Revegetation ground preparation

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1. Herbaceous Weed Control

This standard provides technical information for a range of chemical, mechanical and manual methods to control herbaceous weeds:

- In preparation for replanting
- To assist native species regeneration within remnant vegetation.

Herbaceous weeds compete with native plants for space, light, nutrients and water. Therefore, careful weed control can be considered one of the most important factors contributing to the survival and growth rates of both planted vegetation and natural regeneration by suppressing the growth of undesirable weeds.

Weed control is usually the most important factor for the successful establishment of vegetation in agricultural areas. Young seedlings need time to develop a vigorous and deep root system that can tap into reliable sources of soil moisture. Weeds can reduce a plant's early growth rate by up to 70 per cent compared to weed free sites, and can decrease survival from an expected 90 per cent of trees planted to as little as 10 per cent. The effects with direct seeding are even more dramatic. Failure to control competing herbaceous vegetation can result in complete failure of direct sowing attempts.

Within remnant vegetation, herbaceous weeds can impact on:

- Abundance - by entirely occupying a niche utilised by an indigenous plant
- Diversity - by displacing one or more plants simply by competition
- Structure - by displacement of a strata or stratum
- Function - by altering or excluding critical resources for fauna
- Process - by altering nutrient composition and cycling of soils and hence altering the process of a site to advantage further exotic colonisation.

The most common techniques used to control herbaceous weeds are:

- Chemical control
- Mechanical/manual control.

1.1 Chemical control

1.1.1 Advantages

- Cost effective and efficient option compared with mechanical or manual methods
- Can be used selectively, with precision, in difficult topography
- Often the only effective method for weeds that are difficult to control e.g. perennial weeds
- Limits physical disturbance to site and avoids promotion of subsequent weed establishment associated with mechanical methods

1.1.2 Disadvantages

- High risk in sensitive areas such as along waterways
- Risk of off-target damage to desirable native herbs (and remnant vegetation generally), unless skilfully applied
- Risk of off-target damage to adjoining properties (e.g. vineyards undergoing springtime bud-burst)
- Not appropriate for organic farms
- Can require an Agricultural Chemical Users Permit (ACUP) to use some chemicals
- Precise hand spraying can be time consuming
- A very high degree of expertise is required particularly when working in high quality remnants
- Has associated chemical safety requirements for storage and use of chemicals
1.1.3 Technique

1.1.3.1 In preparation for replanting
Site preparation weed control usually aims for selective removal of undesirable vegetation present on the site. In highly disturbed areas, the most common herbicide application technique is strip spraying. This technique uses machinery such as a tractor or quad bike to spray strips 2 to 4 metres wide with a grassy strip retained between rows.

Alternatively, spot spraying involves the use of knapsack sprayers to apply herbicide in spots 1-1.5m in diameter. This technique SHOULD be employed where:
- Supplementary planting will be undertaken within existing remnants (to reduce potential off target damage to native vegetation from spray drift)
- Minimal weed infestation has occurred
- The replanting is to be undertaken adjacent to a waterway
- Existing herbaceous weed cover is considered advantageous e.g. buffer protection from catchment runoff, habitat for fauna.

1.1.3.2 To assist native species regeneration within remnant vegetation
The application of chemicals to control herbaceous weeds in remnant vegetation requires an even more targeted approach than those described for replanting site preparation. In these areas, specialist plant identification and herbicide application skills are essential.

The two techniques most commonly employed for the chemical control of herbaceous weeds in remnant vegetation are:
- Spot-spraying. In many cases, this technique will be much more targeted than those described for replanting site preparation and may require the use of specialised nozzles. It may also be necessary to carry out some level of hand weeding prior to spraying where sensitive and important ground flora is present
- Wick-wiping. This is a very targeted technique that involves the use of a herbicide coated wick to wipe herbicides onto specific weeds.

Chemicals must be very accurately applied to the foliage of herbaceous weeds with no overspray. This is particularly important where extensive areas of herbaceous weeds are controlled and regeneration is the objective. Liquid marking dye additives SHOULD be used to assist in the control of overspray and to ensure that all necessary areas have been treated.

