



Department of
**Primary
Industries**

**Guidelines for
Environmental
Management in
Exploration
and Mining**

3

REHABILITATION PLANS

***& OTHER ENVIRONMENTAL ASPECTS OF
WORK PLANS***

**Minerals and Petroleum Division
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1. Preamble

The purpose of these guidelines is to provide assistance to mining licensees, under the *Mineral Resources Development Act 1990*.

The Guidelines are an **advisory** document. They provide guidance on matters that the Department of Primary Industries (DPI) generally looks at in assessing plans. They do not set requirements for plans, beyond those statutory requirements, which are already in place. Nor are they intended to be a text on environmental management and rehabilitation techniques. Publications such as the *Mine Rehabilitation Handbook* produced by the Australian Mining Industry Council and *Best Practice in Environmental Management in Mining* produced by the Federal Environment Protection Agency are available for this purpose.

In addition to the Guidelines, Minerals & Petroleum Division (MPD) can provide direct assistance to licensees on the preparation of their Work Plan and the gaining of authorities from other Government agencies. Licensees are advised to contact MPD at an early stage in the preparation of their Plan.

A wide range of environmental and rehabilitation matters are addressed in the Guidelines. Not all of these will be applicable to every Work Plan. This is particularly so in the case of small mining operations (less than 5 hectares), and licensees should carefully consider which matters are relevant to their operations. In some cases, matters, which are not covered here, should also be addressed in the Plan.

Some mining proposals will be the subject of an Environmental Effects Statement (EES). Most of the matters covered in the Guidelines would also be covered in an EES. In cases where project design is at an advanced stage when the EES is prepared, it may be possible to combine the Work Plan and EES into one document. More commonly they will be separate documents, with the EES being more conceptual in nature and the detailed design being incorporated in the Work Plan. Where an EES has previously been prepared, the Work Plan should make reference to its analyses and findings but need not report its studies in detail.

2. Requirement for Work and Rehabilitation Plans

The *Mineral Resources Development Act 1990* (MRD Act) requires that a licensee proposing to do work under a Mining Licence or an Exploration Licence must submit a Work Plan.

In the case of a Mining Licence, the Work Plan must include a Rehabilitation Plan. This is a requirement whether the work proposed is mining or exploration.

3. Rehabilitation Plans

3.1 Statutory Requirements and Consultation

Some general guidance as to the content of Rehabilitation Plans is provided by the MRD Act, which requires that rehabilitation be progressive and that the Plan takes account of:

- (1) any special circumstances of the land, and
- (2) the surrounding environment, and
- (3) the need to stabilise the land, and
- (4) the desirability or otherwise of returning agricultural land to a state that is as close as

reasonably possible to its state before the Mining Licence was granted.

Schedule 13 of the Mineral Resources Development Regulations 2002 (Appendix 1) also prescribes general requirements and objectives for rehabilitation.

The MRD Act requires that the Rehabilitation Plan be prepared by the licensee after consultation with the owner of the land, if the land is private, or the land manager (part of the Department of Sustainability and Environment), if the land is Crown land.

MPD will require some verification, preferably written that the necessary consultation has taken place.

In the case of a Rehabilitation Plan for work on Crown land, the MRD Act also requires that MPD reach agreement with the land manager as to the amount of the rehabilitation bond. This may be difficult if the content of the Rehabilitation Plan has not already been agreed between the licensee and the land manager. To avoid delay to approvals, the licensee should make every effort to reach agreement as to the content of the Plan.

3.2 General Principles

3.2.1 End use objectives and final concept plan

Rehabilitation is an integral part of mining operations. It should be planned from the outset and, as far as practicable, undertaken during the operational life of the mine.

Rehabilitation planning should incorporate two elements. The first is a final concept plan. This need not be detailed but it should establish expected end use/s of the site and its general characteristics at the completion of rehabilitation. It provides the basis for rehabilitation activities throughout the life of the project.

There are a variety of possible end uses for mine sites. Options for open-cut pits include water bodies, landfill, return to agriculture or native vegetation and industrial/commercial use. In the case of long lived operations, it should not necessarily be assumed that proposed end uses, such as landfill or industrial development which may require further planning and environmental approvals, will be acceptable at some future time. Proposals should be practical and currently achievable. This approach will most often focus on the return of the site to a use similar to that before mining and involve basic landscaping and revegetation.

The end use objective for most agricultural land is the return of the land to a productivity level comparable with that prior to the mining operation. However, with the landowner's agreement, a change of land use need not be precluded. For example, former cropping or grazing land could be converted to wood production plantations or water storage.

The final concept plan should include a schematic plan showing salient features of the land following rehabilitation. These might include revegetated areas, pit faces, roads, drainage lines and water bodies.

