Quarry
Code of Practice
3rd Edition

May, 2017

EPA TASMANIA
ENVIRONMENT PROTECTION AUTHORITY

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Contents

1. Glossary of terms

Acceptable standard	These are commonly agreed standards which will normally ensure that acceptable environmental performance is achieved. Where a specific issue requires attention at a quarry, the acceptable standard may be modified by the approval authority for inclusion in a Permit or Environment Protection Notice.
Air blast	Air vibration or air blasts are the pressure or shock waves that radiate in air.
Overpressure	from an exploding charge. When a pressure wave passes a given point, the pressure of the air rises rapidly before returning to atmospheric pressure after a period of oscillations. The maximum pressure is the 'Air Blast Overpressure' measured in decibels (dB) or dB(Linear).
Ambient noise	This is the total encompassing sound in a given situation at a given time where no particular sound is dominant. It is composed of sound from all sources near and far, normally experienced in the area. The ambient noise level, measured in dB(A), is influenced by many things such as the prevailing weather, local traffic, animal noise, industrial equipment and domestic activities. The ambient noise level is expected to vary over time and any measurement of the ambient noise level requires appropriate descriptive qualification.
ANZEC	Australian and New Zealand Environment Council.
Approval authority	The authority with responsibility for environmental assessment and regulation of quarry premises. The approval authority is the Environment Protection Authority (EPA) in the case of Level 2 activities or the relevant planning authority in the case of Level 1 activities.
AS #### - (date)	Australian Standards.
Batter	The uniform side slope of walls, banks, cuttings, etc.
Bench	A ledge constructed in a batter or natural slope.
Blasthole	A hole that has been drilled or prepared for the purpose of being charged with explosives or has been charged with explosives.
Blasting	The firing of explosive charges.
Board	The EPA Board (as established by the *Environmental Management and Pollution Control Act 1994*).
Bond	The rehabilitation bond, which is determined and held by MRT as a guarantee that the mining lease will be rehabilitated after the extractive activity has ceased.
Bund	An earthen mound wall which may be used for noise attenuation or visual screens. Bunds may also be used to contain spillage of liquid materials.
Contour bank	An earth mound or similar, constructed approximately along the contour and which is designed to control water run-off.
Contour drain	Drainage channel constructed approximately along the contour, and which is designed to permit the flow of water to a control feature/sediment trap on site.
Corrugation	Parallel ridges on a gravel road running at right angles to the direction of traffic formed through material displacement as a result of tyre action.
Council	The local municipal council which has jurisdiction over the area in which the quarry is situated.

Code of Practice	In this case, a practical guide issued by the Environment Protection Authority to the Quarry Industry to document acceptable and environmental guidelines for quarrying.
Cribwork	Layers of timbers, steel beams or similar on top of and at right angles to each other to support the toe of a batter or abutment.
Culvert	One or more adjacent pipes or enclosed channels for conveying water below formation level.
Curtilage	The enclosed area of land adjacent to a dwelling. The curtilage includes the house garden and is an area where domestic activities are likely to occur. It does not extend beyond the property boundary and would not normally extend beyond about 25 metres from the residential building(s).
Cut-off drain	A ditch and earth bank constructed to prevent water from building up, for example, along a track, and allowing redirection of running water into surrounding areas.
dB (A)	The sound pressure level measured with the 'A-weighting' frequency response. The A-weighting response is an approximation to the frequency response of the human ear at moderate sound pressure levels.
dB lin. peak	The maximum instantaneous noise level above a 2 Hz frequency cut off as registered by a sound level meter, monitoring air blast overpressure during blasting at a quarry, without any frequency weighting applied to the reading.
Decibel (symbol dB)	In acoustics, the decibel is the unit of sound pressure level which is used to express the absolute magnitude of sound pressure in terms of the logarithm of its ratio to a reference pressure of 20 microPascals.
Declared weed	A weed species that has been 'declared' under the *Weed Management Act 1999*. Once 'declared', appropriate legal actions can then be taken against the person responsible for managing the plant species at a particular location.
DPEMP	Development Proposal and Environmental Management Plan. This is a document used by the Board of the EPA for the purpose of environmental impact assessment of a deemed Level 2B activity.
DPIPWE	Department of Primary Industries, Parks, Water and Environment. The legislation specifies that certain approvals may only be granted by the EPA Board, or in other circumstances by the Director EPA.
Drainage line	A natural depression with no streambed channel, which may only carry surface water during rainfall events.
EER	Environment Effects Report. This is a document used by the Board of the EPA for the purpose of environment impact assessment of a deemed Level 2A activity.
EII (Mining) form	The Environmental Impact Information (Mining) form available from Mineral Resources Tasmania, which must be completed for Mining Lease applications.
EMPCA	The *Environmental Management and Pollution Control Act 1994*.
EPA	Environment Protection Authority.
EPA Board	The Board of the Environment Protection Authority.
Environmental harm	Any adverse impact on the environment, of whatever degree or duration and includes an environmental nuisance as defined in EMPCA.
Environmental Nuisance	Emission of a pollutant that unreasonably interferes with, or is likely to unreasonably interfere with, a person's enjoyment of the environment, as defined in EMPCA.

Environment Protection Notice	A notice issued under section 44 of EMPCA.
Firing	The act of initiating an explosion.
Flume	An artificial channel which conveys run-off down a steep slope or diverts a watercourse without causing erosion (concrete, riprap, plastic, etc.).
Fly-rock	Rock thrown an excessive distance from the blasting site.
Forestry quarry	A quarry qualifies as a forestry quarry if: it falls within the meaning of a 'Forest Practice' as defined in the *Forest Practices Act 1985;* it is established on State forest or private timber reserve; and the material extracted is used exclusively for the construction and maintenance of forest roads on land of the same status.
Gabions	Rectangular, galvanised wire baskets filled with rocks and used as pervious, semi-flexible building blocks for slope and channel stabilisation.
Ground vibration	The movement of the ground due to blasting. This is expressed in terms of vector peak particle velocity (symbol v_{ppv}) and is measured in mm/s.
Hay bale barriers	Hay bales fixed in a drainage line used as an aid to assist in off-site run-off and sediment control.
L_{90}	The noise level that is exceeded for 90% of the time, over a specified time period.
L_{eq}	The noise level of the mean energy of the noise averaged over a specified measurement period. It can be considered as the continuous steady noise level which would have the same acoustic energy of the real fluctuating noise measured over the same period.
Level 1 Activity	An activity which may cause environmental harm for which a Permit is required, but does not include a level 2 or 3 activity.
Level 2 Activity	An activity specified in Schedule 2 of EMPCA. This includes quarries producing greater than 5,000 m^3 of product per annum, or rock crushing premises processing over 1,000 m^3 per annum.
Level sill outlet	A pond or drain outlet point which causes water to spread evenly across a level surface to dissipate energy before being released to the environment.
LUPAA	*Land Use Planning and Approvals Act 1993*.
Mark out	The term for marking out the mining lease as described in section 72 of the *Mineral Resources Development Act 1995.*
MRDA	*Mineral Resources Development Act 1995.*
MRT	Mineral Resources Tasmania, within the Department of State Growth.
Noise level	Also known as 'sound Level'. The level of sound pressure as measured by a sound level meter. The measurements may be frequency-weighted and are generally measured over a specified time period. The unit of noise level is dB.
NOI	Notice of Intent. Initial document provided to the Board of the EPA outlining a development project and potential environmental issues.
Permit	A Permit issued by a planning authority under the *Land Use Planning and Approvals Act 1993,* or a former Licence/Registration issued under the former *Environment Protection Act 1973*.
Phytophthora cinnamomi	A soil-borne water mould which causes a condition in plants that is often referred to as 'root rot' or 'dieback'.
Planning Authority	The local Council is the relevant planning authority.

Pond decant pipes	Pipes which allow a pond to drain when the water level is above the pipe inlet.
ppv	Peak particle velocity measured in mm/sec is a unit of ground vibration. Single values for ground vibration are expressed as the vector sum of the three orthogonal axis values.
Quarry	In this document, the term quarry is used for simplicity, and includes all extractive pits from which material for building construction, road making and agricultural purposes is obtained. Such material includes rock, sand, soil and clay. Referred to as an 'Extractive Industry' in Planning Schemes.
Quarry face	The vertical or near vertical working surface of a quarry, rock excavation or gravel pit; also the steep section between benches.
Residential premises	Any building or part of a building lawfully used as, or for the purposes of, a private residence or residential flat and including the curtilage of the building or, where the boundaries of the curtilage are not ascertainable, the land within a distance of 25 metres from the building.
Riprap	Medium to large sized rock protection applied to the face of an embankment.
Sediment trap	A structure or pond to collect sediment.
Sensitive use	Noise sensitive premises including but not limited to, residential premises, libraries, schools, hospitals, aged and child-care facilities, caravan parks and other places at which individuals may abide for long periods for reasons other than employment or active recreation.
Slash	The term for the seed bearing branches spread on stabilised surfaces as a part of the rehabilitation method described in section 8.6.2.2.
Spillway	Drainage channel specifically designed to allow for overflow from one water body to another without damaging the dam structure (i.e. pond/dam to a river or other pond/dam).
Stemming	The material used to fill a blasthole after the explosive charge has been inserted to prevent the explosion from blowing out along the hole.
The Land	The land on which the activity may be carried out. The Land is typically defined in a Permit.
Watercourse	A natural depression carrying perennial or intermittent flows of surface water for part or all of the year in most years. Consisting of a defined channel, with banks and a bed along which water may flow.
Windrows	Elongated mounds of material stripped from a site to be developed.

2. Purpose

This document is not a Code of Practice for the purposes of Sections 23A(4) and 102(2)(d) of *EMPCA*, which refer to Codes of Practice made and approved in accordance with EMPCA regulations. Rather, the purpose of this code is to document acceptable environmental guidelines for quarrying, in order to:

- promote industry self-regulation
- provide information for planning authorities on the assessment and control of quarries under LUPAA and *EMPCA*
- provide the basis for uniform planning scheme standards
- further the objectives of Tasmania's Resource Management and Planning System, which seeks to provide sustainable development of Tasmania's resources
- assist in compliance with the *Mineral Resources Development Act 1995* (MRDA) and provide an assessment standard for mining leases
- increase general community awareness about environmental management within the industry, and
- assist operators in the operation and rehabilitation of quarries.

3. Preamble

This is the third edition of the Quarry Code of Practice. It updates references to Government legislation and websites, and contains a number of changes and corrections to the original text, including clarification of the approvals process for the extraction of minerals (Figure 1).

As the code is primarily aimed at environmental assessment and management of quarries, details of work health and safety requirements have been removed, and readers are directed in Section 9 to the comprehensive information available at http://worksafe.tas.gov.au.

The contents of the original code were agreed by Industry, Local Government and relevant State Government agencies through a consultative process which included a public comment period.

The code was developed to further the objectives of Tasmania's Resource Management and Planning System, which seeks to provide for sustainable development of Tasmania's resources.

The code comprises elements for both the proposed use and development of land for extractive purposes as well as ongoing environmental management.

The sections of the code are not in themselves legally enforceable. They are intended to encourage operators to achieve good environmental performance without the need to resort to legislative enforcement mechanisms.

The provisions of the code can be enforced as Permit conditions, or by issuing Environment Protection Notices. If necessary, an Environment Protection Notice may be used to vary the conditions on an existing Permit.

While the code outlines acceptable standards, it is important to note that where an operator is able to demonstrate that the potential environmental impacts can be managed by other means to the satisfaction of the approval authority, appropriate site-specific conditions for the operation should be applied in the Permit.

Permit conditions may be subject to appeal by the operator or a member of the public who made a representation during the period of public notification of the application.

The safety section of this code is not intended to be enforced by a planning authority and is the responsibility of WorkSafe Tasmania.

The code does not include the full detail of all statutory requirements with which quarry operators may be required to comply. The 'References' section towards the end of this document contains a list of legislation, policies, Australian Standards and guidelines which should be consulted for additional detail.

4. Legislation and state policies

4.1 Legislation and planning

The Resource Management and Planning System (RMPS) of Tasmania is an integrated legislative and policy framework for ensuring that decisions about resource use in this State are all headed in the same direction; towards sustainable development.

EMPCA is an integral part of the Resource Management and Planning System.

Compliance with this code should reduce the potential for environmental harm or environmental nuisance, as defined in EMPCA. This Act provides enforcement mechanisms such as Environment Protection Notices, which may require the prevention of environmental harm, or the remediation of harm, at any quarry site, whether or not a Permit is held.

A major feature of EMPCA is that it integrates environmental management with the planning system. There is no requirement for a separate environmental licence, as environmental conditions are attached to planning permits.

LUPAA came into effect in 1994. The central function of LUPAA is to integrate the planning and development approval processes at local government level.

Tasmanian Sustainable Development Policies (State Policies) have been developed for air, noise and water. The policies are: *Environment Protection Policy (Air Quality) 2004*, *Environment Protection Policy (Noise) 2009* and *State Policy On Water Quality Management 1997*. Some of the requirements in these policies are relevant to quarries.

