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Department of Primary Industries

Mine Rehabilitation Options and Scenarios for the Latrobe Valley

Developing a Rehabilitation Framework

June 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Executive Summary

The Latrobe Valley contains extensive brown coal resources that have been mined to provide the major source of electricity generated to meet Victorian needs over the last 80 years. The mines are of massive scale - covering large areas, and are very deep (150m to 250m deep and even deeper with new technology). Even though the mines have long project lives, progressive rehabilitation and planning for Mine Closure is an essential part of mine approval and mining. The LV2100 Coal Project examined future mining areas in the Latrobe Valley (Figure 1), and recommended further examination of the coal fields rehabilitation strategy.

For many years coal mining and mine rehabilitation was managed for the Victorian Government by the State Electricity Commission (SECV). Following privatisation of the industry the approval of mine and mine rehabilitation plans primarily rests with the Department of Primary Industries.

Mine rehabilitation planning and approval is on a project-by-project basis with limited consideration of regional issues and without a regional strategy identifying the appropriate mine development and rehabilitation arrangements.

This study, carried out by GHD for DPI, discusses rehabilitation issues particular to open cut coal mining in the Latrobe Valley and Gippsland and provides a Rehabilitation Framework to assist industry, government and the community to evaluate options for the rehabilitation of future mines.

The Framework assumes that mine rehabilitation planning should comprise both a **Final Land Form design** and a **Final Land Use assessment**.

The Final Land Form is the overall shape of the mine at the end of mining operations, including the rehabilitated mine and overburden dumps. The Final Land Form is a fundamental determinant in the mine design and in the rehabilitation. It will define the location of the final mine crest, mine slopes, coal recovery, waste dump locations and long-term aquifer dewatering requirements. Hence it is critical to determine the Final Land Form as part of the initial mine planning and approval even though mine closure might be 50 or even 100 years in the future.

On the other hand The Final Land Use assessment describes the potential use(s) of the rehabilitated mine site after closure and as in most cases there are a number of options the final land use may not be determined until closer to the end of the mine life.

Mining should progressively develop towards the Final Land Form so that worked out areas or completed waste dumps can be progressively rehabilitated and returned for other uses. Changing the Final Land Form part way through the life of the mine is likely to be a very difficult and costly exercise and should only be considered in association with a significant change to the Mine Work Plan.

The appropriate Final Land Form for a rehabilitated mine area should:

- Make mine rehabilitated areas safe and stable,
- Minimise fire risk from exposed coal seams,

- Optimise the recovery of coal and the use of water resources;
- Reduce the continued impact on regional aquifers / regional subsidence; and
- Provide the community with a rehabilitated land area that provides opportunities for land uses that are safe for use and sustainable into the future i.e. a lasting legacy to the community.

In the Latrobe Valley brown coal mines, the rehabilitated mine areas are likely to be extremely large and varied so it is possible to have a significant number of alternative uses for rehabilitated mine lands. Rehabilitated mine areas could be used for water storage; flora or fauna specialist habitats, forestry, agriculture, industry; or even for tourism - concerts, rock climbing or trail biking. Storage ponds could be used for storage, water treatment, fish farming etc. As it is difficult to accurately predict land uses that will suit community needs for the future, it is suggested these can be selected closer to the closure date. As areas are progressively rehabilitated, the Environmental Review Committee, set up for each mine and involving key community and government representatives, can assist assessing appropriate Land Uses. In this way, final decisions for the required Land Use of a rehabilitated mine can be modified to suit the changing needs of the community and a number of sustainable uses could be carried out concurrently.

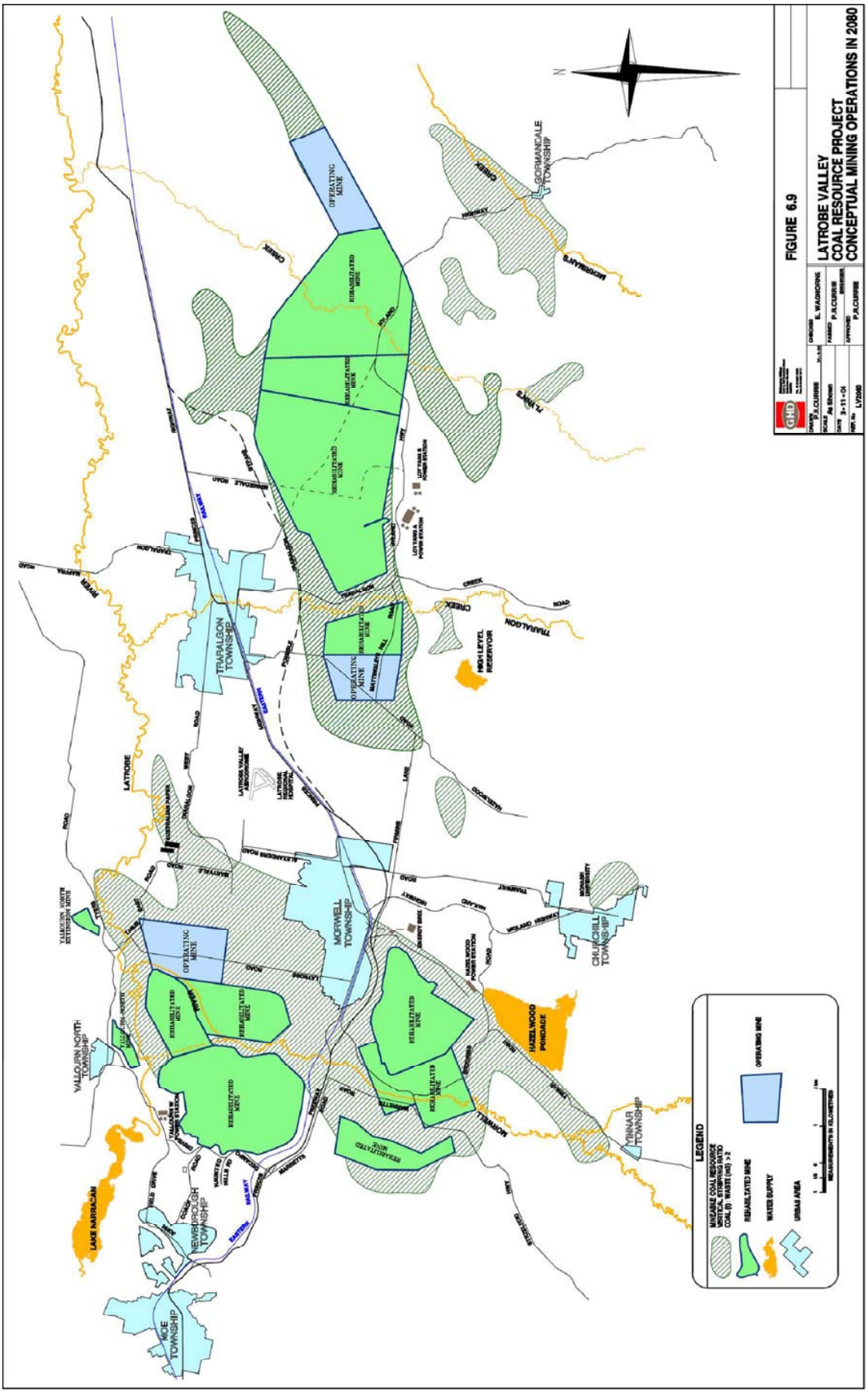
This study has developed a Framework for implementation and provided Framework Guides to assist design or evaluate mine rehabilitation strategies of open cut mines. This study has also highlighted a number of specific issues relating to the long-term rehabilitation of the Latrobe Valley and Gippsland open cuts that need further evaluation in consultation with industry and other key stakeholders. These include: -