1.1.3.3 Types of herbicide
There are three main types of herbicide used to control herbaceous weeds prior to replanting:

- Contact herbicides. These herbicides kill the above ground parts of weeds, acting by contact on the green tissue of the plant. They are most useful for control of annual weeds. They will not control perennial weeds which can propagate from underground parts (e.g. Couch grass) as they only affect tissue they contact. Generally, contact herbicides are non-selective, which means that they damage or kill any type of plant
- Systemic knockdown herbicides. These herbicides are translocated throughout the plant and can kill perennial plants and those with underground perennating organs. Generally, systemic herbicides are broad-spectrum, i.e. they are non-selective and will kill most species (if applied at sufficient concentration). They can, nevertheless be used selectively, for example:
  - By spatially targeted application (to avoid desirable plants)
  - By reduced concentration to target annual and other highly susceptible plants amongst perennial or otherwise resistant plants
  - By seasonal application to minimise impact on dormant species while targeting actively growing weeds.
Residual (pre-emergent) herbicides. These herbicides are applied to bare, moist soil and kill the germinating weeds before they emerge from the soil (but may have little or no effect on existing weeds). Residuals remain active in the soil for between two and twelve months, depending on the type of chemical, application rate and soil type. When used correctly, these herbicides can be very effective with limited impact to the environment. This is particularly true in non-riparian situations where correctly applied herbicides tend to remain at or close to the point of application until they break down to harmless substances.

However, application of these herbicides in riparian areas can pose a greater risk to aquatic and riparian plants and animals through spray drift, runoff or overbank flooding. This is particularly true for some residual herbicides which can be toxic to aquatic plants and animals including fish and invertebrates.

Therefore the use of residual herbicides in riparian areas MUST be avoided. Furthermore, any herbicide selected for use to control herbaceous weeds MUST be registered, i.e. on label, for that particular weed problem and situation.

1.1.4 Timing

1.1.4.1 In preparation for replanting
The experience of many practitioners around Australia shows that the best results are achieved by keeping the planting zone weed-free for two years prior to planting. Satisfactory results are achieved by controlling weeds for at least one full year before planting.

To ensure that plantings have the best chance of success, site preparation SHOULD include both pre-season and pre-planting weed control. This involves the application of a herbicide in the year before planting (when weeds/grasses are actively growing) followed by a second application one month prior to planting. This pre-season application is essential if highly competitive but winter-dormant perennial weeds (e.g. Couch grass, Sorrel) are present (as they cannot be controlled by the pre-planting application).

1.1.4.2 To assist native species regeneration within remnant vegetation
The aim of weed control in remnants is to remove the competitive mass of the weed and/or exhaust the weed seed bank so that niches are available for regeneration of indigenous plants to occur. For example control of Yellow Flag Iris on waterways, prior to or at flowering in early Spring, prevents seed set and enables a niche to be exploited by Tall Sedge which releases seed in February and germinates opportunistically to occupy available niches. Likewise the control of Galenia in early spring provides a niche to be occupied by Wallaby Grasses which set seed in early summer and germinate in autumn and spring or when conditions are favourable.

Therefore, herbaceous weed control SHOULD be timed in a way that takes account of the mechanism for seed dispersal and establishment of both desired and undesired flora and times action to advantage the indigenous species. As is standard with any weed management intervention control SHOULD be carried out when plants are actively growing.

To manipulate the site to advantage remnant vegetation and exclude/suppress exotic vegetation, project managers SHOULD utilise contractors with proven skills in plant identification (indigenous and exotic) and ecological restoration.

1.1.5 Licences/permits
Before using any herbicide, users MUST:

- Ensure that it is registered for the particular weed problem and situation
- Read the product label and follow all label instructions carefully.

Legal use of some chemicals requires the user to possess an Agricultural Chemical User Permit (ACUP). In Victoria, an ACUP is required to use agricultural chemical products that are ‘restricted use’ chemicals. These are chemicals that have a potentially higher risk of adversely affecting the user’s health, the environment and trade and include ester formulations of MCPA, 2,4-D, 2,4-DB or triclopyr, which are particularly relevant for woody weed control. A full list of restricted use chemicals can be found on the DEPI website.
Other restrictions on chemical use apply within Agricultural Chemical Control Areas (ACCAs). Nine ACCAs have been established in Victoria to protect high value herbicide sensitive crops. These areas can be found on the DEPI website.