3.2.2 Progressive rehabilitation

The second element of rehabilitation planning is the progressive plan. This should set out in some detail the proposed rehabilitation works, how they will be undertaken and their sequence and timing. The plan should specify rehabilitation standards or "completion criteria" which will be achieved. These can cover a wide variety of matters, including:

- * native revegetation - plant growth, plant density, species diversity
- * productivity of rehabilitated agricultural land
- * final slopes of pits, waste dumps, dam walls, etc.
- * chemistry and levels of suspended solids of runoff waters.

It is generally not sufficient only to cite compliance with licence conditions or regulatory agencies' requirements.

The progressive plan may cover the life of the licence/operation or a shorter period, say two to five years, with updates submitted later. Provision is made for staged rehabilitation plans, by variation of the Work Plan, in the MRD Act (section 41).

A site plan/s should be included. This can either be incorporated in the site plan required as part of the Work Plan (Appendix 1) or be a separate plan/s at the same scale. The site plan should indicate the location of proposed rehabilitation works and the progress of rehabilitation over time. Topsoil and waste dumps, bunding, final pit faces, benches, areas of landscaping and revegetation, roads, drains and dams should be featured.

3.2.3 Landscaping and screening

Landscaping should leave a final landform visually compatible with the surrounding natural landscapes, ensure that the land is stable and will not erode, and provide an adequate substrate for revegetation.

Rehabilitation planning should consider critical views and incorporate landscaping, screening, buffers and a site layout which minimise views of exposed faces, unvegetated waste heaps, stockpiles and plant. Thoughtful bunding, vegetation screening, progressive rehabilitation and selection of working directions can all reduce visual impact. Angular or straight landforms, flat surfaces and steep faces should be avoided where possible.

Erosion will result where slopes are too steep or too long. In soft, readily erodible material recommended slopes are 1V:3H or shallower. Long slopes should be broken by benches.

The Rehabilitation Plan should include analysis of the visual impact from critical views and specify final slopes.

3.2.4 Soil removal

Retention of soil is the key to revegetation. Topsoil, together with leaf and plant litter, should be removed and stockpiled separately from underlying material. Depending on the soil profile, up to 300 mm of topsoil may need to be stripped.

The Rehabilitation Plan should indicate the location and depth of soil stripping.

3.2.5 Soil resspreading

Soil should be resspread as soon as possible after stripping in order to maximise its fertility, seed viability and microbial activity.

The Rehabilitation Plan should indicate the approximate depth of resspread soil and its location. Consideration may also need to be given to the resspreading techniques used, with a view to minimising soil compaction that can inhibit later revegetation.

3.2.6 Soil stockpiling

In cases where stripped soil cannot be resspread immediately, it should be stockpiled. Stockpiles should be established as close as practicable to areas to be rehabilitated. They should be low (generally less than 2m in height), gently battered and located away from drainage lines. The Plan should include their locations and dimensions.

3.2.7 Seedbed preparation

The seedbed is the medium for plant growth. Following the resspreading of soil, treatment may be required to prepare the seedbed for planting. The treatments which are appropriate to a particular case will depend on the physical and chemical properties of the soil, the species used in revegetation and other factors such as climate and slope.

Soil treatments that may be required include:

- * deep contour ripping or ploughing
- * application of chemical and organic fertilisers
- * application of gypsum, lime and trace elements
- * covering with mulch or brush
- * planting of cover crop
- * hydromulching
- * bituminous spraying
- * application of weedicide or weed removal

The Rehabilitation Plan should indicate the proposed seedbed treatments and the reasons for their selection. Advice from the landowner or land manager may be sufficient to determine the appropriate treatments. Alternatively, studies of soil characteristics and other factors particular to the site may be required. For instance, chemical analyses of soils might be necessary to determine the appropriate type and application rate of fertiliser or the application rate for gypsum.

On some sites, particularly in old mining areas, there is little or no topsoil left on site for stripping and resspreading. Preparation of seedbeds without soil has been quite

successful in many cases. It involves the same range of treatments listed above, although application rates of fertilisers will generally need to be higher. Importing of soil is not recommended, especially in areas of native vegetation, because of the risk of the imported soil introducing weeds or plant diseases.

3.2.8 Revegetation

Revegetation is usually the primary objective of rehabilitation and is often the measure of its success.

Revegetation with native species may involve direct seeding, planting tubestock, natural regeneration or any combination of these. A variety of seeding techniques can be used, including hand broadcasting, mechanical broadcasting or drilling.

Species selection is important. Species should be local to the area and suitable for the on-site conditions, such as soil type and drainage. In areas of native vegetation, species should reflect the original vegetation. A pre-mining vegetation survey may be required to determine the appropriate species mix.

The Rehabilitation Plan should indicate the proposed revegetation method (seeding, tubestock, and natural regeneration) and the general mix of species. The source of seed or tubestock should also be indicated. Vegetation cleared for the operation should, where possible, be the primary source of seed. This can be supplemented with seed collected locally. Tubestock can be supplied by local nurseries or propagated on-site. Regional Department of Sustainability & Environment (DSE) offices can usually provide local advice on species selection and sources of seed and tubestock.