Flora and fauna biodiversity is regulated through State and Commonwealth legislation. The relevant Tasmanian legislation is the *Threatened Species Protection Act 1995*, *Nature Conservation Act 2002* and *National Parks and Reserves Management Act 2002 (Part 3)*. In the case of Commonwealth legislation it is the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

Under the *Forest Practices Act 1985* a Forest Practices Plan is not required for land clearing where that clearing has been authorised under a Permit issued by a planning authority under LUPAA.

4.2 Mining

The MRDA requires that operators of quarries hold mining leases to extract stone and other minerals from private or Crown land. Conditions including rehabilitation bonds are imposed on leaseholders and are administered by MRT.

4.3 Workplace health and safety

Operators must comply with the safety requirements of the *Work Health and Safety Act 2012* and the *Mines Work Health and Safety (Supplementary Requirements) Act 2012* which apply to owners, managers, contractors and employees at mines, quarries and mining leases.

The *Dangerous Goods (Road and Rail Transport) Regulations 2010* prescribe specific measures for the transport and packaging of various classes of dangerous goods such as fuels, oils, explosives, and corrosives.

5. Approvals for the extraction of minerals

5.1 The approval process

The process for gaining approval to operate a quarry can be complicated. Figure 1 provides an overview of the process by which approval to operate a quarry can be gained.

5.1.1 Landowner

Landowner consent is necessary for the extraction of minerals on private land.

5.1.2 Mining lease

A lease issued by MRT is necessary for the extraction of minerals from private or Crown land, except in the following situations:

- Forestry quarries operated in State forest (Permanent Timber Production Zone land)
- where lawful earthworks are made for construction purposes, a lease is generally not required unless an ongoing extractive operation is envisaged
- landowners may extract stone for their own use or sell less than 100 tonnes per annum, and
- soil and loam are not minerals under the MRDA.

5.1.3 Forest Produce Licence

In a State forest, a Forest Produce Licence is required for soil removal.

5.1.4 Permit

New extractive industries generally require a Permit under all Planning Schemes. All applications must be submitted to the relevant planning authority. Most Permits will be discretionary and will require public advertisement of the application. Following this, the application will either be refused or granted subject to conditions. A right of appeal is available through the Resource Management and Planning Appeal Tribunal.

In particular, operators of new extractive pits, except forestry quarries, will be required to hold a Permit issued by a planning authority under LUPAA.

5.1.5 Forest Practices Plan

An operator of a forestry quarry will require an approved Forest Practices Plan.

5.1.6 Department of Primary Industries, Parks, Water and Environment

All Permit applications must be submitted to a planning authority. The planning authority will refer applications for level 2 activities to the Board of the EPA for environmental assessment.

While the extraction of soil and loam do not require assessment under EMPCA, such applications may be referred to the EPA by the local council for comment, where the activity is considered to have environmental significance.

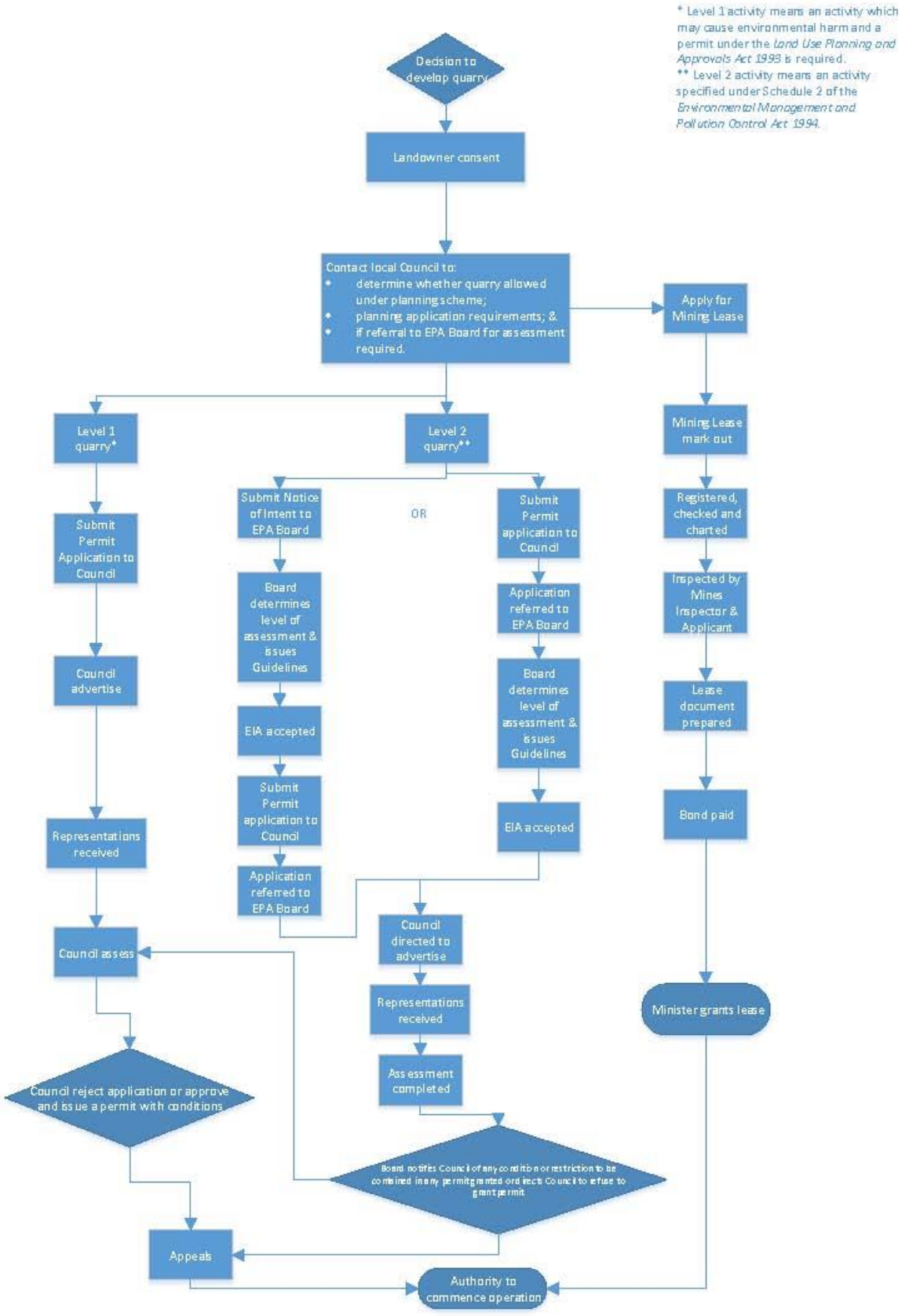

Figure 1. Overview of Process for Quarry Approval

6. Operation planning

When making decisions in relation to the effect quarry activities may have on the environment, the assessment will need to adopt a precautionary approach to ensure all aspects of the environment are considered. Where approved, an operation should provide for fair, orderly and sustainable use and development of the resource for the benefit of the community.

6.1 Site selection

6.1.1 Principle

Careful site selection after consideration of all possible alternatives may reduce future problems, particularly with respect to neighbours. Consideration should also be given to factors such as flora, fauna and other conservation values, particularly with respect to the *Threatened Species Protection Act 1995 and the Forest Practices Act 1985*.

6.1.2 Suggested measures

Disturbance should not occur within 40 metres of any watercourse, or within 10 metres of obvious drainage lines, except with the prior consent of the approval authority (after consideration of sediment control measures).

Where possible, quarries should be located to minimise visual dust, and noise impacts on adjacent sensitive uses, in order to reduce the potential for environmental nuisance. New quarries should not be located close to existing residences or other sensitive uses. Similarly, proposals to locate new residences adjacent to existing quarries should be discouraged, if possible, to reduce the potential for environmental nuisance.

It is suggested that planning authorities and operators seek to maintain the following separation distances, measured from the planned maximum extent of quarry operations to any sensitive use:

1. where regular blasting takes place 1,000 metres
2. where material is crushed only 750 metres
3. where vibrating and trommel screens alone are utilised 500 metres, and
4. where no blasting, crushing or screening occurs 300 metres.

The approval authority may consider variations of the above distances where the nature or manner of the operation can justify this. Modelling noise from proposed quarrying and processing activities and the measurement of pre-existing noise levels can be used to support such variations. Ground vibration and air blast overpressure should also be modelled where blasting is expected within 1,000 metres of a sensitive use.

The Natural Values Atlas is a database for threatened flora and fauna that should be consulted where appropriate. It is available at https://www.naturalvaluesatlas.tas.gov.au

Sites of possible cultural heritage significance should be identified during the site selection phase. Potential heritage sites should be identified and protected. In the case of Aboriginal relics, the *Aboriginal Relics Act 1975* requires that such finds be reported to the office of Aboriginal Heritage Tasmania within DPIPWE and also requires that the sites remain undisturbed and undamaged. For further advice regarding the surveying and protection of heritage sites contact Heritage Tasmania within DPIPWE.

The possibility of spreading *Phytophthora cinnamomi* should also be considered in the site selection stage (see section 7.8 for further details).

6.2 Site planning

6.2.1 Principle

Consideration of the layout of a quarrying operation prior to the opening up of new areas will greatly reduce the effort required to meet environmental and safety requirements (see Plate 1).

Initial earthworks on any site or stage of an operation are the ones with the greatest potential for adverse impact. In particular, an inappropriately located initial test pit or access track may lead to problems for the life of the excavation.

Site planning is essential to the successful and cost effective rehabilitation of all quarries. Rehabilitation planning should commence even before the site is opened up and all rehabilitation effort should be focussed toward a clearly defined end land use for the site. Good planning will save time and money in the long run.

6.2.2 Acceptable standard

The proponent must submit a management plan with any application to operate a quarry. Headings that should be included in a management plan are detailed in Appendix 1. An approved management plan will be made binding on the proponent.

An application to operate a quarry must include a statement of the proposed annual rate of production from the quarry. This amount will be recorded on the Permit, and must not be exceeded without prior approval.

6.2.3 Suggested measures

An adequately completed Environmental Impact Information Mining (EII) form may suffice as a management plan for a Level 1 activity, and a Forest Practices Plan may suffice in the case of forestry quarries.

A Level 2 activity, other than a forestry quarry, will require a written environmental management plan typically in the form of an EER or DPEMP depending on the significance of potential environmental impact. The document will include a large scale map of operations (see Appendix 1).

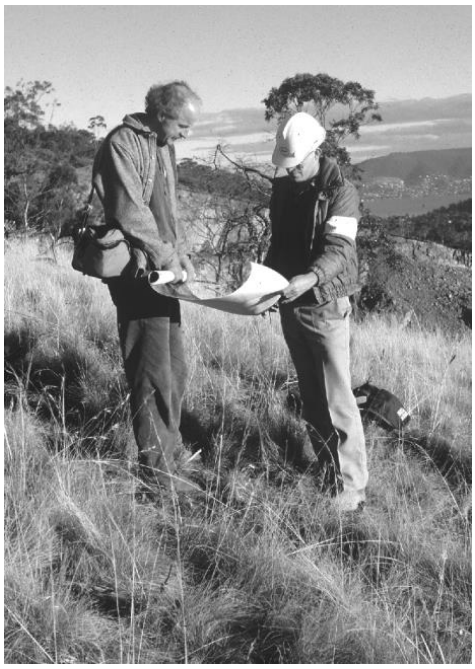

Plate 1. On-site planning

The best direction in which to work the deposit should be planned early, to assist in determining the best location for topsoil stockpiles, working areas, progressive rehabilitation, etc.

Neighbours and vantage points should be considered during site planning, in particular planning should consider use of existing vegetation and topography for screening to reduce noise, dust and visual impacts. However, the noise attenuation benefits of vegetative screens are marginal.

Community consultation is an important part of site planning, design, operation and rehabilitation, which helps the local community to understand what the extractive industry does, and how it may affect them. Community consultation also enables the operator to identify community concerns early and take action where necessary. It creates a relationship between the extractive operator and the community, which is designed to increase trust and awareness.

Operators may wish to discuss with the planning authority whether land use controls on surrounding lands are adequate to reduce encroachment of residential development into the area affected by the operation of the quarry. Alternatively, operators may consider purchasing, leasing or entering into an agreement over surrounding lands.

Operators may be able to influence the development of lands adjacent to their premises through the Council planning process under LUPAA. The opportunities provided include:

- any person may comment on a draft planning scheme during the exhibition period
- any person may request a planning authority to amend a planning scheme
- any person may make comment during the public notification period of a Permit application, and
- any person who made comment as above may appeal against the decision of a planning authority to the Resource Management and Planning Appeal Tribunal.

Consideration should be given to the location of the access to the quarry and haulage road. Access and haulage roads should be located and constructed to provide safe passage by heavy vehicles and to reduce the disturbance caused to residents and the environment.

Under certain circumstances (i.e. road access) a quarry operator may wish to formalise an agreement with an owner of the land covered by a planning scheme or a special planning order. Part 5 of LUPAA allows for agreements between the planning authority and owner of the land. An alternative method of establishing the Operator's rights over access is to include the land in the Mining Lease and use a compensation agreement.