1.1.6 Maintenance
Good pre-planting weed control minimises the need for post planting spraying. However, weeds often grow back after planting. An appropriate allocation of resources for weed maintenance MUST be included as an essential component in all replanting projects. If replanting sites cannot be maintained in an appropriate condition they SHOULD NOT be established.

The long term success of a planting project will depend on the level of maintenance. Herbaceous weed control in remnant vegetation will require ongoing maintenance depending on the invasiveness of the target herbaceous weed and the value/sensitivity of the remnant flora being protected.

1.1.6.1 Technique
Options for weed management post planting include:
- Manual weed removal (see Hand removal or chipping section)
- Chemical control by overspray with a selective herbicide e.g. where grasses are dominant, plantings may be oversprayed with a selective herbicide which does not damage broadleaved plants
- Chemical control by spot spraying or wick-wiping.

1.1.6.2 Timing
Revegetation sites: Weeds SHOULD be controlled when they are actively growing, before they set seed and before they begin to compete with newly installed plants. Reducing surrounding competition is most important when seedlings are in their first year of growth. To maximise survival and growth of newly installed plants, the area within one metre of plantings should be kept weed-free for a minimum of two summers following plant installation.

Natural regeneration: Herbaceous weed control to assist natural regeneration within remnant vegetation may require several years of follow-up treatment (dependent on species, degree of infestation and site conditions). Once again the objective is to remove the competitive mass of the weed, and/or exhaust the seed bank so that niches are available for regeneration of indigenous plants to occur.

1.2 Mechanical/manual control
In many cases it is more environmentally sensitive to consider non-chemical weed control. This is particularly the case when using herbicides near waterways. In these circumstances, it is important to consider other techniques that can be alternatives to, or complementary with, the use of herbicides. The suitability of the most common mechanical/manual approaches used to control herbaceous weeds are summarised in Table 1.

### Table 1. Mechanical/manual approaches to control herbaceous weeds

<table>
<thead>
<tr>
<th>Control Option</th>
<th>Assisted native species regeneration</th>
<th>In preparation for planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Mulching</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Weed matting</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Fire</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Grazing, slashing or mowing</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Hand removal or chipping</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Y – suitable  N – not suitable
1.2.1 Cultivation

1.2.1.1 Applicability
Cultivation is carried out to remove competing weeds, thereby improving moisture and nutrient availability to planted seedlings.

However, it can also allow other weeds to invade or aid the spread of weed seed through the soil. Table 2. SHOULD be used to assess the suitability of cultivation for herbaceous weed control under a range of landscape conditions.

Table 2. Suitability of cultivation for herbaceous weed control

<table>
<thead>
<tr>
<th>Condition</th>
<th>Suitability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light, well drained and friable soils</td>
<td>Y</td>
<td>increases water infiltration and stimulates germination of weed seed by exposing it to light and water (Perry 2004) caution is required in areas prone to wind erosion.</td>
</tr>
<tr>
<td>Heavy soils</td>
<td>N</td>
<td>may destroy soil structure (Perry 2004)</td>
</tr>
<tr>
<td>Soils of high and very high</td>
<td>N</td>
<td>on slopes above 10% and 15% respectively (Stackpole 1998)</td>
</tr>
<tr>
<td>Areas of high erosion potential e.g.</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>proximity to waterway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas of very high rainfall</td>
<td>N</td>
<td>for some moderate and moderate-high erosion class soils above 15% slope (Stackpole 1998)</td>
</tr>
<tr>
<td>Cultural heritage values</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Sites with intact native cover</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

Y – suitable    N – not suitable

Cultivation MUST NOT be used for herbaceous weed control to assist natural regeneration within remnant vegetation.

1.2.1.2 Timing
Where applicable, cultivation SHOULD be undertaken in the season before planting. This will increase the effectiveness of any pre-planting herbicide that may be used.