The objective of revegetation for most agricultural land is the return of the land to productivity. Accordingly, seedbed preparation and crop types should be determined in close consultation with the landowner and included in the Rehabilitation Plan. Catchment Advisory Services, DSE can also provide advice on seedbed preparation and crops.

3.2.9 Alternative revegetation methods

Licensees may wish to use revegetation methods other than those described above. Such alternative methods are acceptable provided that the rehabilitation standards achieved are at least equal to those that would be expected using conventional methods. Where alternative methods are proposed they should be supported by examples of their success elsewhere or a program to trial the methods should be included in the Plan. Where trials are proposed, their success will ultimately determine the acceptability of the method. Revegetation directly onto tailings is one instance where trials could be used to establish the viability of an alternative method.

3.2.10 Roads, tracks and other compacted areas

Rehabilitation of roads and tracks starts at the time of construction, when rehabilitation of embankments and fills should be undertaken.

Final rehabilitation of tracks and roads should only be undertaken following agreement with the landowner or land manager, as to whether the road or track will be retained after operations cease.

The Rehabilitation Plan should cover progressive rehabilitation, decommissioning and final rehabilitation of those tracks and roads not retained. Advice on such rehabilitation is provided in the *Guidelines for Exploration and Rehabilitation of Exploration Sites* and, where appropriate, should be referred to in the Rehabilitation Plan.

Other highly compacted areas such as loading areas, carparks and stockpile pads may require special treatment, such as deep ripping or removal of compacted material, prior to respraying of topsoil. Such measures should be included in the Rehabilitation Plan.

3.2.11 Runoff and erosion control

In most instances, the measures required for long-term run-off and erosion control on rehabilitated sites are similar to those required in the operational phase of mining (see 4.2.9). *Minesite Water Management Handbook* published by the Minerals Council of Australia and *Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria* published by the Soil Conservation Authority provide advice on a range of techniques that can be applied to control runoff and erosion on mine sites.

The Rehabilitation Plan should outline permanent control measures, such as drainage channels and dams, which are to be incorporated in the final landform.

3.2.12 Removal of plant and equipment

The Rehabilitation Plan should cover removal of plant, equipment and rubbish at the completion of works. Particular attention should be given to removal of plant foundations and underground facilities such as pipes and storage tanks.

Rubbish should be disposed of at an appropriate rubbish disposal site.

3.2.13 Site safety and security

Mining and exploration sites must be left in a condition that ensures the safety of the public. The Rehabilitation Plan should cover the security of the site and public safety, following cessation of operations. This may require limiting public access by fencing and barring of vehicular access tracks. Where applicable, the safety and stability of the pit faces, access to underground workings and safety of water bodies should be addressed.

3.2.14 Maintenance and monitoring

Maintenance of rehabilitated sites is often the difference between the ultimate success or failure of rehabilitation. Both during and following rehabilitation works, routine maintenance of structures such as drains, dams, silt traps and fencing should be undertaken. Maintenance of revegetation may also be required, in the form of replanting or reseeded in failed areas, weed control, watering, pest control and installation/repair of tree guards and fencing for protection from grazing.

Monitoring of rehabilitation will determine whether rehabilitation objectives and requirements are being achieved. In particular, performance against "completion criteria" should be monitored during and following rehabilitation.

The Rehabilitation Plan should propose schedules for maintenance and monitoring.

3.3 Exploration

Guidelines for rehabilitation of exploration sites are provided in the *Guidelines for Exploration and Rehabilitation of Exploration Sites*. Plans need not restate the provisions of these guidelines, but should refer to them where appropriate.

3.4 Shallow Surface Mining

The principles set out above cover most aspects applicable to shallow surface mining. The following matters should also be addressed in the Rehabilitation Plan:

- * Progressive rehabilitation is possible in many cases. A staged program should be developed, covering the sequence and timing of clearing, mining, backfilling and rehabilitation, and indicating the maximum areas open or unrehabilitated at any one time.
- * Proposals should indicate the materials to be used for the refilling of pits, the extent to which pits will be refilled and the resulting changes to landform. Of particular importance, is battering of final faces and the integration of the rehabilitated area into the surrounding landscape.
- * Some alluvial deposits will be mined on and around drainage lines. Plans should include any proposals for buffer zones around creeks, temporary or permanent diversion of creeks, and the final form, grades and erosion control structures of reconstructed drainage channels.

3.5 Opencut Pits

Opencuts most often change the landform permanently. Except for landfill operations, backfilling of deeper pits is generally not practical due to cost or lack of available fill material. It may however be a viable option for shallower pits.

