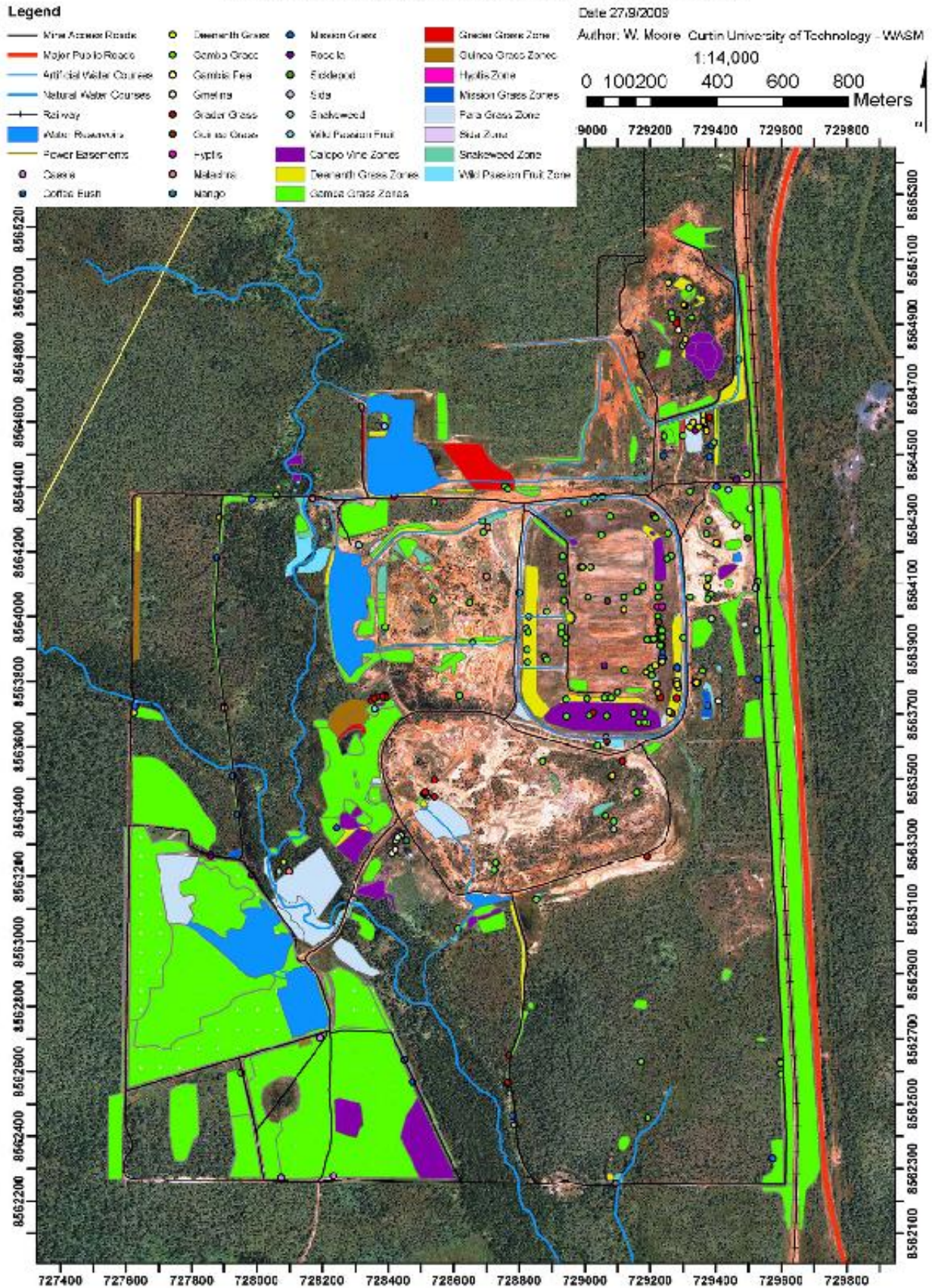


Figure 2. Example of a weed distribution map (Moore 2009).

For additional information about NT weeds and to obtain guidance in weed related matters, the NRETAS Weed Management Branch has produced the document: *Guidelines for the Weed Data Collection in the NT*. This is a particularly useful reference as it describes what information to collect when mapping, controlling and monitoring weeds in the NT. The nationally based guidelines can be downloaded from the following web address:

www.nt.gov.au/nreta/natres/weeds/mapping/index.html

Step 2: Develop a weed management plan

a) Set objectives and targets

The plan should contain both objectives and targets. Objectives include general statements (e.g. 'implement weed control activities'), whereas targets are specific and measurable (e.g. 'reduce area of infestation of species x by y percent within timeframe z'). Objectives and targets will be based on the prioritisation of weed infestations, and where applicable, risks should be identified. These are outlined in the sections below.

b) Prevent the introduction and spread of weeds

A weed management plan should include measures that will be implemented to prevent the introduction and limit the spread of weeds. Examples of such measures include:

- use of timely prescribed burning to reduce weed biomass, reduce seed production and improve access for other control methods;
- if required, fire prevention during the seeding of weed species may assist with the suppression of seed;
- appropriate standards of hygiene e.g. inspection of earthmoving equipment entering site, provision of adequate vehicle wash down facilities, etc;
- early detection and eradication of 'satellite' outbreaks including neighbouring properties;
- implementation of quarantine measures e.g. 'no-go' areas with dense infestations;
- use only established access roads to prevent further spread;
- minimise the introduction and spread of feral animals that may be further spreading weeds on or off site; and
- education and awareness of weed related matters for employees and contractors.

c) Prioritise weed control activities

Weed control activities should be prioritised to maximise the use of the resources allocated and to take advantage of timing in relation to burning, seeding and growth periods of weed species (plant life cycle). Examples of general factors to consider when prioritising weed control efforts for a particular species include:

- the level of weed invasiveness (consult literature & Weed Management Officers);
- effect on environment (consult literature & Weed Management Officers); and
- weed classification under the *NT Weed Management Act* (e.g. Class A weeds as highest priority).