6.3 Planning for final rehabilitation

6.3.1 Principle

In order for final rehabilitation of the site to be successful, it is essential that the future rehabilitation requirements are considered in the planning stages.

A Closure Plan may be a requirement for larger quarry operations.

6.3.2 Suggested measures

It is most important that operators plan for progressive rehabilitation while operations are ongoing. Planning of final rehabilitation of a pit should occur well before the cessation of operations. Any plan for the rehabilitation of a site should include a brief description of the site prior to the commencement of operations, including: soils, landform, flora and fauna, drainage and conservation values.

The future intended land use of the site should be determined at an early stage (the Rehabilitation Objective) in consultation with the landowner, Council or relevant Government agency, because this will guide site planning. Examples of rehabilitation objectives include: native vegetation, wetlands, building site and pasture.

A section of the management plan for each quarry should be dedicated to rehabilitation. The rehabilitation plan is an integral part of any extraction or mining plan. The Environmental Impact Information – Mining form (EII) that is generally filled out for Mining Lease applications may suffice as a management plan, if filled out correctly.

Plans for the location of topsoil stockpiling sites should ensure that topsoil will not be buried or contaminated and will not be in the way of future site development.

Plans for the location of roads, working areas and facilities should seek to minimise the total area required to be disturbed.

A plan of drainage works and final drainage pattern should generally be included in the rehabilitation plan for the site (see section on drainage and erosion control).

Analysis of the visibility of the quarry from frequently used roads or vantage points may show up some highly visible sections of the quarry which should be given a high rehabilitation priority.

Plans for removal and disposal of wastes and any hazardous or contaminated materials (such as fuel drums, soil which has been contaminated with leaked fuel or oil, and weed infested soil) should be described in the rehabilitation plan, as appropriate for the scale of the operation. Contact the Waste Management Section of EPA Tasmania if advice on hazardous materials is required.

Plans for machinery hygiene during rehabilitation works should also be considered in relation to weeds and the root rot disease *Phytophthora cinnamomi*. Consult the Weed and Disease Planning and Hygiene Guidelines (Invasive Species Branch, DPIPWE) if you require further information.

Forestry Tasmania or the Parks and Wildlife Service will be able to advise whether the quarry is located in a *Phytophthora cinnamomi* infected area. The Invasive Species Branch of DPIPWE should be consulted in regard to weeds.

More comprehensive information on rehabilitation is contained in section 8.

6.4 Access

6.4.1 Principle

Access to quarry sites is of primary importance and should be considered very early in site planning because this will constrain management alternatives for the quarry in future.

6.4.2 Suggested measures

Factors to be considered in siting the access track include: drainage, visibility, proximity to neighbours, dust control, gradient, type of equipment used on the road and access to benches at different levels of the face.

Tracks should be well maintained and provided with drainage, as poorly maintained tracks will increase the level of noise emitted by the quarry.

Tracks provide corridors for the invasion of weeds. Weed management along tracks should ensure that weed species are not introduced into new areas.

When determining the point of access to the site and internal haulage roads, it is important to remember that empty trucks may be louder than full ones, and that vehicle speed may significantly affect the noise of a vehicle. The gradient of tracks may also result in increased noise from vehicles due to greater use of brakes or increased engine power to climb slopes, especially when under load.

Provision of road signs should be considered in conjunction with the Transport Division of the Department of State Growth.

Provision should be made for safe line of sight along access tracks.

The location and direction of tracks where they meet public roads and the provision of slip lanes should be agreed with the Council or the Transport Division.

6.5 Road traffic

6.5.1 Principle

The effects of traffic density and traffic noise associated with a quarry's transport operation may, in certain circumstances, have a significant impact on other road users and/or the amenities associated with residential and/or sensitive use areas.

Operators should be aware of these potential impacts and take them into consideration.

6.5.2 Acceptable standard

The condition of cartage vehicles must be in accordance with the applicable transport regulations; that is, they must be in safe and in a road worthy condition.

All vehicles must be operated by appropriately licenced operators, and loaded and driven with care in accordance with the relevant traffic laws.

Trucks should be loaded to prevent spillage and no mud should be carried out onto the public road.

6.5.3 Suggested measures

When planning new quarry developments, access to the site needs to be considered in relation to the impact of any change in traffic movements on existing roads, taking into account the road's category classification and/or existing traffic movements.

Depending on the Road Category, provisions may need to be made for site-specific entry onto the public road.

Attention may need to be given to noise emissions related to engine noise and, when running empty, to possible body noise. If the access route has a significant gradient, noise associated with engine braking may also need to be addressed. Additional management may be required for night time haulage.

6.6 Plant location

6.6.1 Principle

Fixed plant and other working areas should be located on the premises with due regard to dust and noise emissions which may affect neighbours outside the premise's boundary. Plant location should also take into account the visibility of the plant.

6.7 Staging of operations

6.7.1 Principle

Deposits should be worked in a systematic manner, generally across or down the slope, so that worked out sections can be rehabilitated and left to revegetate without further disturbance.

6.7.2 Acceptable standard

In all cases, operations must be conducted in discrete stages with all valuable material fully extracted so that progressive rehabilitation can be carried out (see Figure 2 and Plate 2). At older quarries, partially extracted areas and abandoned sections must be fully worked out and closed.

The regulatory authority will specify a maximum total disturbed area for the premises. This must be adhered to and must not be exceeded. Should an increase be required then an application may be made to the relevant regulatory authority.

6.7.3 Suggested measures

Where substantial volumes of waste rock or overburden will be produced by the operation of the quarry, this material should be placed in properly designed dumps, which are located and shaped to blend in with the surrounding landscape. Costly reshaping of dumps during the rehabilitation phase is then avoided.

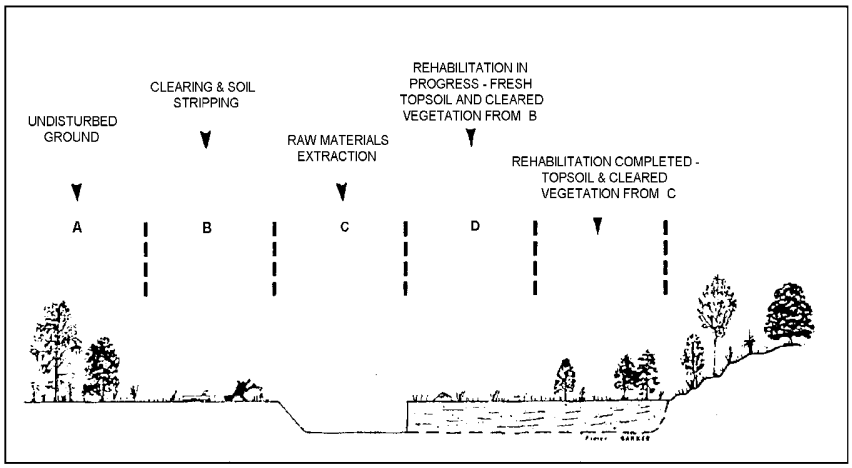

Figure 2. Planned bay method

Plate 2: Example of planned bay method

6.8 Minimising disturbance

6.8.1 Principle

Environmental impacts, such as erosion caused by storm water run-off and weed invasion, increase proportionally with increasing area of disturbance. It is very important that the total disturbed area be minimised.

6.8.2 Suggested measures

Minimisation of the total disturbed area is the best method of reducing final rehabilitation costs.

Limit the area disturbed to the minimum that is required for efficient operations. Surrounding vegetation is a valuable resource that can be needlessly destroyed by brief activities with heavy machinery at the pit boundary.

Use the approved mine plan and boundary markers, such as stakes and flagging tape, to indicate to machinery operators how the site is to be worked. This should provide a clear understanding of the extent of the areas approved for clearance.

Supervise machinery operators carefully during operations. It is not usually necessary to clear ground for the entire life of the operation in the first year.

6.9 Progressive rehabilitation

6.9.1 Principle

There are three broadly defined stages of rehabilitation. These are land reinstatement, revegetation and monitoring maintenance.

Progressive rehabilitation refers to the rehabilitation of worked out, or surplus areas, while extractive operations are ongoing. Progressive rehabilitation is an important component of quarry management, particularly where the pit is large or expanding.

6.9.2 Suggested measures

Each section of the quarry should be fully worked out and should be programmed for rehabilitation works as soon as possible.

As new sections are opened up, worked out areas should be progressively rehabilitated to avoid increasing the total disturbed area of the quarry. Topsoil can be stripped from areas being opened up and placed directly onto worked out areas which are being rehabilitated, to avoid double handling of soil, and to prevent degradation of the soil while in stockpiles.

Quarries and pits should be developed systematically as a series of benches or bays as outlined under the heading Staging of Operations (section 6.7). This allows rehabilitation of discrete sections when worked out.

Rehabilitation works may be considerably more efficient if carried out while the necessary machinery is on site and the pit is operating, rather than if machinery has to be transported back to the site.

Progressive rehabilitation can reduce the total liability of rehabilitation. Rehabilitation should not be left entirely until the deposit runs out or the resource becomes less economical to work.

Rehabilitation bonds are assessed by MRT as part of the Mining Lease renewal process and are based on complete rehabilitation of the site.

7. Environmental management

7.1 Environmental commitment

7.1.1 Principle

All personnel must be made aware of this code and its contents and be encouraged to develop a commitment to compliance with the environmental legislation and to being good neighbours.

The Permit holder is ultimately responsible for ensuring compliance with the legislation. All persons who may be responsible for the operation of the premises should be familiar with the content of the code and manage the operation accordingly.

7.1.2 Acceptable standard

If the release of a pollutant in the course of the activity causes or threatens serious or material environmental harm, or environmental nuisance, then the person responsible for the activity must immediately take all reasonable and practicable action to minimise any adverse environmental effects.

The person must also notify the approval authority as soon as reasonably practicable but not later than 24 hours after becoming aware of the release of a pollutant. This includes any release resulting from an emergency, accident or malfunction (see Section 32 of EMPCA).

The Permit holder must not without prior approval in writing from the approval authority:

- change the process used at the premises
- construct or remove any structure associated with the premises
- increase the quantity of materials dealt with at the premises from that specified in the Permit, or
- change the nature of materials dealt with at the premises in any manner that might cause, or substantially increase, the emission of a pollutant or noise from the premises.

7.2 Noise

7.2.1 Principle

All earth-moving operations have the potential to produce noise, and this can be a source of public disapproval of quarries. Where residences exist adjacent to a quarry, precautions should be taken to reduce the impact of noise.

Confining operations to reasonable operating hours together with sufficient separation distances to sensitive uses is the simplest means of avoiding unreasonable noise impacts.

7.2.2 Acceptable standard

Noise related to the use of explosives is covered in section 7.4 and is not covered in this section.

7.2.2.1 Hours of operation

Hours of operation should be restricted to:

- 0700 to 1900 hours, Monday to Friday
- 0800 to 1600 hours, Saturdays, and
- No operations on Sundays.

Extended operating hours may be approved following submission of supporting noise monitoring reports and/or consultation with affected neighbours. This may be accomplished via a development application, or through the issue of an Environment Protection Notice (provided that Council do not require a new development application).

Where noise is identified as an issue at a quarry, operating hours negotiated between the approval authority and the operator must be specified as a Permit condition.

The approval authority may approve a one-off extension of operating hours if an appropriate case is established where this is provided for in the Permit. Where existing permits do not contain provisions for one-off extensions Permit conditions may be amended via an Environment Protection Notice.

Operations may only be permitted on Sundays and public holidays that are observed state-wide (excepting Easter Tuesday) with prior approval.

7.2.2.2 Level of noise

Noise from quarrying and associated activities, including equipment maintenance, when measured at any neighbouring sensitive use must not exceed the greater of:

- the A-weighted 10 minute L90, excluding noise from the quarry, plus 5 dB(A), or
- the following levels:
    - 45 dB(A) from 0700 to 1900 hours (daytime)
    - 40 dB(A) from 1900 to 2200 hours (evening), and
    - 35 dB(A) from 2200 to 0700 hours the following day (night time)

when measured as a 10 minute L_{eq}.

Regulatory authorities may require compliance with alternative noise limits derived from a site-specific noise assessment.

7.2.2.3 Separation distance

Noise emitted by mobile and fixed equipment reaching neighbouring premises will be attenuated by increasing the separation distance. The greater the level of generated noise the greater separation is required to achieve the levels in section 7.2.2.2, all else being unchanged. It is difficult to provide definitive noise output levels for various types of equipment because the acoustic output is influenced by the power rating of the particular device, the type or mode of operation, the inclusion of low-noise options and the level of equipment maintenance.

The distances provided in section 6.1.2 are generally consistent with avoiding unreasonable noise impacts.

7.2.2.4 Screening

Additional attenuation can be provided by screening, either by earthen bunds placed close to the operating area or by topographic features in the intervening land profile. It is generally considered that screening that just breaks the line-of-sight can provide about 5 dB(A) attenuation, however, this can be influenced by the shape of the screening landform and the prevailing weather conditions.