Where voids are left, the following matters should be addressed in the Rehabilitation Plan:

- * The final pit slope and geometry should ensure that the pit walls are structurally stable and allow for the placement and long term stability of the rock fill (overburden) and soil required for revegetation. Plans should include cross-sections showing rock faces, benches and thickness of rock fill and soil cover placed on rock surfaces.
- * The shaping of the final pit walls may involve either battering or benching or a combination of these. The methods to be used to shape the walls, such as backfilling on benches and collapse of faces by blasting should be indicated.
- * Where possible, final pit walls and pit floors should be progressively rehabilitated. The Plan should indicate the sequence and timing of rehabilitation works and the expected maximum length of faces and area open or unrehabilitated at any one time.
- * Ripping or light blasting of pit floors and benches may be required to break up solid rock, prior to placement of rock fill and soil and revegetation.

- * Where opencuts intersect the water table, a permanent water body will be created unless the pit is backfilled to a level above the water table. Information on the depth of the water table and groundwater quality will be required to ascertain whether a water body should be part of the final rehabilitation proposal. If a water body is proposed, the regional water authority and DSE may also require studies of the impact of the opencut on aquifer systems, recharge areas, groundwater users and local rivers and streams.
- * Pit safety and security should have high priority as the risk to public safety can be high. Measures should be included to limit public access to opencut sites. Design of final pit faces, especially upper faces, and water bodies should minimise risk to the public.

3.6 Underground Mines

Matters that should be addressed in the Rehabilitation Plan include:

- * Removal of surface facilities and site rehabilitation.
- * On completion of mining, surface access to the works by shafts, adits or declines should be permanently closed off to the public and the site made secure. Details of proposals for capping or backfilling should be included.
- * Groundwater will be encountered in many underground workings. The Plan should indicate if any long-term discharges of groundwater to surface are likely to result from mining, the quality of that water and measures that will be taken to stop discharge or treat the discharged water. Where mining is below the oxidised zone and the ore body contains sulphides, particular attention should be paid to long term control of acidic and metal contaminated waters. Discharge of water offsite generally requires approval from the Environment Protection Authority (EPA) as outlined in section 4.2.10.

3.7 Tailings Retreatment

The rehabilitation principles for mines generally apply to tailings retreatment. The following matters may also require attention in the Rehabilitation Plan:

- * Gold mining tailings often carry high levels of arsenic and mercury. Rehabilitation should ensure that the retreated tailings are confined in properly constructed and rehabilitated tailings dams, so as to prevent contamination.
- * Tailings removal should ensure that all contaminated material is removed or stabilised prior to revegetation.
- * Tailings removal sites will often have little, if any soil available for rehabilitation. Original soils underlying the tailings may be contaminated and should be analysed prior to use in rehabilitation. Where soil is not available or not suitable, the Rehabilitation Plan should specify the techniques, which will be used to achieve revegetation.

3.8 Tailings Dams

The rehabilitation of tailings dams is often a most difficult element of rehabilitation due to their physical instability and chemistry.

At the outset, planning should ensure that sufficient material (rock, clay, sand, and soil) is available for covering of the tailings in final rehabilitation.

Initially the dam must be dried out so that machinery can access the dam surface. Access and rehabilitation can be delayed for years if appropriate measures to aid drying are not in place. The Rehabilitation Plan should detail measures proposed to hasten drying, such as surface drainage, under-drainage, decant structures and thickening or filtering of wastes.

The Plan should address battering of external dam walls to allow effective revegetation and prevent erosion (slopes of 1V: 3H or shallower are recommended), installation of cut-off drains to reduce water flowing onto the dam surface, and long-term collection and treatment of seepage from the dam.

Dam rehabilitation techniques will largely depend on the chemistry of the tailings. For tailings with extremes in pH or high levels of heavy metals, other toxicants or salinity special rehabilitation measures will be required. The Plan should detail proposals which may include capping with a low permeability (clay) layer, placement of a coarse layer for drainage and as a capillary barrier, covering with soil and other fill material and crowning of the surface for drainage. Where tailings are acidic (low pH), lime to neutralise the tailings may be applied. Permanent water cover is an alternative rehabilitation approach for sulphidic tailings with potential for acid generation.

Tailings which are not chemically contaminated or saline, such as those from some gravity separation plants, can generally be revegetated by placing directly onto the tailings, soil and other fill material of sufficient depth to allow root development.

Species selection can be very important and should be addressed in the Plan. Shallow rooting species and, for saline tailings, salt tolerant species should be considered. Trialing of different species is also recommended. In some instances, revegetation directly onto tailings has also been successful.

Tailings Containment- Best Practice Environmental Management in Mining published by the Federal Environmental Protection Agency provides further information on tailings management.

3.9 Waste Dumps and Leach Heaps

Well located, landscaped and vegetated dumps can form very effective visual screens for operations. Conversely, bare and eroding dumps can be an eyesore. To minimise visual impact during operations, dump construction and rehabilitation should, where practicable, start on the outer dump perimeter with later dumps inside the rehabilitated perimeter dumps.

For erosion control, final slopes of 1V: 3H or shallower are recommended, with benches to break long slopes.

Where toxic or acid-generating wastes are involved, dumps may require capping with a low permeability (clay) layer and drainage and treatment of contaminated waters.