1.2.2 Application of mulch

1.2.2.1 Applicability
Mulches SHOULD only be used for very small-scale projects. Mulches SHOULD NOT be used to assist natural regeneration within remnant vegetation. Mulches are likely to be ineffective if not used in combination with other techniques, in particular herbicide treatment.

1.2.2.2 Technique
Materials
Many materials can be used as mulch including straw or hay, bulk organic material such as wood chips, sawdust or cotton waste, newspaper, rice hulls, gravel, carpet, grass or leaf mould. Some materials (e.g. hay and straw) may include seeds of weed species not already on site (or even in the district).

Other materials include commercial jute mats and woven jute matting (refer to weed matting section).

Once a material has been selected, the main considerations when placing mulches are:
Thickness
Whilst a thick layer of mulch placed around young plants helps to conserve soil moisture, improve soil structure, modify soil temperatures and suppress weed growth, care should be taken to ensure that mulch layers are not too thick.

For example, the most commonly used mulches (wood chips and barks) SHOULD be layered to a thickness no greater than 100mm, thicker mulch layers can:

- Be expensive
- Limit opportunities for natural regeneration from seed fall from revegetated plants
- Retain too much moisture in the root zone leading to root rot
- Inhibit water penetration from rainfall, leading to drought stress
- Increase susceptibility to frost by preventing radiant heat being released overnight

As a general rule, the thickness of the mulch layer depends on the material being used (with finer materials resulting in thinner mulch layers).

1.2.2.3 Proximity
Mulching materials MUST be kept clear of the seedling stem as contact can cause collar rot.

1.2.2.4 Timing
Mulches SHOULD generally be applied either just prior to planting or at the time of planting.

In very cold areas, mulches SHOULD NOT be placed during winter as they can prevent the soil from warming and lead to frozen soil around the roots.

1.2.3 Weed matting

1.2.3.1 Applicability
Advantages and disadvantages of weed matting are provided in Table 3.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve soil moisture content by acting as a mulch</td>
<td>Inhibits ability of plants to uptake moisture</td>
</tr>
<tr>
<td>Effective way of suppressing weed growth, particularly in areas where herbicides are undesired or inappropriate</td>
<td>Decomposes quickly especially in riparian areas</td>
</tr>
</tbody>
</table>

| | Expensive when revegetating a large area |

In low rainfall areas, weed matting can inhibit a plant’s ability to uptake moisture. As such, the use of weed matting SHOULD generally be limited to areas with medium to high rainfall (annual rainfall >500mm) where weed competition is the greater issue not moisture availability.

In addition, weed matting SHOULD NOT be used to assist natural regeneration within remnant vegetation.

1.2.3.2 Technique
Weed matting can be purchased as either:

- Long rolls of weed mat (with pre-cut slits) for lines of plantings
- Small squares of weed mat for individual seedlings

After unrolling, weed matting rolls are secured in place with metal pins at a rate of 4-5/m² (but allow for extra pins in flood prone areas).
Weed mat squares have three slits for stakes (so that they can be used in conjunction with plastic tree guards and stakes) and a central slit for the seedling. Where no tree guard is used, the weed mat is secured with four pins.

1.2.3.3 Timing
Installation of weed matting rolls SHOULD be undertaken after at least one initial spray run and prior to planting (with the plants subsequently installed into the pre cut holes). Weed mat squares SHOULD be placed after plants have been placed in the ground. This will prevent soil clods being left on top of the matting and reduce maintenance costs.

Mulch can also be placed over weed mat or jute rolls to increase the sites resistance to weed invasion and retain moisture.

1.2.4 Fire

1.2.4.1 Applicability
The use of fire to control herbaceous weeds is generally employed where there is an objective to reduce chemical use and is more effective on broadleaf weeds than grasses, which are more resistant to heat methods.

1.2.4.2 Technique
Spot burning with a flame burner is the preferred technique for fire treatment of herbaceous weeds.

Flame burners are devices that employ propane gas or kerosene as fuel to provide a constant flame and use a hand wand to allow the flame to be applied onto the target weeds. The method does not require that the plant is burnt; in fact for many species this may actually stimulate regrowth. Rather, the method works best when plant leaves are severely wilted as a result of exposure to the intense heat and subsequently die.