7.2.3 Suggested measures

Under certain circumstances, it may also be appropriate for the regulatory authority to differentiate between certain activities taking place on the land; for example, to allow carting of materials to take place at the site during a wider range of hours than other extractive activity or materials handling.

Enclosures may be required around crushing and screening plants.

Solid barriers, such as bund walls and topographical features, provide the most effective 'in line' reduction of sound levels. Reliance on a barrier of vegetation alone will result in only marginal reduction in noise levels.

Access tracks and haul roads should be well maintained to prevent corrugation that contributes to truck noise, and truck drivers should be encouraged, where possible, to use access roads which have the least impact on the community.

Machinery should be well maintained and lubricated. Modern equipment is generally quieter than ageing machinery.

Compressors, noisy engines, generators and exhausts should be fitted with silencers.

7.3 Drilling

7.3.1 Principle

Accurate blast hole drilling is essential for good blasting performance. If drill hole position and alignments are not properly controlled, the subsequent blast may cause uncontrolled fly-rock, high levels of ground vibration and air-blast noise, unsafe bench faces and quarry floors.

The immediate impact of drilling may be generation of undue noise and dust during the drilling process.

7.3.2 Acceptable standard

All drilling for quarry blasts should follow a pre-determined blast design plan, which includes relevant drilling prescriptions.

Deviations from the design of drill holes should be identified prior to blasting and corrective measures should be taken. Such measures may include re-drilling the holes and/or adjusting explosive loading. All relevant details of corrective measures should be incorporated in the Blast Report.

7.3.3 Suggested measures

Each blast should be planned in advance with the drill pattern marked out on the quarry bench by an appropriately competent person. The design should define; drill hole diameters, drill hole depth, drill hole inclination and drill hole direction (azimuth).

The drill plan should form part of the Blast Report.

Each drilling operation should be executed in accordance with the drilling plan, and proposed modifications should be evaluated and approved by the responsible person prior to implementation.

Drill holes identified as being outside design tolerances should either be discarded and re-drilled or explosive masses should be adjusted.

Drilling equipment should be of appropriate capacity to drill the required holes to specified diameters, depth and true to line.

Drilling machines should be provided with appropriate measuring tools to set and maintain booms to specified inclination and azimuth.

Dust extraction and collection equipment should be provided to minimise dust escaping to the atmosphere.

Noise suppression on drill hammers and/or engines may be required in exposed drilling situations. If noise emission remains high, drilling hours may need to be restricted to coincide with times of day when background noise masks the noise emanating from the drilling operation (see section 7.2).

Drilling tasks should be performed and overseen by personnel possessing relevant proven competencies.

7.4 Blasting control

7.4.1 Principle

Blasting is necessary at some operations. Operators should be aware that blasting may be distressing to the public. Blasting produces ground vibration and low frequency air blast, both of which should be minimised.

7.4.2 Acceptable standard

Blasting must not take place unless specifically authorised in the Permit issued by the planning authority, and carried out in accordance with any conditions imposed therein.

Secondary breaking with explosives should not take place unless specifically authorised in a Permit issued by the planning authority.

Blasting must take place during the specified blasting hours within the Permit.

Blasting must be carried out such that, when measured at the curtilage of the nearest residence (or sensitive use) in other occupation or ownership, air blast and ground vibration comply with the following:

a) for 95% of blasts, air blast overpressure must not exceed 115 dB (Lin Peak);

b) air blast overpressure must not exceed 120 dB (Lin Peak) at all;

c) for 95% of blasts, ground vibration must not exceed 5 mm/s peak particle velocity; and

d) ground vibration must not exceed 10 mm/s peak particle velocity at all.

The ground vibration level at heritage buildings and structures of significant intrinsic value should not exceed 3 mm/s peak particle velocity.

It has been recommended that the long term regulatory goal for ground vibration should be 2 mm/s peak particle velocity and, where possible, this may be a suitable design target.

See the ANZEC Guidelines (1990) for further information.

Ground vibration from blasting can damage karst features. In the absence of technical assessment, the level of ground vibration must not exceed 7.5 mm/s at any karst feature.

Vibration and air blast overpressure must be monitored at all blasts within 1km of a sensitive use or a known karst feature.

All measurements of air blast overpressure and peak particle velocity must be carried out in accordance with the methods set down in *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*, Australian and New Zealand Environment Council, September 1990 and *Australian Standard AS 2187.2 Explosives-Storage and use Part 2: Use of explosives*.

7.4.3 Suggested measures

Hydraulic rock breakers produce less noise than secondary blasting with explosives.

The approval authority should be advised in advance of any blast on the premises.

In general, operators should avoid using surface detonating cord for charge initiation.

Where there is a history of complaints about blasting, it is recommended that nearby residences be informed in advance of blasts.

Sufficient stemming and appropriate delays between shot holes should always be used. Use of non-electric detonators has won widespread approval as the quietest delay system for initiating blasts.

Avoid blasting in overcast and other adverse weather conditions as this may result in amplification of the airblast overpressure, even at significant distances. Where blasting times are not specified in the Permit (e.g. between 1000 hours and 1400 hours weekdays), a regular blasting time should be adhered to.

7.4.4 Safety

The holder of an appropriate shotfirer's permit must be responsible for loading and firing shots. All persons handling explosives must be under the control of the holder of a shotfirer's permit.

Storage of explosives must be in licensed magazines, and must comply with AS 2187.1-1998.

AS 2187.2-2006 provides requirements, information and guidance for the use of explosives.

Blasts must be designed to prevent fly-rock from leaving the site.

The site must be evacuated and all approaches guarded before shots are fired. A distinctive, audible warning signal must be given before firing, and at the all-clear.

Adequate provisions must be taken to prevent fly-rock, excessive noise and vibration.

Transport of explosives on public roads must comply with the ATE code (the Australian Code for the Transport of Explosives by Road and Rail).

7.5 Air pollution and dust control

7.5.1 Principle

The primary air emission associated with quarry operations is dust. Dust can be a nuisance to neighbours and may be a safety hazard to quarry employees. Generally, the emission of visible dust should be confined within the boundary of the premises, except in remote areas.

7.5.2 Acceptable standard

Dust should not normally be visible crossing the boundary of the premises.

Environmental factors, such as wind conditions, may on occasion, make the retention of all visible dust on the site impossible. In such cases, the operator must take all reasonable actions to ensure that the emission of dust from the premises is minimised.

Roads within the boundary of the premises must be watered or sealed when necessary or when directed by the approval authority, to minimise environmental nuisance.

Trucks must utilise effective dust control measures such as tarpaulins, load dampening when travelling by public roads and carrying loads containing a significant quantity of material that passes a 4 millimetre sieve.

Dust produced by the operation of the quarry or by transport, crushing and screening plant must be effectively controlled to the satisfaction of the approval authority.

7.5.3 Suggested measures

The direction of the prevailing winds and the placement of the stockpile on the site should be considered during the planning stage. Trees should be planted for windbreaks or topography and/or embankments utilised, to shield stockpiles and working areas from prevailing winds.

As conveyors and transfer points can be major sources of dust, enclosures, mist sprays (including chemical dust suppressants), or approved dust extraction equipment may be required. Drop distance between discharge point and top of the stockpile should be kept to a minimum.

The speed of vehicles is an important factor in the generation of dust. The speed of vehicles on site may need to be restricted. In addition, where transport routes are along unsealed roads, it may be advisable to slow down in the vicinity of residents along these routes.

Stockpiles and roads can be sprayed with substances such as magnesium chloride to produce an impermeable layer, which reduces dust development. Alternatively, regular spraying with water can also be used to suppress dust. Waste oil must not be used as a dust suppressant.

The nature of the material being transported and its potential to emit dust should be considered in the loading of trucks. Generally, the highest point of the load should not exceed the height of the tray walls, unless the load is covered.

Environmental factors play a large role in the nature of air pollution and dust emissions. Extra care should therefore be taken at times of high wind speed, or during other adverse weather conditions, to minimise dust emissions. Decreased vehicle speeds, increased watering of roads and stockpiles and reduction of the amount of product transported per load, may be appropriate in adverse weather conditions.

7.6 Benching

7.6.1 Principle

Quarrying should be carried out in a series of working benches if the material is stable. Lower face heights between benches are safer and considerably easier to rehabilitate.

7.6.2 Suggested measures

Orientation of benches should take into account the underlying geology and vantage points from which the quarry is visible.

All benches should be self-draining. Each bench should act as a table drain, carrying water along the bench to a suitable discharge point or settling pond. If drainage is allowed to flow down the face from one bench to the next, erosion will occur and the benches may be lost.

Benches must not overhang and batters must be constructed at a safe angle. Quarrying activity should not extend within 10 metres of a boundary.

When worked out, loose material should be scaled off faces, leaving benches in place. Loose material may be pushed to the toe of the faces.

Face heights in hard rock should be determined on the basis of topography, rock type and the final land use. The distance between these benches should not exceed 15 metres (see Plate 3). Benches in loose material such as sand or gravel that can be dug without blasting must be no higher than the vertical reach of the excavating equipment used. For clay pits, it is usual to have active bench widths of more than twice the vertical height of the face.

Plate 3. The uppermost benches of this quarry have been revegetated using native species

Where practicable, the uppermost benches of the quarry should be established and worked out first. This allows the upper sections of the face which are often the most visible to be rehabilitated early in the life of the operation. Rehabilitation can then progress downhill as successive benches are worked out (see Figure 3). For rehabilitation, benches should be irregularly shaped and the top of the quarry face scalloped to blend in with the surrounding landscape.

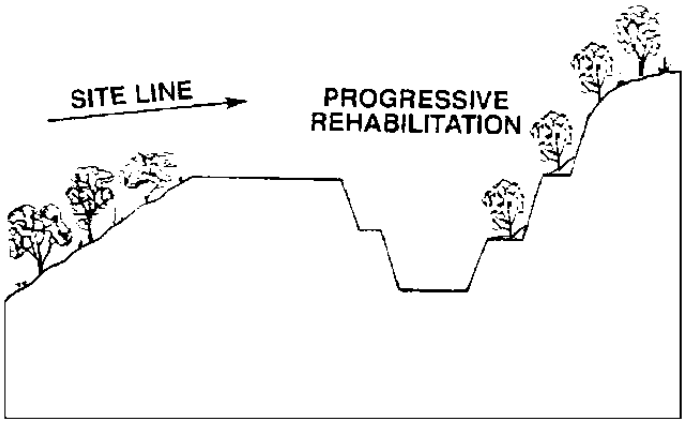

Figure 3. Rehabilitation on worked out benches

7.7 Vegetation clearing and topsoil stripping

7.7.1 Principle

Topsoil is usually the darker, upper soil layers. Though only 10 - 30 cm deep, it contains nutrients, minerals, seed, and organic matter which help to bind it all together. A thin layer of topsoil can support a forest and protect the subsoil from erosion.

The regenerative capacity of the natural soil should be protected during the opening up of new areas at quarries.

7.7.2 Suggested measures

Vegetation being cleared may contain small amounts of seed, or provide useful fauna habitat. Logs, limbs and stumps should be cleared and stockpiled (or cut and removed for timber) separately to the topsoil stripping operation.

Smaller sized vegetative material may provide useful mulch for later use in erosion prevention works, or else it should be combined with the topsoil.

Topsoil is a very important requirement for low cost revegetation of disturbed sites. Topsoil from all working areas and access tracks should be stripped carefully and stockpiled, or used immediately to rehabilitate worked out areas.

Wherever possible, stripped topsoil should be placed directly onto an area being rehabilitated. This avoids stockpiling and double handling of the soil. Topsoil placed directly onto rehabilitation areas contains viable seed, nutrients and microbes that allow it to revegetate more rapidly than topsoil that has been in stockpile for long periods.

Do not strip topsoil when saturated, as this will exacerbate the damage to the soil structure.

If topsoil must be stockpiled, remember that it does deteriorate in quality while stockpiled. The following practices will help maintain soil quality:

- topsoil should be kept separate from overburden, gravel and other materials
- if possible, windrows of topsoil should not exceed one metre in height to reduce 'souring'
- topsoil stockpiles should be protected from erosion
- growing vegetation on the stockpiles (shrubs or grasses) reduces erosion and will maintain biological activity in the soil
- topsoil should not be buried or driven on, as this will damage soil structure, and the soil should be stored somewhere out of the way, and
- excessive handling of topsoil should be avoided.

On hillside operations, it is best to store topsoil above or beside the excavation (depending on which direction the deposit is being worked). This provides storage safe from contamination and low re-spreading cost.

Overburden (reject material between the topsoil and the product mined) should also be stockpiled as it may be useful later for rehabilitation purposes such as backfilling of hollows, and providing additional rooting medium over hard rock areas.

7.8 Control of declared weeds, non-declared weeds and plant diseases

7.8.1 Principle

Land clearing and disturbance provides opportunity for the invasion of exotic weeds. Weeds should be controlled such that quarries do not become a source of weed propagules to surrounding construction sites.