The Rehabilitation Plan should indicate dump locations, dimensions, slopes, erosion control measures, capping, drainage and revegetation.

Rehabilitation of leach heaps can be dealt with in much the same manner as other waste dumps. The Plan should outline measures that ensure that remnant cyanide in seepage from heaps will be at acceptable levels and will not create a health risk or cause environmental harm in the long-term.

4. Other Environmental Aspects of Work Plans

4.1 Exploration

The principles of environmental care are set out in the *Guidelines for Exploration and Rehabilitation of Exploration Sites* and need not be restated in the Work Plan.

4.2 Mining

4.2.1 Statutory requirements

Schedule 13 of the Mineral Resources Development Regulations 2002 (Appendix 1) requires that Work Plans for Mining Licences over 5 hectares include proposals for disposal of tailings, mine waters, drainage, erosion control, suppression of noise and dust, and environmental monitoring.

4.2.2 Environmental planning and monitoring.

Potential environmental concerns should be identified at an early stage and design feature to minimise impacts incorporated in the Work Plan. In some cases, background monitoring and specialist environmental studies will be required to ascertain impacts and appropriate control measures. For substantial operations, preliminary work might include flora and fauna, acoustic, surface water, groundwater and traffic movement studies.

Workplans for larger operations should include an environmental monitoring program based on preliminary studies of environmental impacts. Information from environmental monitoring assists in fine tuning existing control measures or implementing new ones as required, and identifying emerging environmental problems. Issues that may be addressed in environmental monitoring programs include, dust and noise emissions, progressive rehabilitation, tailings dams, surface water and groundwater. The workplan should outline the proposed methods for monitoring these parameters.

4.2.3 Vegetation removal and buffers

Site planning should ensure that the area of land disturbed and vegetation cleared for mining operations is minimised. This will reduce environmental and visual impact and the area to be rehabilitated. Retained vegetation may also reduce the need for planting of buffers and visual screens and act as a source of seed for revegetation. Where vegetation is cleared it may be necessary to collect seed before clearing to ensure that seed of local provenance is available.

The Work Plan should indicate areas of native vegetation which will be cleared and where appropriate incorporate a vegetated buffer zone, at least 30m wide, at the periphery of the licence area.

4.2.4 Flora and fauna protection

Mining operations can impact on native flora and fauna, particularly where the clearance of native vegetation is required.

Any proposals for the clearing of native vegetation should be specified in the workplan. A planning permit for native vegetation clearance is not generally required. However, where clearing is proposed the DPI must consider whether it is necessary or justified. In assessing the proposal DPI will take into account the rehabilitation plan and other proposals for replacement of the lost vegetation. Where locating facilities elsewhere could reduce the impact on native vegetation, the work plan should explain the reasons for the choice of location. The licensee should also consult the local Municipality as some local planning schemes contain specific provisions for protection of native vegetation.

DSE can initiate action to protect threatened species and their habitats, under the *Flora and Fauna Guarantee Act 1988* (FFG Act). A permit to take protected flora may be required under the FFG Act if the land has been defined as “critical habitat” or if threatened species are involved. Where an EES has been prepared, it will routinely address the impact of the project on flora and fauna and permits will not be required.

Where native vegetation is to be cleared some assessment of the impact on flora and fauna may be required. This could involve a review of existing information pertaining to the area or flora and fauna field surveys. The degree, if any, to which such assessment is required should be determined in consultation with DSE. The Work Plan should include a summary of the assessment.

4.2.5 Noise

Noise is most likely to be a problem for mines located close to residences, especially when operations are to be conducted outside normal working hours. Native fauna can also be affected by noise.

Sources of noise include trucks, mobile machinery, ore bins, crushers, grinders, generators, ventilation systems and treatment plants. Standard approaches to reduction of noise levels are acoustic barriers, housing of machinery and silencing of machinery.

In rural areas with very low background noise levels, EPA guidelines advise that limits at residential premises may be as low as:

Day	(7am-6pm Mon-Fri, 7am-1pm Sat)	- 45 dB (A)
Evening	(6pm-10pm Mon-Fri, 1pm-10pm Sat, 7am-10pm Sun)	- 37 dB (A)
Night	(10pm-7am)	- 32 dB (A)

In metropolitan Melbourne, and provincial cities and rural areas with comparable background noise levels, the noise limits are determined according to the State Environment Protection Policy N-1. These are generally higher than those applying to rural areas with low background noise levels.

During the construction phase of operations, the daytime limit is raised by 10 dB (A), but may not exceed 68 dB (A).

The EPA should be consulted as to the noise limits, which will apply to specific sites.

The Work Plan should assess the effect of operations on local residences and demonstrate that the predicted noise levels will be in compliance with EPA limits. The location of residences, relative to the mine, should be described or marked on a site plan. The Plan should also include details of noise control measures to be adopted and hours of operations.