Spot burning SHOULD target a particular plant or small area rather than a general burn of an area.

1.2.4.3 Timing
Spot burning SHOULD be undertaken in spring to reduce weed seed-set.

1.2.5 Grazing, slashing or mowing

1.2.5.1 Applicability
Replanting sites
Grazing, slashing or mowing of a replanting site can be used to reduce weed biomass prior to chemical control.

Natural regeneration
Within remnant vegetation, ecological grazing is an available technique but SHOULD only be used within specific vegetation communities.

1.2.5.2 Technique
Grazing
Grazing SHOULD be managed to maximise the vegetation condition, rather than for animal condition. This optimal grazing SHOULD be applied based on a combination of the indigenous plant diversity, vegetation structure, and the plant biomass.

Slashing/mowing
The basic technique is to slash/mow the weeds as low as possible. General equipment for slashing/mowing includes:

- Tractor slashers (for large areas)
- Mowers, brush-cutters or whipper-snippers (for medium to small areas).
Grazing for natural regeneration
The key to the control of weeds within grassy ecosystems is to time grazing with the critical stages in the weed life cycle. This is usually after weed flowering but prior to seed set i.e. over spring and summer. However, this timing coincides with the critical life stages of native plants which tend to flower and set seed during late spring and early summer.

Therefore, in combination with appropriate fencing to protect adjacent native vegetation, grazing for herbaceous weed control SHOULD only occur in autumn and late winter/early spring. Irrespective of the time of year, livestock MUST NOT be used to control herbaceous weeds when:

- Soil moisture levels are high. Grazing at such times will lead to pugging and compaction
- Soil is very dry e.g. during a drought. At such times, the ground layer may be too sparse, leading to over-grazing and soil erosion

Grazing in replanting sites
Grazing SHOULD be avoided where replanting has occurred, until plants are beyond browsing height. This will normally be after three years from planting.

Slashing/mowing
Slashing/mowing will not eradicate weeds but can prevent or greatly reduce weed seed production if timed appropriately i.e. after weed flowering but prior to seed set.

1.2.6 Hand removal or chipping

1.2.6.1 Applicability
Pulling out weeds by hand or digging them out with a hoe (chipping), along or beside a seeding or planting line is a simple and effective method for small scale projects. However, it does not prevent growth of new weed seedlings.

1.2.6.2 Technique
When removing weeds by hand, care SHOULD be taken to:

- Create minimal disturbance
- Avoid disturbing the roots of any remnant, sown or planted seedlings
- Remove all plant parts capable of re-growth

1.2.6.3 Timing
This technique SHOULD be undertaken prior to weeds flowering and producing seed (generally late winter/early spring).
2. Soil preparation for re-planting

Determining whether soil preparation for re-planting is an appropriate activity for a particular vegetation management project is the responsibility of the project manager and will be dependent on a number of factors, including:

- The project goal
- The relevant ecological vegetation class (EVC) for the project site
- The condition and extent of remnant vegetation at the project site, which in turn determines whether the project will focus on:
  - Establishment of overstorey and/or understorey plants within a remnant patch i.e. supplementary planting
  - Establishment of native vegetation in formerly cleared areas outside of remnant patch i.e. revegetation.
- Specific site conditions e.g. soil type, slope, location in the landscape (e.g. floodplain)
- The type and severity of threats present.

Therefore, this standard should not be read in isolation, but rather sequenced and applied with other relevant standards as appropriate.

2.1 Scope

This standard covers standard physical methods to prepare soil for re-planting, namely:

- Ripping
- Mounding

It does not cover chemical methods to address poor soil health (e.g. nutrient deficiencies or pH issues).

2.2 Background

In some areas, soil preparation is required to produce loose, well drained and aerated soil ready for re-planting.

The major benefits and potential issues associated with soil preparation are outlined in Table 4.