Quarries can also be the focus for the dispersal of the exotic, soil-borne, root rotting pathogen *Phytophthora cinnamomi*. The risk of quarries becoming the source for dispersal of *Phytophthora cinnamomi* can be reduced by locating new quarries in areas free of the fungus. Existing quarries, particularly those producing crushed rock, can be managed to reduce the risk of their spreading the fungus.

7.8.2 Acceptable standard

The *Weed Management Act 1999* outlines a person's responsibility in regard to preventing the spread of declared weeds on soil, vehicles, machinery and product. Each declared weed has a Weed Management Plan prescribed for it under the *Weed Management Act.*

If a quarry is to be constructed in an area that is of significant biological value and/or is relatively free from exotic species, then more stringent measures will need to be employed to minimise the impact of the quarry on such an area.

Similarly, if the quarry is to supply material for use in areas of significant biological value and/or relatively free from exotic species (including pathogens), then measures that are more stringent need to be used to minimise the risk of quarry material being contaminated with exotic weeds (and pathogens).

7.8.3 Suggested measures

Movement of contaminated quarried material can spread the root rot pathogen *Phytophthora cinnamomi.* The risk of the quarried material being contaminated with the pathogen can be reduced through:

- locating new quarries in areas free of *Phytophthora cinnamomi*
- maintaining good drainage to prevent mud building up in working areas
- provision of cut-off drains to prevent spores of *Phytophthora cinnamomi* washing into the pit from surrounding areas
- careful washing of machinery which is brought onto the site, and
- careful stockpiling of topsoil so that water from the stockpile drains away from working areas.

Crushed rock can be considered free of contamination by *Phytophthora cinnamomi* provided it is not contaminated with topsoil.

Myrtle wilt is caused by a pathogenic die-back fungus which kills myrtle beech (*Nothofagus cunninghamii*), especially when there has been some form of disturbance. The fungus spreads by the movement of air and water-borne spores. It enters mature myrtle beech naturally through an exposed wound in the outer bark. To limit the spread of myrtle wilt to those trees not required to be cleared avoid damaging the area around the tree roots and bark.

Specific advice on *Phytophthora cinnamomi* and myrtle wilt hygiene can be obtained from Forestry Tasmania or the Invasive Species Branch of DPIPWE.

Sites should be regularly inspected for the presence of declared weeds, their presence should be recorded, and if necessary a control program implemented. There is also another category of weeds referred to as non-declared agricultural and environmental weeds. Steps should be taken to restrict the spread of such weeds.

Where weeds need eradication, this should be done by appropriate means. Where the problem is large or where conventional methods of eradication are not effective, advice should be sought from the local council or DPIPWE.

The use of chemicals should be minimised wherever practical. This can be achieved by spraying at appropriate times of the year/day and when the weeds are young (see Plate 4).

It should also be noted that some chemicals should only be applied by a qualified person under the *Work Health and Safety Act 2012*.

The inadvertent introduction of declared weeds or other pest plants should be avoided by ensuring that species selection for all plantings is appropriate for the area and that any organic mulches or seed mixes used are free from any declared and non-declared weeds.

For more information on weeds, including legislative requirements, visit the following websites:

http://dpipwe.tas.gov.au

http://www.forestrytas.com.au/

7.9 Drainage and erosion control

7.9.1 Principle

Sediment derived from erosion by water, and other water borne contaminants such as oil, are often sources of pollution arising from quarries. If environmental management is inadequate, water quality may be affected far beyond the premises boundary. Water leaving quarry premises should be treated to minimise sedimentation and turbidity problems.

A good drainage and sediment capture system may have a number of useful benefits, such as reducing waterlogging thereby making machinery operations more efficient, reducing sediment movement off the site, and reducing the likelihood of *Phytophthora cinnamomi* spread.

7.9.2 Acceptable standard

7.9.2.1 Drainage

Wherever possible, drainage works should seek to mimic natural drainage patterns and utilise natural drainage lines with retained vegetation.

A cut-off drain or diversion banks above the excavation will help prevent water from entering the site and adding to erosion problems. Cut-off drains should discharge into vegetated natural drainage lines or via a level sill that distributes run-off across a stable area.

Contour banks and contour drains can also be used to capture and slow down water that would otherwise gather momentum as it travels down the slope.

Working areas should be kept in as dry condition as possible, and machinery should not be driven through flowing water.

Rate of run-off increases dramatically following vegetation removal, hence the total area exposed should be kept to a minimum.

Access tracks often have a major impact on water quality. Gradients should be controlled, table drains well maintained, and regular cross drains or culverts installed.

7.9.2.2 Sediment control

All run-off from working areas, should be collected in settling ponds before being discharged from the premises. Water from washing, screening, or dust reduction plants should also be treated in the same way.

Accepted methods for removal of sediment from run-off include settling ponds (see Figure 5 and Plate 5), aggregate filters, and wetlands (shallow ponds planted with suitable swamp plants).

For quarries in vegetated areas, run-off should be directed through vegetation prior to reaching any watercourse to enable further filtering of sediment.

Sediment should be removed from settling ponds as required, so that excess capacity is always available for the next storm event.

Settling ponds should discharge into natural drainage lines that are stable and vegetated via properly constructed spillways, ripraps or culverts.

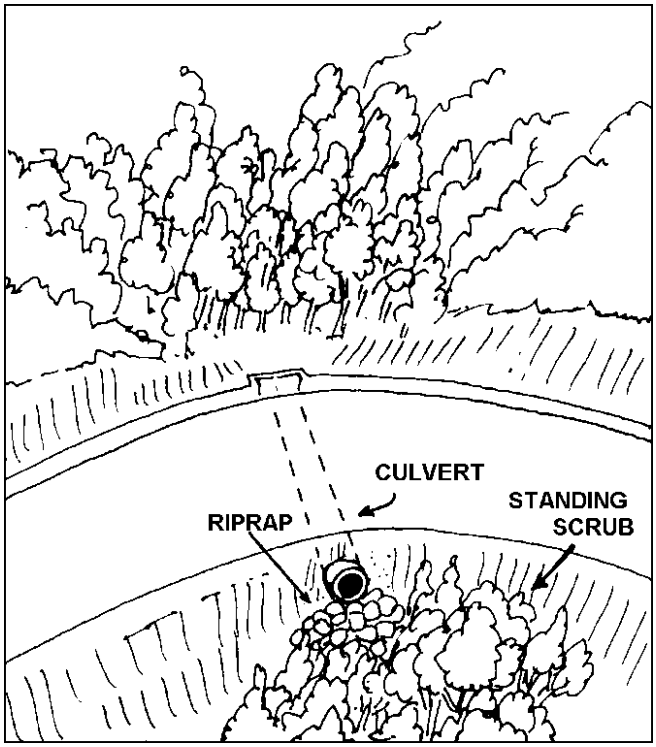

Figure 4. Drainage works

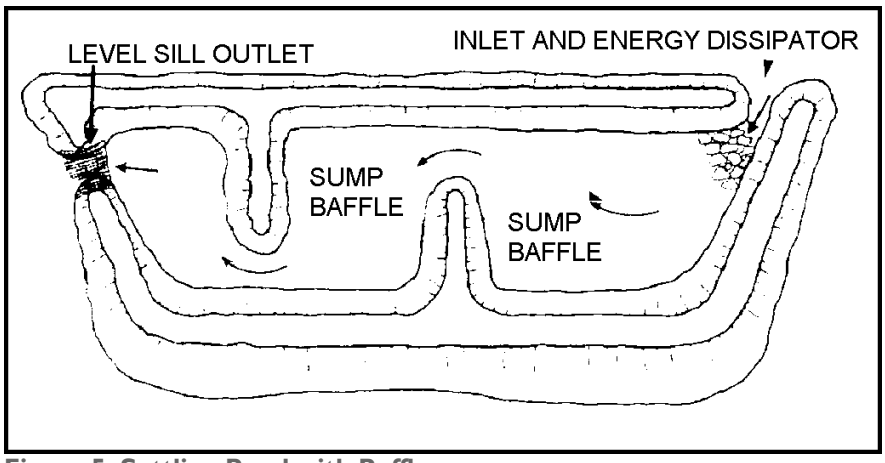

Figure 5. Settling Pond with Baffles


Plate 4. An example of a settling pond with baffles

7.9.2.3 Water quality

Total suspended solids (or Non Filterable Residue) in run-off discharged to inland waters should not exceed a concentration of 30 mg/L. During a storm event any plume leaving the site should not be visibly more turbid than the receiving waters.

If cut-off drains are not in place and effectively diverting water around the site, more stringent limits should be imposed. Regular checks should be made of surrounding waterways to ensure that there is no noticeable discoloration or sediment build up.

Discharge should be visibly free of oil and grease. Interceptor traps and oil absorbent materials contained in a spill kit may be required to capture oil and grease.

Discharge water can be recycled for watering roads, washing, promoting revegetation, etc.

Disturbance should not occur closer to a watercourse than is specified under Site Selection - Suggested Measures, or in the case of forestry quarries, as specified in the Forest Practices Code.

A 40 metre filter strip of undisturbed native vegetation adjacent to all watercourses is one of the best available means of protecting water quality.

Certain minerals have the potential to cause acid drainage pollution when exposed to air and water. A site's potential for causing acid drainage is not likely to be identified until it is being worked. Likely visible signs include the presence of pyrite minerals and iron rich precipitates; these may be evident in the form of brown staining on rocks or in water.

If such staining is observed, consult the EPA or MRT to discuss management options. Note that pyrites may occur in a finely disseminated form within black shales but may not be visible to the naked eye.

7.10 Waste disposal and storage of chemicals

7.10.1 Principle

Quarries should not be allowed to accumulate rubbish, disused plant, waste oil or other waste materials. Necessary chemicals and fluids should be kept in approved storage areas. On-site sewage treatment should not result in the pollution of surface or groundwater, and must be approved by a Council permit.

7.10.2 Acceptable standard

All rubbish, equipment, structures, and waste material must be removed on a progressive basis from the premises and recycled wherever possible, or disposed of at an approved disposal site, unless otherwise approved in writing.

Hazardous materials, known as controlled waste, must only be disposed of at an approved controlled waste disposal facility. Transporters of controlled waste must have a Controlled Waste Handler Certificate of Registration. Operators must seek approval from the appropriate regulatory authority in order to dispose of any controlled waste.

Extractive industry operations may use a variety of chemicals, hydrocarbons and explosive products. Australian Standards may apply to the use, storage and disposal of such substances.

Some types of waste materials may be used for the rehabilitation purposes, subject to approval from the Director, EPA.

Fuel, lubricants, coolant, waste oil and waste chemicals must be stored in an approved manner such as in drums or surface tanks with impervious bunds to contain spillage, and located away from operating areas and drainage lines.

The EPA Tasmania *Landfill Sustainability Guide 2004* provides information on acceptable and unacceptable material types.

On-site sewage treatment should not occur without approval from the regulatory authority.

7.10.3 Suggested measures

Materials imported to the site should be carefully selected as standards apply to the definition of clean fill; this information can be obtained from the EPA. Care should be taken when importing clean fill or topsoil to avoid introducing weed species or contaminated materials.

Various Australian Standards apply to the bunding of hazardous materials that may be stored at a quarry site. See also EPA Tasmania's *Bunding and Spill Management Guidelines December 2015*.

Above ground storage tanks with impervious bunds should be used in preference to underground storage tanks, as these reduce the risk of groundwater contamination. Storage areas should be located away from waterways and areas prone to flooding.

Fluids released during machinery maintenance operations should not be spilled on the ground. They should be caught and removed to an approved disposal site, or recycled, in order to avoid long term site contamination.

Hazardous materials should be disposed of at designated sites; contact the relevant authority.

Hazardous material management procedures, which aim to minimise risks to the environment and include emergency response plans, should be developed.

Regulations apply to the storage of explosives and other hazardous materials.

7.11 Visual management

7.11.1 Principle

The visible intrusion of quarries into the landscape may be out of all proportion to the area they occupy. Any new quarry should be located to manage its visibility from neighbours, roads and vantage points.

Visibility is the cause of much public complaint at many otherwise well managed quarries. It is essential that the visual impact of a proposed quarry be considered in the planning stages.

7.11.2 Suggested measures

The visual impact of a site will be dependent on:

- the size of the area exposed
- the orientation of the site in regard to residential areas, public roads and vantage points (see Figure 6)
- the visual contrast between the quarry and the surrounding area (for example, pale coloured rock in the quarry will have a high degree of visual contrast when surrounded by a dark coloured eucalypt forest)
- the distance of the site from residential areas, public roads and vantage points, and
- the perceived aesthetic and natural value of the area.

This impact will vary markedly from site to site, even if operations are similar.