4.2.6 Vibration

Like noise, vibration caused by blasting may be a problem for mines located close to residences.

DPI applies limits for ground vibration and airblast recommended by the Australian and New Zealand Environment Council. Ground vibration must be below 5mm/s in at least 95% of cases and must not exceed 10mm/s. Airblast must be below 115dB(L) in at least 95% of cases and must not exceed 120dB(L).

In addition inspectors are empowered to take whatever action is necessary to ensure vibration and airblast do not exceed levels recommended in Australian Standard AS 2187.2 for protection of property.

Where blasting could have impact on local residences and population, the Work Plan should provide an assessment of the levels of ground vibration and air blast which will be experienced at local residences and other sensitive locations, and demonstrate these will be within the prescribed limits. Blast design and techniques can usually be varied to achieve compliance with prescribed limits.

4.2.7 Dust and other emissions to air

Dust from mining operations is most likely to be a problem during summer and early autumn in mines located close to residences. Dust may also have an adverse impact on surrounding vegetation.

Dust may be generated from stripping operations, pits, stockpiles, waste dumps, crushing and handling plants and roads.

Dust can be controlled by the use of watering systems and housing of crushers, screens, conveyors and loading areas, watering of roads and stockpiles, chemical dust suppressants, windbreaks and rapid revegetation of exposed areas.

In sensitive locations and for larger operations monitoring of dust emissions, using deposit gauges, may be required.

The Work Plan should assess the likely impact of dust from the operation on local residences and vegetation and outline measures for suppression and, where appropriate, monitoring of dust.

Other emissions to air may include exhaust fumes from vehicles and machinery, mine ventilation exhausts, and fumes and exhausts from processing plants. These will not

generally be of concern, but should be considered and, if necessary, control measures outlined in the Plan.

4.2.8 Traffic movements

Movements of trucks and other vehicles on local roads often cause concern to local residents and councils, for reasons of the safety of other road users, nuisance and road maintenance.

Traffic issues are usually addressed in agreements between Local Government and the licensee or in Local Government planning approvals or in an EES. If so, then only a summary need be included in the Work Plan. If not, traffic issues should be addressed in the Plan and may include:

- * identification of the number and type of vehicle movements, traffic routes, hours of road use and control measures, such as speed limitations,
- * assessment of the impact of increased vehicle movements on road safety, local nuisance and road maintenance, and
- * proposals for road works, if required.

4.2.9 Runoff and erosion control

Steep slopes usually cause runoff and erosion problems, clearance of vegetation, failure to revegetate and inadequate drainage. Control is best achieved by lowering slopes, minimising unvegetated areas and installing cut-off drains to keep water off the site, by properly constructed exit drains to direct water from the site and reduce flow velocities, and by sediment traps and dams to minimise sediment discharge from the site.

The Work Plan should detail drainage and erosion control measures, including dams, drains and sediment traps. As a general guide, drains and sediment traps should be designed for a one in 100 year flood event.

Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria published by the Soil Conservation Authority provides advice on a range of techniques that can be applied to control runoff and erosion on mine sites.

4.2.10 Water storage capacity and discharge

Water storage capacity must be sufficient to either contain all waters on-site or hold excess water for treatment and/or desilting prior to discharge. As a general rule, if no discharge is proposed, dams should be designed to contain rainfall of a one in 10 year rainfall regime.

For substantial projects in which water management is an important part, the Work Plan should provide calculations of the required storage capacity, taking account of seasonal factors, high rainfall events, surface runoff coefficients, evaporation and groundwater extraction resulting from dewatering of underground or opencut workings. Where significant groundwater flows are likely to be encountered and extracted, hydrogeological information will be required for water balance calculations.

Other options for disposal of excess water include re-use in processing, evaporation ponds, on-site irrigation and recharge to aquifers. (Recharge to aquifers requires a licence from the regional water authority and may also require a discharge licence from the EPA). Where proposed, these methods should be detailed in the Work Plan and incorporated in the water balance calculations.

Discharge of water from Mining Licence areas generally requires an EPA Works Approval and Waste Discharge Licence. Discharges must meet EPA standards for physical and chemical water quality. Much of the groundwater encountered in Victoria is too high in dissolved salts for discharge to surface waters. In auriferous areas, elevated arsenic and iron levels may also preclude discharge without treatment.

Where discharge of mine waters is proposed, and unless otherwise covered in an EPA Works Approval, the Work Plan should provide chemical analyses of waters, details of water treatment systems and demonstrate that the operation can meet EPA discharge standards.

4.2.11 Process water requirements and dewatering

Mining operations often use substantial volumes of water for processing and may require supplementary supplies of surface or underground water. A licence from the regional water authority is required for surface water and groundwater extraction. Regional water authorities also license groundwater extraction for dewatering purposes.

Water extraction, either for supply or dewatering purposes, can cause environmental harm to streams, damage to aquifers and adversely affect other water users.