<table>
<thead>
<tr>
<th>Major Benefits</th>
<th>Potential Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creates an easier path for roots to penetrate the soil</td>
<td>Cost</td>
</tr>
<tr>
<td>Makes re-planting easier</td>
<td>Can stimulate weed germination</td>
</tr>
</tbody>
</table>

2.3 Method

The following sections describe appropriate techniques and timing to prepare soils for replanting.

2.3.1 Ripping

Ripping is used to improve aeration, rainwater infiltration and moisture retention of particular soils to improve the root development of seedlings through faster downward root growth and deeper soil penetration.

In addition, ripping can enable the efficient use of manual planting tools and mechanical planters.

2.3.1.1 Applicability

To determine whether ripping is necessary/suitable for a re-planting project, a number of factors MUST be considered, in particular:

- Soil type and condition
- Landscape setting

These factors are detailed in the following sections and have been developed into a decision tree (refer to Figure 1). The decision tree MUST be used to determine whether ripping is necessary/suitable for a particular re-planting project site.
Soil type and condition

Ripping SHOULD only be used for those soil types and conditions that impede root growth. For other soils, ripping will result in either negligible project benefit or an overall degradation of the project area.

Table 5 - Ripping suitability for various soil types and conditions

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Suitability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay loams</td>
<td>Y</td>
<td>Assists root development by re-aerating soils</td>
</tr>
<tr>
<td>Compacted soils</td>
<td>Y</td>
<td>Breaks up subsoil and allows deeper penetration and faster growth of plant roots by improving aeration and infiltration of rain water</td>
</tr>
<tr>
<td>Cracking clays</td>
<td>N</td>
<td>Tends to crack along the rip lines in summer, exposing the plant roots to the drying air and pests (TreeProject, 2003)</td>
</tr>
<tr>
<td>Heavy clay soils or sub-soils</td>
<td>Y</td>
<td>Breaks up subsoil allowing root penetration and exploration</td>
</tr>
<tr>
<td>Highly erodible soils</td>
<td>N</td>
<td>Disturbance should be minimised on highly erodible soils</td>
</tr>
<tr>
<td>Light, sandy soils</td>
<td>minimal benefit</td>
<td>Little advantage in ripping sands as water will readily penetrate to the roots of the seedlings</td>
</tr>
<tr>
<td>Sodic soils</td>
<td>N</td>
<td>Can bring sodic material to the soil surface and cause or increase soil crusting</td>
</tr>
<tr>
<td>Soils with a hardpan layer</td>
<td>Y</td>
<td>Breaks up any impediments to tree root development</td>
</tr>
<tr>
<td>Wet soils</td>
<td>minimal benefit</td>
<td>Unlikely to have any benefits as the soil needs to be dry to produce cracks</td>
</tr>
</tbody>
</table>

Y – suitable  N – not suitable
Figure 1 – Decision tree to determine whether ripping is necessary/suitable

Project site requires re-planting

Is the project site located:
- On or adjacent to the banks of a waterway
- In a waterlogged area
- On rocky ground.

DO NOT rip the project site

Does the project site include:
- Intact native ground flora
  or
- Intact native understorey cover.

Ripping is SUITABLE and BENEFICIAL to replanting

Does the project site include any of the following soil types:
- Cracking clays
- Highly erodible soils or
- Sodic soils.

Ripping is SUITABLE but most likely UNNECESSARY

Does the project site include any of the following soil types:
- Light, sandy soils or
- Wet soils

Ripping is SUITABLE and BENEFICIAL to replanting

Project site requires re-planting
Landscape setting
Ripping produces a high level of soil disturbance which may make it an inappropriate method for soil preparation on some sites. In particular, ripping MUST NOT be undertaken on:

- The banks of waterways and waterlogged areas
- Riparian areas
- Sites of cultural significance
- Rocky ground
- Sites where there is a high level of intact native ground flora

Project scale
For small-scale projects (e.g. <2,000 plants), ripping may be too costly or difficult. In these situations, individual planting holes SHOULD be dug using a spade or tree planter.

2.3.1.2 Technique
Ripping is usually done with either a bulldozer or three-point linkage, tractor-mounted, winged ripping tyne (Corr 2003).