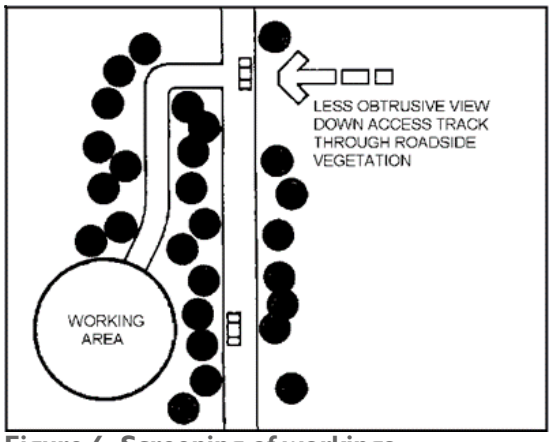

Figure 6. Screening of workings

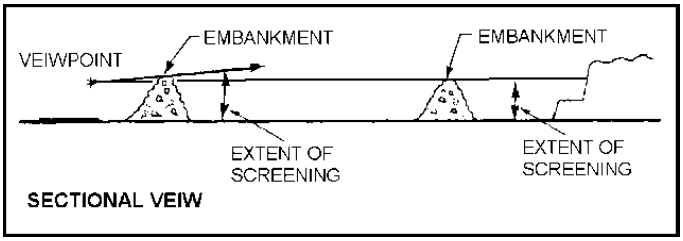

Figure 7. Embankment screening

The operational features of a quarry that have the potential to visually affect the environment include:

- the colour, form and bulk of plant and buildings
- the clearing of vegetation
- the exposure of the ground surface or rock face
- the location, size and shape of bund walls, stockpiles and waste disposal areas (see Figure 7)
- operating equipment
- location of access roads, and
- fences.

Natural vegetation is a valuable resource that should be employed for screening purposes. Vegetation may needlessly be destroyed by brief activities with heavy machinery at the pit boundary. Clearing should be consistent with the approved mine plan and kept to the minimum absolutely necessary for efficient operations. Planting of vegetation will also provide additional screening.

Quarry faces should be screened from frequently used roads and commonly visited vantage points. Existing topographic features may be utilised as effective screens and any landscaping undertaken should be designed to be visually compatible with the surrounding landscape.

Where practical, working faces should be oriented away from vantage points and neighbours and the direction of working should be carefully chosen so that the working face is hidden from the most critical view (Plate 6 and inset).

Where possible, uppermost benches should be worked out and rehabilitated as soon as possible.

New premises should not be opened adjacent to roads frequently used by the public, unless adequately screened by topography and/or vegetation. Access tracks should be aligned to avoid continuous line of sight from vantage points.

All exterior surfaces of buildings and fixed plants should be designed to blend in with the environment. See 'Site Selection' (section 6.1).

Plate 5 and 6 (inset). Due to site selection, this gravel pit is barely visible from the adjacent main road

8. Rehabilitation

8.1 Principle

Quarrying activities create changes to topography that may continue to cause visual impacts and water pollution long after the productive life of the operation. The term rehabilitation is used to encompass all of those measures, which seek to repair disturbed or degraded land, and to return such land to a self-sustaining, stable and non-polluting state, which is suitable for the proposed future use of the land.

The main aims of rehabilitation work are to:

- achieve long term stabilisation of all worked out areas to minimise ongoing erosion
- revegetate all worked out areas with suitable plant species
- minimise visual impact of disturbed areas, and
- ensure that worked out areas are appropriate for future uses.

Rehabilitation of extractive pits is a legally enforceable requirement of most quarry permits issued under LUPAA and Mining Leases issued under the MRDA.

Larger quarry operations may be required by the EPA to produce a stand-alone Closure Plan.

8.2 Site cleanup

8.2.1 Principle

The first step in the rehabilitation operation is a general clean up and making safe of the area.

8.2.2 Suggested measures

Site clean-up works to be undertaken after cessation of extractive operations include:

- removal of all fixed and mobile plant
- removal of all temporary and permanent structures unless required for an agreed future use
- levelling of noise control bunds and overburden stockpiles
- removal and appropriate disposal of all waste materials including hazardous materials
- break up and burial or removal of concrete slabs
- rehabilitation of surplus roads, office sites, hard standing areas etc, and
- identification of any hazardous or contaminated materials and weeds.

(Approval to retain any of the above items, which may be consistent with the proposed final land use, should be sought from the regulatory authority).

After site clean-up, it may be appropriate to deny vehicular access to the site by erecting gates, fences, trenches, etc, as necessary to prevent unauthorised four-wheel drive or motor cycle access, which is likely be detrimental to regenerating vegetation.

On sites with a long history of operation, consideration should be given to the potential heritage value of the site, and equipment/structures around the site. Expert advice should be sought from DPIPWE or MRT on how best to protect these cultural heritage values.

8.3 Site preparation

8.3.1 Principle

Site preparation is vital to the successful stabilisation and revegetation of any disturbed site. The largest proportion of the cost of rehabilitation is usually incurred here. Cutting corners in this area will jeopardise the success of the entire revegetation program.

8.3.2 Suggested measures

The first step in the site preparation process involves reshaping the area. The final land use of the site will determine the final landform. Generally, the site should be shaped to blend in with the surrounding landscape.

Knobs and stockpiles should be levelled or re-graded, steep slopes battered back, and waste rock/overburden pushed into hollows or the toes of faces. The site should generally be left in a stable, free draining state that blends in with the surrounding area.

On erodible sites, it is most important that slopes be reduced during site preparation. Steep slopes of greater than about 3 to 1 (20 degrees or 36%) will generally continue to erode unless expensive stabilisation measures such as pegging out of geotextiles or mulch mats, or benching to break up the slope are undertaken.

Where long slopes cannot be avoided, the slope should be broken up by construction of benches at regular intervals.

Benches may be cut in half to reduce the time for trees or shrubs to effectively screen faces.

A stable final landform should be created before topsoil spreading and revegetation works commence.

Topsoil should be re-spread uniformly over the area at a suitable depth to support revegetation. Remember that a thin layer of topsoil is far better than none at all.

Re-spread soil should be left with a rough surface with many suitable locations for seeds to lodge and germinate. Smooth surfaces should be ripped, ploughed or manually cultivated to improve the 'roughness' of the seedbed.

Avoid spreading soil when saturated or sticky, as compaction and other damage to the soil structure will occur.

Where topsoil is not available on site, alternatives must be sought - these may include any clay material available on site, any overburden with a high proportion of fines, highly weathered rock, or imported topsoils (subject to regulatory approval this material can sometimes be back-carted from construction sites). **Extreme care should be taken when importing topsoils because they often contain seeds of vigorous weeds.**

All compacted areas should be deep ripped along the contour. This may be carried out before or after spreading topsoil. Ripping will promote water infiltration and root penetration. It should be carried out when the soil is relatively dry to increase soil break-up. Ripping after soil spreading will also help to 'key' in the soil to the underlying material, and provides a rough surface for seed application.

Where soils have been spread some time before seeding, settling and formation of a hard crust may have occurred. If this is the case, the area should be harrowed, contour ploughed, or manually cultivated to provide a receptive seedbed.

8.4 Erosion prevention

8.4.1 Principle

Erosion will continue long after extractive activities have ceased unless preventative measures are implemented. Poor drainage management can lead to damage or destruction of the rehabilitation investment (see Plate 7). The best erosion prevention at a site is the establishment of revegetation (see Plate 8). However, while revegetation is becoming established, it may be necessary to employ other erosion prevention techniques.

8.4.2 Suggested measures

It is generally wise to retain any existing drainage controls, such as contour banks, rock filters and cut-off drains, upslope of the area being rehabilitated, to slow down surface run-off. A rough surface will capture more water and allow rainfall to infiltrate rather than flow directly downhill. Deep ripping will improve water infiltration. Rip when the soil is relatively dry to increase shattering.

Plate 7. Example of erosion

Where settling ponds already exist on site, it may be beneficial to retain these in the long term (with the landowner's approval). These ponds will require periodic cleanouts in the first year after commencement of rehabilitation, as the first storms after rehabilitation may cause some erosion.

Settling pond outlets and drain outlet points will usually require erosion protection mechanisms. These may include; spillways to undisturbed natural drainage lines, level sill outlets, pond decant pipes, riprap outlets, flumes or other forms of energy dissipaters.

Care should be taken to avoid leaving any 'up and down' features on slopes, such as bulldozer tracks on re-soiled areas, as these will channel run-off downhill and increase erosion. Where possible, machinery should travel along the contour.

Plate 8. Example of the stabilisation of erosion by vegetation

Surface mulches around growing seedlings and on steep batters may help to reduce erosion, reduce weed establishment and conserve soil moisture, as well as adding useful nutrients and organic matter.

Materials which may be used in surface mulches include:

- compost
- wood waste - chips/sawdust, (use of these materials will increase fertiliser requirements)
- straw
- spray on wood fibre matting, and
- hessian and geo-textiles (must be pegged out carefully).

Where batters are slumping, the toe of the slumped area should be shored up and allowed to drain using rocks or log crib-work or other form of landslip prevention work; for example, gabions. Expert advice should be sought where landslips occur or are known to be prevalent.

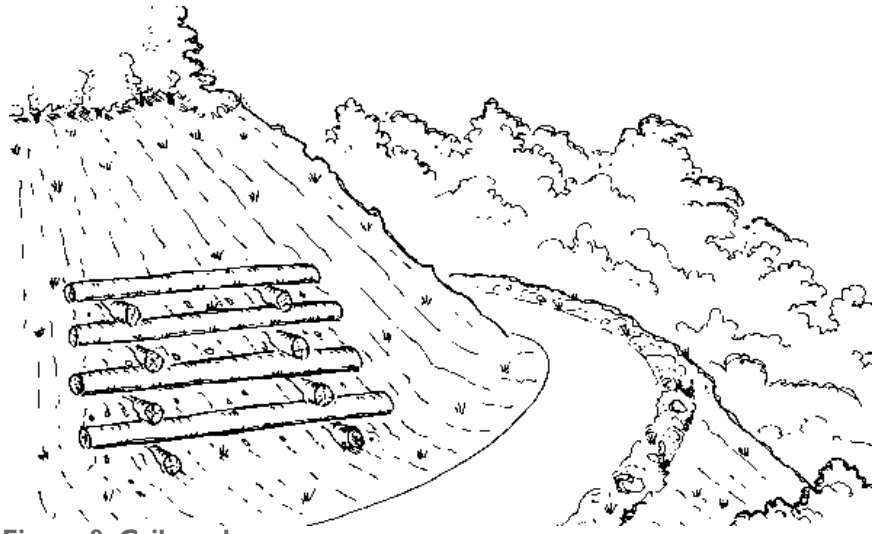

Figure 8. Cribwork

The following soils are known to be prone to erosion, and special care should be taken when disturbing the soil, particularly in steep areas:

- gravelly soils (particularly granite or quartzite gravels)
- soils on steep mudstone sites carrying dry forests (dispersible clays)
- sandy soils and soils formed on sandstone bedrock, and
- soils that are actively eroding even before the operation has commenced.

8.5 Revegetation

8.5.1 Principle

Establishment of a self-sustaining cover of vegetation is the best low maintenance stabiliser of disturbed sites in the long term. Revegetation also minimises the impact of visual intrusion. Generally, the vegetation type which existed before the disturbance or a similar vegetation type will be most successful afterwards, following an initial re-establishment period. Revegetation will be considerably easier to achieve where site preparation has been done well.

8.5.2 Suggested measures

Where the establishment of forest is unreasonable, the objectives of revegetation should be to establish a native ground cover, to prevent erosion on the site, and to manage adverse visual impacts from critical viewpoints.

8.5.2.1 Crown land

On Crown land, the objective of revegetation efforts is to re-establish a native vegetation cover which is similar in species composition to that which existed before the disturbance, unless otherwise approved by the relevant land management authority.

8.5.2.2 Private land

On private land, depending on the proposed final use, revegetation may aim to establish native plants, pasture, or other approved means of land stabilisation. It should be remembered that establishment of non-native vegetation types often requires more input than re-establishment of the original vegetation. Soils for exotic species must be relatively fertile and maintenance treatments such as fertilising and thinning may be necessary.

8.5.2.3 Species selection

Plants which are colonising road sides and other disturbed sites adjacent to native vegetation in your area are likely to be useful for quarry rehabilitation, with the exception of weed species. See Appendix 2 for further information on suitable species.

Acacias (wattles) should be used in virtually all seed mixes as these are fast growing colonisers of disturbed sites which gradually improve soil fertility by fixing nitrogen from the atmosphere.

Non-local native species may be required in some areas where the site has been impacted to such an extent that the original natives cannot establish under the altered conditions. Hardy coloniser species that are relatively short-lived should then be sown, with the aim of allowing the naturally occurring species to move in and dominate over a period of time.

Exotic grasses and clovers can quickly provide vegetation cover and a fibrous root mat which will bind the soil against erosion.

On steep or highly erodible sites, it may be necessary to provide a fast growing cover crop to stabilise the soil while the natives become established. A hybrid or non-persistent exotic grass species such as ryecorn (*Secale cereale*) or the more persistent Concorde ryegrass (*Lolium multiflorum*) should then be included in the seed mix. Natives will establish in the shelter of the grasses and will later dominate the site as the hybrid grass naturally dies off and provides an organic mulch.

8.5.2.4 Mulching

Surface mulches, while beneficial around existing seedlings, may inhibit the germination of the seed of some species.