Where significant water extraction is planned, the Work Plan should provide an assessment of the impacts and any management or monitoring proposals. Such assessments may involve hydrological, ecological or hydrogeological studies.

4.2.12 Waste disposal

The disposal of mining and processing wastes to tailings dams, leach heaps, leach vats, dumps, opencuts or underground is an integral part of most mining operations.

The Work Plan should describe the treatment and waste disposal methods to be employed and provide the layout and design of waste disposal facilities.

Matters that should be covered include:

- * the chemical characteristics of the wastes, in particular estimated concentrations of toxic components,
- * computation of the volume of wastes to be disposed of and demonstration of the adequacy of capacity of the proposed storage facilities,
- * monitoring proposals to measure any contamination of the surrounding environment.

Construction, management and monitoring requirements for tailings dams, heap leach pads and vat leach systems can be obtained from Minerals & Petroleum Division (MPD).

4.2.13 Management of process chemicals, hydrocarbons and explosives

Mining and processing operations use a variety of chemical, hydrocarbon and explosive products. Requirements for the safe handling, use, storage and transport of these materials is prescribed in detail in the OH & S (Mines) Regulations 2002 and regulations under the *Dangerous Goods Act* 1985.

The Work Plan should identify the broad types of hazardous materials, if not the specific products, which will be used on-site and transported to the site. General proposals for the handling, use, storage and transport of hazardous materials should be outlined. More detailed management procedures should be provided in the Operations Plan required under clause 2.32 OH & S (Mines) Regulations 2002. They need not be included in the Work Plan. However, where environmental impacts are likely these should be described and control measures outlined in the Plan.

4.2.13.1 Cyanide

Cyanide is used extensively in the treatment process for gold recovery. In some forms cyanide is highly toxic, though it does break down rapidly on exposure to air and sunlight.

Information on the behaviour and management of cyanide and controls on its use can be obtained from MPD.

The Work Plan should indicate if cyanide is to be used and include proposals for its management.

4.2.13.2 Mercury

Mercury is used to aid the recovery of gold in some small scale operations. It may be mixed with concentrates to produce an amalgam or used to coat the copper plates of conventional stamp batteries.

It is extremely toxic, particularly so as vapour, and in some forms accumulates in aquatic organisms. Both environmental and occupational health concerns must be managed where mercury is used.

Occupational health concerns arise primarily from the handling and storage of mercury and the retorting and smelting of amalgam, which generally take place in the goldroom. These matters, including the methods and plant used, should be detailed as required under the OH & S (Mines) Regulations 2002. They need not be included in the Work Plan. The Department's *Guidelines for the Use of Mercury in the Gold Mining Industry* should be consulted when preparing this aspect of the Operations Plan.

Environmental concerns also arise from the disposal of solid waste (concentrates or tailings) and waste water. Wastes potentially contaminated with mercury must be contained or removed.

The Work Plan should indicate if mercury is to be used in the operation and include proposals for containment or removal of potentially contaminated wastes that will ensure that mercury is not released to the environment. Again, the Department's *Guidelines for the Use of Mercury in the Gold Mining Industry* should be consulted when preparing this aspect of the Work Plan.

4.2.14 Acid mine drainage (AMD)

AMD is most commonly associated with base metal mines, though the potential exists for acid generation in any metalliferous mining involving unoxidized, sulphidic ore and in coal mining.

Where the potential for AMD exists, proposals for its management should be included in the Work Plan. These should cover the tailings containment system, the collection and treatment of runoff from stockpiles, mine water and seepage from the tailings dams, and monitoring.

4.2.15 Tailings retreatment

The general principles applying to gold mining and ore treatment can be applied to the retreatment of gold-bearing tailings, using cyanide.

Arsenic and mercury are often concentrated in tailings. Retreatment of tailings affords the opportunity to contain toxic wastes, which might otherwise contaminate land and waterways, in properly constructed dams.

Work Plans should provide chemical analyses of tailings, including arsenic and mercury levels, and proposals for final containment in dams. In cases where arsenic or mercury levels are high, the Plan should pay particular attention to the handling and transport of tailings and dust and erosion control measures.

4.2.16 Pest plants and animals

Licenseses are required to manage pest plants and animals on Mining Licences. Advice on this can be obtained from Catchment Management Officers at regional DSE offices. *Win the War Against Weeds* published by DSE provides information on the control of serious weeds. Where pest plants or animals are likely to be of concern, the Work Plan should include detailed proposals for their management.

4.2.17 Heritage

Most of Victoria's current gold mining operations are in areas where mining has occurred previously and where relics of those activities remain.

The protection of sites of archaeological significance is provided for in the establishment of Historic Areas and Reserves and under section 45 of the MRD Act.

Where relics are located on a proposed mining site, the Work Plan should address heritage preservation. The advice of Heritage Victoria should be sought. In some cases, pre-mining archaeological surveys may be required to assess which relics are significant. A summary of such surveys should be incorporated in the Plan.