The key considerations when ripping re-planting lines are:

- Depth of rip lines
- Removal of air pockets
- Orientation of rip lines
- Topography of project area
- Proximity to existing vegetation.

Depth
The recommended depth of rip lines varies from 30cm to 100cm, depending on the depth of the impeding soil layer.

For the majority of re-planting projects, ripping to a depth of 50-60cm SHOULD be sufficient to alleviate compaction. Deeper ripping (up to 100cm) SHOULD only be required to increase drainage in dense subsoils.

Removal of air pockets
It is essential ripping does not result in the creation of air pockets beneath the soil.

A concrete roller (at least 60 cm wide) should be attached behind the ripper to help crush rocks, remove air pockets and settle the soil. Alternatively, a tractor tyre can be used although narrow tractor tyres should be avoided as they can cause compaction and guttering.

Orientation
To create a more natural aesthetic, ripping SHOULD follow either:

- A 'wavy' pattern
- A linear pattern (to allow for ease of management e.g. weed maintenance) with plants installed alternatively across rip lines.

Topography
On slopes, riplines MUST follow contours to reduce erosion risk.

Proximity to existing vegetation
To avoid damage to remnant vegetation, ripping MUST NOT occur:

- Where there is intact native understorey and/or ground flora
- Within an area twice the diameter of the canopy of existing indigenous trees.
Timing
Deep ripping MUST be timed to allow maximum shattering of the soil, ensuring that the soil is easy to work but not so wet that the soil glazes affecting root penetration. These conditions tend to occur in late summer/autumn.

However, ripping before the autumn break may prove difficult with commonly available equipment, so the standard practice is often to rip after the autumn break.

All ripping SHOULD be done at least six months in advance of re-planting. This will allow enough time for both:
- Rain events and soil settling to minimise air pockets between soil clods; and
- Adequate weed control prior to re-planting (see Maintenance section below).

 Longer timeframes may be required on some sites e.g. those with clay or compacted soils.

Licences/permits
High impact activities in culturally sensitive landscapes (e.g. deep ripping within 200m of a named waterway) can cause significant harm to Aboriginal cultural heritage.

In these situations the Aboriginal Heritage Act 2006 may require the project manager to prepare a Cultural Heritage Management Plan or obtain a cultural heritage permit or enter into a cultural heritage agreement with the relevant Registered Aboriginal Party.

If ripping is proposed within a culturally sensitive landscape, the project manager MUST determine if a Cultural Heritage Management Plan or cultural heritage permit is required. Specific information on considering Aboriginal cultural heritage needs can be sourced here.

Maintenance
The extensive soil disturbance created by ripping may inevitably lead to an increase in weed cover, either through invasion or the spread of weed seed through the soil.

This weed cover MUST be controlled quickly to minimise any competition with re-plantings (refer to the Herbaceous Weed Control and Woody Weed Control standards for details).

2.3.2 Mounding
This is a technique involving the mounding of topsoil over a rip line to provide improved conditions for tree establishment.

2.3.3 Applicability
There are five main reasons for mounding:
- Soft soil makes re-planting easier
- To improve drainage and soil aeration
- To build up a friable soil bed to allow rapid root growth
- To combat cracking soils
- To combat saline soils

Mounding is most commonly undertaken to facilitate early plant growth on:
- Heavy soils
- Wet and poorly drained sites
- Saline soils (critical for moderate to highly saline soils)

It should be noted that mounding produces a high level of soil disturbance and MUST NOT be used for soil preparation on the following sites:
- Fragile saline sites
- Sites with cultural heritage values
- Sites where there is a high level of intact native ground flora
2.3.4 Technique
Specific techniques for mounding (e.g. m-profile mounding for saline sites, mouldboard ploughing for heavy wet soils) are set out in Greening Australia’s handbook Revegetation Techniques. A Guide for Establishing Native Vegetation in Victoria (refer to pages 78-82).

These techniques SHOULD be followed for mounding projects in Victoria.

2.3.5 Timing
Mounds SHOULD be created at least six months in advance of re-planting to enable the mound to settle and, in saline areas, to allow salts to flush out.