8.5.2.5 Fertilising

Nutrients are lost during the disturbance of quarry sites. Fertiliser application is a relatively inexpensive treatment, which will promote growth of both exotic and native species. Care should be taken when fertilising native vegetation because excessive application rates can encourage weed invasion, and even 'burn' natives.

A general purpose chemical fertiliser (such as an 8:4:10 + magnesium mix) should be applied at 250 - 300 kilograms per hectare. Where necessary (especially if the topsoil has been lost) repeat fertiliser applications should be made every 1-2 years until vegetation is healthy and self-sustaining.

Slow release fertilisers (for example blood and bone and Osmocote) are recommended where soil and organic matter have been completely lost from the site. These fertilisers may be costlier to apply, but will assist in the long term by promoting deeper root development and adding humus to the soil.

Chemical fertilisers are significantly cheaper and easier to apply. However, these fertilisers are generally highly soluble and some of the nutrients will be carried away in run-off if there is no topsoil, or plant root systems, to bind up the nutrients.

8.5.2.6 Browsing

Browsing by livestock, native wildlife, and/or rabbits often becomes a severe problem at rehabilitation sites. Poisoning and shooting campaigns give only short term relief. Perimeter fence construction (fences should be stock and rabbit proof) has been shown to produce excellent results, giving the effect of an extra year or more of growth on revegetated areas (see Plate 10). When plants are large enough fencing materials can be re-utilised elsewhere on the premises.

Plate 10. Example of use of fencing to control browsing

8.6 Plant vs seeding

8.6.1 Principle

In most cases, quarry revegetation will involve the re-introduction of suitable plant species to supplement regeneration via wind borne or soil stored seed. This re-introduction may be in the form of nursery propagated seedlings, or direct application of seed to the prepared seedbed or a combination of both for the best overall result.

8.6.2 Suggested measures

8.6.2.1 Planting of nursery grown seedlings

This technique is relatively expensive and labour intensive, and tree growth may be slowed by planting shock and browsing. However, if successful, it can provide the most rapid greening of a site. This method is worthy of use on small critical areas, such as vegetation screens near vantage points.

Seedlings must be pre-ordered from a nursery, preferably 12 months in advance. The seed used should be collected in the local area of the quarry. Tube-stock or open grown seedlings usually give better growth than potted seedlings.

Planted seedlings may require plastic guards and stakes to protect them from wind damage (sandblasting) and browsing.

8.6.2.2 Spreading of seed bearing brush (slash)

This technique works particularly well with the tea tree species. Capsule laden branches are spread around areas to be revegetated, thereby providing seed, shelter and a mulch of leaves as they fall off the branches.

8.6.2.3 Direct seeding methods

These involve applying the seed and waiting for natural processes to do the rest. Site preparation and timing are very important. Benefits are that many small seedlings will establish in a good year and those which are best suited to the site will survive and eventually dominate. Direct seeding methods include:

- natural seed fall - this method is only applicable on small disturbed areas (up to about 1 hectare) which are virtually surrounded by mature vegetation
- hand broadcasting of seed and fertiliser - suitable for small areas
- hydro-seeding - a slurry of seed and fertiliser and water is sprayed on (normally used for large areas or sites where access on foot is difficult)

- hydro-mulching - a slurry of seed, fertiliser, mulch and an adhesive is sprayed on. The mulch and adhesive hold the seed and fertiliser in place when sprayed onto steep slopes (see Plate 11)
- spray on matting - seed, fertiliser, wood fibre and a binder are applied in a slurry which dries to form an erosion resistant mat on the soil surface. Seeds germinate in, and grow through the mat, and
- aerial broadcasting of seed from low flying aircraft or helicopters (suitable only for very large sites).

8.6.2.4 Notes on direct seeding

A mixture of species should be selected and a significant proportion of the seed should be collected (or purchased from a reputable collector) from the local area. It is important that species and provenances (varieties) which occur naturally in the area are used. These plants will be adapted to the local climatic and soil conditions and will often show better germination and growth in the long term than imported varieties.

Native seed should be sown at quantities of 2 - 3 kilograms per hectare of disturbed area. Where topsoil has been lost, a higher rate of seed application will be necessary.

Many native plant species require pre-treatment to promote germination, and this should be understood at the planning stage. At least 50 percent of seed of *Acacia* species should be heat treated (cover with boiling water and leave to cool) prior to sowing. Scarification (scratching/etching) is also necessary for many wattles, especially for those species found on sandy substrates. Native seeds may be treated with smoke or smoked water to increase germination rates.

A combination of direct seeding and planting of seedlings is often used to give the best of both worlds.

Enrichment planting may be required some time after direct seeding. This is the planting of seedlings into those portions of the site where seed germination has failed or regeneration is very sparse.

Seed may be collected locally or purchased from a reputable operator (see Plate 12). Seed must be stored in airtight containers in a cool, dry and dark location. Longevity of seeds depends on the species concerned. Addition of insecticides and fungicides to stored seed may increase longevity.

Plate 11. Hydro-mulch application

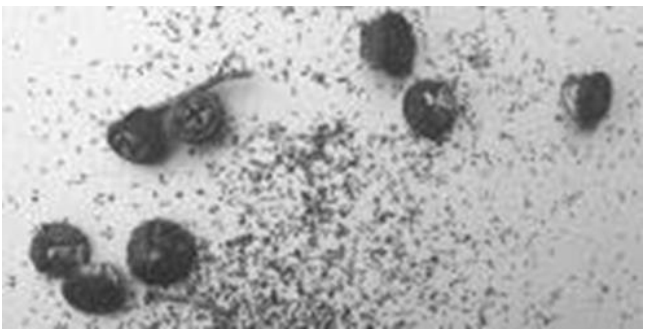

Plate 12. Native seeds (Eucalyptus globulus)

8.7 Timing of revegetation operations

8.7.1 Principle

The timing of revegetation works is critical in determining success or failure. The following information is provided as a guide to assist the planning of future rehabilitation operations. Climatic conditions will obviously vary from year to year and from region to region.

8.7.2 Suggested measures

Site preparation earthworks are best carried out during the drier months.

Seeding and fertiliser application are usually undertaken together at the end of the dry summer period, as close as possible to the onset of reliable rains. Mid-autumn to early winter is the optimum time. However, where frost sensitive species are involved seed should be sown after the last frost.

Seed will generally germinate best if applied to recently disturbed ground. Where the soil has settled and formed a crust inhibiting seed establishment (particularly on clayey soils), some form of cultivation or harrowing of the ground surface prior to seed application may improve seedling establishment.

Optimally, site preparation will be completed in early to mid-autumn and seed application commence in the weeks immediately following. Planting of seedlings, should be carried out in early spring. It is most important that seedlings become well established before the drier months.

8.8 Weed control

8.8.1 Suggested measures

Extreme care should be taken when importing topsoils because they often contain seeds of vigorous weeds.

Weed control (especially of grasses) is always important in the first year where native trees are to be established, though in most cases weed competition is not a substantial problem at quarries.

It is most important that weed infestations be tackled quickly to prevent the build-up of a large seed bank, which may be very difficult to destroy. It is likely that use of chemical herbicides will be required, contact a regional weed management officer from the Invasive Species Branch of DPIPWE for advice.

Some ongoing weed control is often necessary at rehabilitation sites. Manual weeding and/or selective application of herbicides may be necessary until the desired vegetation type begins to dominate.

8.9 Monitoring and maintenance

8.9.1 Principle

Rehabilitation is a process which may take years to produce a stable and self-sustaining ecosystem. Aftercare is vitally important and any failures should be rectified quickly.

8.9.2 Suggested measures

Rehabilitated areas should be inspected regularly to assess the health of the vegetation and to check for erosion, browsing damage and weed infestation.

A site inspection (preferably a joint inspection) should be arranged with the relevant officers of both the regulatory authority and MRT (who may hold a rehabilitation bond) in order to inspect the rehabilitation works. Annual joint inspections may be required at some larger sites after the cessation of operations to ensure the ongoing success of the revegetation.

Poor growth and yellow leaves may indicate nutrient deficiencies which will necessitate follow up fertiliser application. Soil analysis may be required to confirm any soil nutrient deficiencies. Soil samples may be forwarded to a registered laboratory for analysis.

In areas where germination has failed or where revegetated areas are affected by natural disturbances (e.g. fire, flood, disease) it may be necessary to carry out enrichment planting and/or spot sowing (hand sowing of seed into small cultivated patches e.g. kicked up with the heel of a boot).

The most effective protection against natural disturbances is to plant as diverse a range of locally occurring species as possible.

Where significant erosion has occurred it will be necessary to bring machines back onto the site to repair the damage as quickly as possible. It is very important to protect valuable rehabilitation investment from the impact of erosion.

After completion of all the rehabilitation operations and a reasonable maintenance period, the operator may wish to request a letter from the regulatory authority stating that the rehabilitation of the site has been satisfactorily completed.

8.10 Criteria for determining completion of rehabilitation

8.10.1 Principle

Rigid numerical rehabilitation standards are not practicable for the State of Tasmania. The following measures are provided as a guide to assist regulatory authorities and quarry operators in jointly assessing rehabilitated areas, so that a notice of 'completion of rehabilitation' may be issued, effectively absolving the operator of the need to conduct further rehabilitation works.

8.10.2 Suggested measures

Rehabilitation criteria should be considered and agreed jointly between the regulatory authority and the operator. Some suggestions for **minimum** standards are:

- the rehabilitated area should be left in a self-sustaining, stable and non-polluting state
- the area must be suitable for the planned final use or rehabilitation objective
- rehabilitated areas should not be affected by continuing erosion
- the rehabilitated area should be free of declared weeds, and
- revegetation should be established and effective over the whole site.

Evaluation of revegetation will be dependent on factors including; tree density; species diversity; and vegetative cover, as agreed with the regulatory authority.

Where revegetation to the original native ecosystem is the objective, more stringent criteria will be applied, these may include:

- a minimum density of at least 2,000 plants of tree species per hectare (uniformly spread) should be achieved
- a minimum of six different native plant species, from at least three genera, should be present in any randomly located plot of 30 metres by 30 metres, and
- where species other than those which inhabited the site immediately prior to the disturbance have been utilised in the rehabilitation process, the operator should be able to demonstrate that the original vegetation type will recolonise the site in time.

Plates 13 to 16 show a site at various stages of rehabilitation.

Plate 13: At Closure of Quarry

Plate 14: During Rehabilitation – 3 years after closure

Plate 15: During Rehabilitation - 5 years after closure

Plate 16: Rehabilitation Completed – 7 years after closure

9. Work health and safety

Work Health and Safety (WH&S) is recognised as a significant issue in the quarrying industry, and as such should be an integral part of every company's operations.

However, WH&S lies beyond the scope of this Code of Practice.

Nevertheless, a general principle is that each operation should implement a Work Health and Safety system which meets the requirements of the *Work Health and Safety Act 2012*.

For more information, including legislative requirements, visit the following website:

http://worksafe.tas.gov.au

10. Competency

10.1 Principle

To achieve appropriate commercial and environmental outcomes and to maintain a safe and healthy work environment, people engaged in the extractive industry need to possess appropriate competencies to perform the allotted work safely and effectively, or work under the supervision and direction of another person possessing relevant and appropriate competencies.

10.1.1 Extractive Industries Training Courses

For the extractive industry, the bases for these competencies are the training courses detailed on the following Australian Government website:

http://www.myskills.gov.au/Courses

11. References

Standards and guidelines

Australian Code for the Transport of Explosives by Road and Rail, Third Edition. Workplace Relations Ministers' Council, 2009.

AS 2187.1-1998 Explosives - Storage, transport and use Part 1: Storage. Standards Australia, 2006.

AS 2187.2-2006 Explosives - Storage and use Part 2: Use of explosives. Standards Australia, 2006.

Bunding and Spill Management Guidelines. EPA Tasmania, 2015.

Emission Limit Guidelines for Sewage Treatment Plants That Discharge Pollutants Into Fresh and Marine Water. Department of Primary Industries, Water and Environment, 2001.

Landfill Sustainability Guide 2004. Department of Primary Industries, Water and Environment, 2004.

Natural Values Atlas. Tasmanian Government <https://www.naturalvaluesatlas.tas.gov.au>

Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration. Australian and New Zealand Environment Council, 1990.

Weed and Disease Planning and Hygiene Guidelines - Preventing the spread of weeds and diseases in Tasmania. Department of Primary Industries, Parks, Water and Environment, 2015.