Conflict between mining and Aboriginal culture has been rare in Victoria. Under the MRD Act (sections 6 & 45), exclusions or restrictions are placed on mining operations where land of Aboriginal or archaeological significance is involved.

4.2.18 Risk management

Accidents, equipment breakdowns, natural events and human failings can all lead to situations where populations or the environment could be at risk. For mining operations typical examples could include - overtopping of dams, failure of dams, explosions, escape of chemicals, collapse of faces or underground workings, flooding and vehicular accidents.

It is not practical or necessary for the Work Plan to document every such potential situation. However, where significant risks are apparent some appraisal of the risk factors should be undertaken, along with an outline of control measures and contingency plans. Any detailed risk management procedures should be included in the Operations Plan required under the OH & S (Mines) Regulations 2002. They need not be included in the Work Plan.

Mineral Resources Development Act 1990
Mineral Resources Development Regulations 2002*For mining licences exceeding 5 hectares*

1. A general description of geological information including, if available, estimates of ore resources and reserves.
2. A general location plan at scale of 1:100 000 or 1:50 000.
3. A regional plan at scale of 1:25 000 showing the extent of Crown lands, private lands, private land allotments for the proposed work plan area, and, where possible, parks and reserves, within 2 km of the site.
4. A site plan at 1:1000, 1:2500 or other appropriate scale, including cross-sections, showing and describing existing surface contours, etc., and also including--
 - (a) the proposed buildings and surface facilities; and
 - (b) the anticipated extent of open cut extraction, with proposed bench height, berm details and working batters; and
 - (c) the sequencing of open cut extraction; and
 - (d) the location of topsoil dumps, and waste dumps or stockpiles; and
 - (e) proposals for landscaping of the site, including buffer zones; and
 - (f) access roads; and
 - (g) if underground mining is proposed, a schematic drawing showing underground development and the proposed extent of stoping.
5. A description of the metallurgical and mineral recovery methods to be used.
6. A rehabilitation plan that--
 - (a) addresses concepts for the end utilisation of the site; and
 - (b) includes a proposal for the progressive rehabilitation and stabilisation of extraction areas, road cuttings and waste dumps, including re-vegetation species; and
 - (c) includes proposals for the end rehabilitation of the site, including the final security of the site and the removal of plant and equipment.
7. An environmental management plan which--
 - (a) identifies the key environmental issues for the proposal and includes details of background data, baseline studies or existing conditions in relation to environmental issues;
 - (b) includes proposals for the management of environmental impacts including nomination of targets and proposals for the mitigation, control or reduction of impacts;
 - (c) includes proposals for the management of wastes including consideration of the principles of waste minimisation;
 - (d) includes a proposed monitoring program addressing the key environmental issues;
 - (e) includes a proposal for reporting outcomes of the plan to the local community.
8. An occupational health and safety plan that demonstrates, so far as is practicable, that the works are designed and will be operated so as to be safe and without risks to health.

For mining licences not exceeding 5 hectares

1. A general description of any test work undertaken in the licence area.
2. A general location plan with a scale of 1:100 000, 1:50 000 or 1:25 000.
3. A plan of the licence area at an appropriate scale which shows--
 - (a) the proposed buildings and surface facilities; and
 - (b) access roads and tracks; and
 - (c) the location of any proposed tailings dams and water dams; and
 - (d) the general drainage pattern of the area; and
 - (e) the anticipated sequencing and extent of any open cut extraction; and
 - (f) if underground mining is proposed, a schematic drawing showing underground development and the proposed extent of stoping.
4. A description of proposed mineral recovery methods.
5. A description of rehabilitation proposals including--
 - (a) proposals for the progressive rehabilitation and stabilisation of extraction areas; and
 - (b) proposals for the removal of any plant or equipment (if relevant).
6. An occupational health and safety plan that demonstrates, so far as is practicable, that the works are designed and will be operated so as to be safe and without risks to health.

APPENDIX 2

Sources of further advice

Further advice on rehabilitation and environmental management is available from:

District Managers, Minerals and Extractive Operations – Department of Primary Industries

Ballarat	Southwest	BH	03	5336 6802	AH	0408 334 751
Melbourne	Metro	BH	03	9658 4424	AH	0419 593 303
Traralgon	Gippsland	BH	03	5172 2158	AH	0419 375 842
Benalla	Northeast	BH	03	5761 1501	AH	0428 541 169
Bendigo	Northwest	BH	03	5430 4692	AH	0409 541 160

Mining Co-ordinators, Department Sustainability and Environments (Land Manager)

Ballarat	Southwest	BH	03	5336 6744
Melbourne	Port Phillip	BH	03	9296 4517
Traralgon	Gippsland	BH	03	5172 2194
Benalla	Northeast	BH	03	5761 1627
Bendigo	Northwest	BH	03	5430 4626

Industries contacts

Minerals Council of Australia (Victoria Division) telephone (03) 9629 1851
Prospectors and Miners Association of Victoria telephone 0408 176 496

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