Examples of specific factors to consider when prioritising individual areas of infestation include their:

- proximity to roads/tracks (e.g. infestations close to tracks get high priority);
- phase of invasion (e.g. early stages can be controlled more easily, so get high priority);
- size of infestation (e.g. smaller infestations can be controlled more easily);

- proximity to drainage lines/waterways (e.g. infestations close to drainage lines more likely to spread);
- susceptibility to wind dispersal as well as prevailing wind direction (e.g. weeds growing in elevated areas or weeds with light seeds more likely to disperse); and
- proximity to lease boundary (e.g. weeds close to boundary get higher priority).

d) Outline weed control methods

Weeds can be controlled by chemical (i.e. herbicide), physical removal (i.e. hand pulling and the use of machinery), biological and/or land management (i.e. use of fire and cattle grazing) methods. Optimal methods vary from one species to another and may change over time with weed research and/or new chemical products. In terms of herbicide usage, careful consideration needs to be taken in which type to use and the options chosen should be determined by the size of the infestation, the available resources and access (NRETAS 2007). An additional choice needs to be made whether to use selective or non-selective applications. Selective herbicides which are species/plant specific may be used at the recommended rates to kill mostly woody weeds. Minimal damage to grasses as well as some native woody species may also occur. In contrast, most non-selective herbicides will kill all woody weeds, grasses and herbs (native and non-native). However, there are products available (e.g. 'Roundup Biactive') which are non-selective herbicides designed to be environmentally friendly by being biodegradable in soil and water and are often used in and around Top End waterways against aquatic weeds.

Therefore, Regional Weeds Officers from the NT Department of Natural Resources, Environment, the Arts and Sport (NRETAS) should be contacted for up to date information. As previously mentioned, an integrated approach to weed control is recommended.

e) Other considerations

Resources and logistics are also factors that should be taken into account when writing a weed management plan. For example, resources to be dedicated to weed control in the following year should be detailed, such as whether they will be undertaken by on-site staff or contractors. Also, the time and/or cost commitments for this process and equipment to be used needs to be outlined. A logistical challenge that often needs to be taken into account when planning weed control activities is accessibility (e.g. difficult in wet conditions) and optimal timing of weed control (e.g. several species may need treatment at the same time of year).

Once weeds are controlled in an area, the area should ideally be recolonised by locally sourced native plant stock. This will generally aid in reducing the degree of re-infestation from adjacent areas. Mine operators should therefore consider active revegetation with native plant species or at minimum, species designed to meet the pre-agreed beneficial end land use.

Step 3: Implementation of plan

Implementation of a weed management plan should be coordinated with adjacent landholders and any other relevant stakeholders to maximise the effectiveness of weed control measures. For example, costs can be reduced by sharing resources (e.g. spraying equipment and costs to mobilise weed spraying contractors) and the timing of weed control activities should be coordinated to maximise efficiency.

When undertaking weed control measures (e.g. spraying with herbicide), take notice of weather conditions and prevailing wind direction, as strong winds can hinder herbicide application and rainfall can reduce herbicide effectiveness. The timing of control with respect to plant life cycles is also very important and this may vary from one weed species to

another. For example, it is best to apply herbicide when plants are actively growing and prior to the commencement of seeding.

The effectiveness of weed control efforts should be checked and documented soon after treatment. This information will be important during 'Step 4: Monitor and Review' to ensure that the methods and timing of control are optimised in future years.

Mine operators should also ensure that staff/contractors have a safe working environment. Herbicides are usually highly toxic and appropriate personal protective equipment should be provided and used, as directed on the container label and/or Material Safety Data Sheets (MSDS).

Step 4: Monitor and review

A weed management plan should be a dynamic, progressive document. It should be reviewed regularly (at least annually), so that the effectiveness of control measures can be assessed and new priorities incorporated (e.g. new species and classification types). Weed classifications under the *Weed Management Act* may change periodically, as well as knowledge of individual weed species and methods of control.

Questions that should be asked during the review process include:

- Did you achieve your goals e.g. were they too ambitious or too conservative, were they realistic?
- Was there a difference in results for different areas?
- Do resources need to be increased?
- What were the benefits? (NRETAS n.d.)

Mapping of weed infestations will also need to be repeated periodically (e.g. every 2 years) to assess and update the success of current weed management practices and re-prioritise weed control efforts as appropriate.

One of the requirements of the *Weeds Management Act* is to update and review weed management plans. This component of a weed management program is in many ways the most vital component in the process. Without regular monitoring and reviewing of a weed management program, all previous steps and efforts towards managing weeds may be rendered ineffective. Factors such as changes in information, the occurrence of varying control methods according to circumstance and site condition, and the reinfestation of already controlled weeds are all relevant factors that need to be considered in the monitoring and reviewing process. Without such considerations, previous realistically set time frames and goals may become unrealistic and require continual monitoring and evaluation.

References & Further Information

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<http://www.nt.gov.au/nreta/natres/weeds/mapping/index.html>

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