Acts, regulations and policies

Aboriginal Relics Act 1975

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Dangerous Goods (Road and Rail Transport) Regulations 2010

Environmental Management and Pollution Control Act 1994

Environment Protection Act 1973

Environment Protection Policy (Air Quality) 2004

Environment Protection Policy (Noise) 2009

Forest Practices Act 1985

Land Use Planning and Approvals Act 1993

Mineral Resources Development Act 1995

Mines Work Health and Safety (Supplementary Requirements) Act 2012

National Parks and Reserves Management Act 2002

Nature Conservation Act 2002

State Policy On Water Quality Management 1997

Threatened Species Protection Act 1995

Weed Management Act 1999

Work Health and Safety Act 2012

12. Appendix 1 - Guidelines for the preparation of a quarry management plan

General headings to be addressed:

Introduction	Proponent; need for quarry; other approvals required?
Site description	Location; history; existing excavations; vegetation; topography; drainage (see figure 9); geology; soil; land tenure; current land use; location of neighbours; access route; special conservation values; *Phytophthora cinnamomi*; landslide potential; heritage values; geo-heritage values and fauna values.
Development	Plan at 1:5,000 or better showing: resource available; projected extent of pit; sequence of development; screening; location of stockpiles; location of watercourses; access; mining lease boundary if applicable.
Methods	Quantities to be extracted; stockpiling of topsoil; hours of operation; benching; blasting; ripping; buildings; volume of overburden to be removed; crushing; truck movements; major items of equipment; slope of faces.
Environmental Management	Erosion control; visual impact (screening); noise control; dust control; emergency procedures.
Rehabilitation	End use of site; re-vegetation already carried out; re-contouring; ripping; benching; bench height; re-spreading topsoil; source of soil; seeding; planting; species; fertilising; rehabilitation timetable; plan for progressive rehabilitation concurrent with extraction.
Maps, overlays etc	Maps, overlays, photographs to be included as appropriate. The approval authority will provide more comprehensive guidelines for preparation of an Environmental Management Plan (referred to as a DPEMP or EER) where the potential for environmental impact is significant.

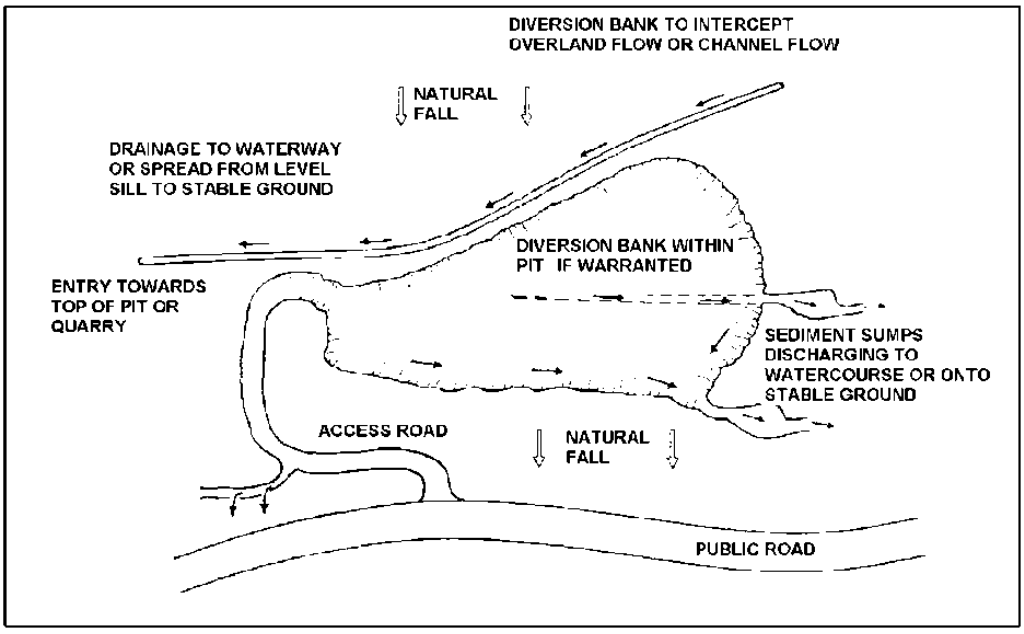

Figure 9. Idealised drainage plan

13. Appendix 2 - List of suitable rehabilitation species

Common Name	Species Name	Habit	Locality in Tasmania	Situation	Regeneration Method	Seed Treatment	Comments
Silver wattle	*Acacia dealbata*	Tree/ shrub	Common statewide, wet and dry areas	Not on poorly drained sites or alpine areas	Direct seed	Boiling waters treatment or scarify Collect Jan–Feb	Fast growing, frost hardy. Becomes a tall tree in wet gullies.
Spreading wattle	*Acacia genistifolia*	Spreading shrub (prickly)	Widespread, esp. eastern half.	Dry, in fertile areas	Direct seed, or cuttings	Boiling waters treatment or scarify Collect Jan-Feb	Very hardy
Black wattle	*Acacia mearnsii*	Tree/ shrub	Eastern half	Drier Areas	Direct seed	Boiling waters treatment or scarify	Hardy, fast growing
Blackwood	*Acacia melanoxylon*	Tree	Statewide	Wet areas (inc. swamps) prefers deep soils	Direct seed or seedling	Boiling water treatment of scarify Collect Feb-Apr	Prone to browsing. Requires clay soil
Narrow leaved wattle, Native willow	*Acacia mucronata*	Tree/ shrub	Statewide, but most common in the west	Damp areas.	Direct seed	Boiling waters treatment or scarify Collect Jan-Feb	_
Coastal wattle	*Acacia sophorae*	Spreading shrub	Common in all coastal areas	Sandy/ gravelly soils	Direct seed	Boiling water treatment or scarify Collect Jan-Feb	Excellent coloniser of sandy sites. Tolerant of sand abrasion and salt spray.
_	*Acacia stricta*	Low shrub	East coast and NE	Dry sites	Direct seed	Boiling water treatment or scarify	Very hardy in dry conditions. Frost tolerant.
Sunshine wattle	*Acacia terminalis*	Shrub/ small tree	Eastern half	Dry sites, tolerates poor soils	Direct seed	Boiling water treatment or scarify. Collect Jan-Feb	Hardy
Prickly moses	*Acacia Verticillata*	Shrub/small tree	Statewide	Damp sites	Direct seed	Boiling water treatment or scarify	Good for sites which are low in nutrients or poorly drained.
Bull oak	*Allocasuarina littoralis*	Small tree	Eastern half	Dry sites, sandy soils	Direct seed	Winged fruits from cones. Long lived seed	Hardy, tolerant of salt spray.
She oak	*Allocasuarina monilifera*	Shrub	Western half	Wet areas, poor soils	Direct seed	Winged fruits from cones. Long lived seed	From wet coastal heaths to subalpine scrub.
She oak	*Allocasuarina verticillata (formerly stricta)*	Small tree	Eastern half	Dry sites, poor shallow soils	Direct seeds. Collect cones all year	Winged fruits from cones. Long lived seed	Very drought resistant tolerant of salt spray.
Laurel	*Anopterus glandulosus*	Shrub	Western half	Rainforest understorey	Grow seedlings from cuttings	Sow in the cooler months. Collect Jan-Feb	Hardy

Common Name	Species Name	Habit	Locality in Tasmania	Situation	Regeneration Method	Seed Treatment	Comments
Banksia/honey suckle	*Banksia marginata*	Shrub/ tree	Statewide	Coastal areas and dry sites inc. subalpine	Direct seed or seedlings	Viable seed may be difficult to collect. Can spread cones.	Hardy, frost tolerant. Tolerant of salt spray. Good on poor sites. Slow growing.
Prickly box, Christmas bush	*Bursaria spinosa*	Shrub/small tree	Eastern half and NW coastal areas	Dry sites including rocky and coastal areas	Direct seed	Sow in the cooler months. Collect Jan-Feb	Hardy
Dolly bush	*Cassinia aculeata*	Shrub	Widespread.	Areas which have been disturbed	Direct seed	Windblown seed. Seed may be prone to attack	Similar appearance to Helichrysum, but occurs in dry areas.
Brown peppermint	*Eucalyptus amygdalina*	Tree	Eastern and northern	Dry areas, below 800m	Direct seed. Collect all year	Scarify at 3 -5° for improved viability	Very hardy, tolerant of shallow and acid soils.
_	*Eucalyptus brookerana*	Tall tree	Western half and the eastern tiers	Damp to wet sites	Seedlings	_	Resembles E. ovata.
Snow gum	*Eucalyptus coccifera*	Tree/ shrub	Central and southern	Rocky areas (dolerite) 800-1300m	Direct seed	Collect seed all year	Frost tolerant, Alpine/ subalpine.
Mountain white gum	*Eucalyptus dalrympleana*	Tree	Eastern and central mountains	Damp sites, 300-900m	Direct seed	_	Similar to E. viminalis which it replaces in colder,
White top stringy bark	*Eucalyptus delegatensis*	Tall tree	Mountains statewide (except the far west)	Damp sites, fertile soils, 450- 900m	Direct seed	Scarify at 3 -5° for improved viability	Excellent germination and growth on good soils in high areas.
Blue gum	*Eucalyptus globulus*	Tall tree	East coast, south east and Bass Strait.	Damp to dry sites.	Direct seed	Collect seed from Dec–Feb	Not highly frost tolerant. Fast growing.
Cider gum	*Eucalyptus gunnii*	Small tree/shrub	Mainly central highlands	High rainfall, high altitude	Direct seed	_	Frost hardy.
Smithton peppermint	*Eucalyptus nitida*	Tree/shrub	West coast	High rainfall sites (not waterlogged)	Direct seed	_	Tolerant of very poor soils, including quartzite areas.
Stringybark	*Eucalyptus obliqua*	Tall tree	Widespread apart from west, south west and high altitudes	Various well drained sites	Direct seed	Collect seeds from Dec-Feb	Vigorous under good conditions.
Black gum, Swamp gum	*Eucalyptus ovata*	Tree	Eastern half and north coast	Poorly drained areas and coastal sandy heaths	Direct seed	Collect seed from Dec-Feb	Frost tolerant, often grows in frost hollows, ideal for the Midlands.
Cabbage gum	*Eucalyptus pauciflora*	Tree	Eastern and central areas	Dry areas and well drained wet sites	Direct seed	Scarify at 3 - 5° C for improved viability	Frost tolerant, a good coliniser of gravels in the far north east.
Narrow leaf peppermint	*Eucalyptus pulchella*	Tree	Southern and eastern	Dolerite foothills, dry sites	Direct seed	_	Tolerant of frosts and poor soils.

Common Name	Species Name	Habit	Locality in Tasmania	Situation	Regeneration Method	Seed Treatment	Comments
Swamp gum, Stringy gum	*Eucalyptus regnans*	Tall tree	Mainly south east and north east (sheltered valleys)	Wet, well drained, moderately fertile sites	Direct seed. Collect seed from Dec.- Feb	Requires fertile conditions	_
Swamp peppermint	*Eucalyptus rodwayi*	Tree	Mainly central and eastern areas	Cold air drainage lines and marsh areas	Direct seed	_	Tolerates cold, wet conditions.
Ironbark	*Eucalyptus sieberi*	Tree	Coles Bay to St Helens and inland	Dry, gravelly sites	Direct seed	Collect seed from Dec–Feb	Requires fertile conditions.
Silver peppermint	*Eucalyptus tenuiramis*	Tree	East and south east	Dry, sites often on mudstone	Direct seed	Collect seed all year round	Tolerant of very poor and shallow soils.
White gum	*Eucalyptus viminalis*	Tree	Eastern half and north coast	Not high altitude or poorly drained sites	Direct seed	Collect from Jul-Jan	Very similar to E. rubida which replaces it in colder, drier climates.
Dolly Bush	*Helichrysum dendroidium*	Shrub	_	Margins of wet forest, streamsides	Direct seed	Windblown seed. Seed may be prone to attack	Similar in appearance to Cassinia above, but occurs on damp areas.
Kunzea	*Kunzea ambigua*	Shrub	East and north east	Dry to damp, well drained sites	Direct seed or cuttings	Seed difficult to collect as it falls when mature	Very hardy.
Coast tea tree	*Leptospermum laevigatum*	Shrub/small tree	West and north coast and Bass Strait	Sand dune areas, (lime sands)	Direct seed or cuttings	_	Very hardy, resistant to salt spray and wind.
Wooly tea tree	*Leptospermum laevigatum*	Shrub/small tree	Statewide	Damp, moderately fertile sites	Direct seed or cuttings	_	Hardy, tolerant of poor drainage.
Shiny tea tree	*Leptospermum nitidum*	Shrub	Western half	Poor soils, button grass plains, wet heaths	Direct seed	_	Tolerant of poor soils.
Tea tree	*Leptospermum rupestre*	Shrub/prostrate	_	Sub-alpine	Direct seed or cuttings	_	Slow growing prostrate.
Tea tree	*Leptospermum scoparium*	Shrub	Common statewide	Areas subject to some waterlogging	Direct seed	Easy to collect	A good coloniser of disturbed sites with poor or no soil.
Swamp paperbark	*Melaleuca squamea*	Shrub/small tree	Widespread.	Peaty heaths	Direct seed	_	Tolerant of very poor drainage.
Scented paperbark	*Melaleuca squarrosa*	Shrub	Statewide except higher areas. Especially north east.	Damp sandy soils, streamsides	Direct seed	Seed yields are low	Tolerant of poor drainage. Damaged by frosts.
Myrtle	*Nothofagus cunninghamii*	Tree	Mainly western	Wet, sheltered conditions	Cuttings or grow seedlings in a nursery	Seed is expensive, but a small amount can produce many seedlings	An important species for revegetation of rainforest sites.

ENVIRONMENT PROTECTION AUTHORITY