- the use of other materials to develop an acceptable subsoil / topsoil layer;
- deposition of acid forming material within dumps;
- how to rehabilitate exposed coal batters;
- sourcing water for a flooded solution;
- interim rehabilitation for mine batters that may be needed for expansion; and
- acceptable aquifer pressure levels for rehabilitation design.

Victorian Legislation requires mining companies to provide a Bond, based on the requirements to achieve the rehabilitation plan.



Figure 1 Conceptual Mining Operations in 2080 (ref LV2100 Coal Project)



1. Introduction

In Victoria, brown coal provides the major source of energy. Energy is essential to our well-being, both as individuals and as a community. It powers, heats and cools our industries, businesses, transport, homes and recreational facilities. It provides the basis of our lifestyle and economy. The sustainable, secure, reliable and affordable supply of energy is a critical policy focus for the Victorian Government Policy "Energy for Victoria – An Overview" (Ref **a**). Until alternative cheap energy is harnessed for electrical power brown coal mining is vital for Victoria. With a view to the future use of the Latrobe Valley brown coal resources, the Victorian Government has introduced the Greenhouse Gas Challenge (Ref **b**) and (Ref **c**) to ensure that new brown coal conversion has a lower impact on greenhouse gas emissions to the atmosphere.

An effective mine rehabilitation plan and strategy is a critical part of any new mine design and approval especially in the Latrobe Valley because the coal mines cover large areas, have long lives, and are a critical part of the community sustainability.

New brown coal mines could be deeper than current mines and complete backfilling to the natural surface with overburden will be impossible to achieve. So rehabilitation strategies are more than an end use determination. The shape of the rehabilitated surfaces and their long term safety and stability are critical parts of the rehabilitated mine. Mine planning and progressive rehabilitation should be practiced to develop an appropriate rehabilitated land form that is safe and stable. Following closure the disturbed mine and dump areas should provide sustainable long-term use beyond the life and benefits of mining.

Mining in Victoria is regulated by the Department of Primary Industries (DPI) through the Mineral Resources (Sustainable Development) Act 1990 (Ref **m**). A number of parts of the Victorian Government Acts and Regulations that are relevant to mine rehabilitation are given in Appendix A.

The Mineral Resources (Sustainable Development) Act 1990 purpose is as follows:

"The purpose of this Act is to encourage an economically viable mining industry which makes the best use of mineral resources in a way that is compatible with the economic, social and environmental objectives of the State."

Part 7 (Rehabilitation) of the Act also requires that land be rehabilitated progressively or at the end of operations and specifies the requirements for the licencee to enter into a rehabilitation bond: -

- *Licencee must rehabilitate land*
- *Rehabilitation plan. A rehabilitation plan must take into account any special characteristics of the land; the surrounding environment; the need to stabilise the land; and the desirability or otherwise of returning agricultural land to a state that is as close as is reasonably possible to its state before the mining licence was granted*
- *Rehabilitation bond. Requirement for a rehabilitation bond (not detailed here)*

- *Rehabilitation. The licencee must rehabilitate land in the course of doing work and must, as far as practicable, complete the rehabilitation of the land before the licence or any renewed licence ceases to apply to that land.*

1.1 Study Aim

The aim of this study is to review rehabilitation strategies and options for the Latrobe valley brown coal open cuts and recommend a Framework for Rehabilitation Design and Approval. Although existing rehabilitation approval processes exist for mining in Victoria, the very large, long life and deep mines used in the Latrobe Valley may require more appropriate arrangements. A more detailed outline for the project scope is given in Section 1.2.

1.2 Project Scope

- Analyse existing rehabilitation plans of current mines
- Assess rehabilitation issues for future deeper mines and merged super pits
- Identify associated environmental issues with regards to mine rehabilitation and potential land use options
- Identify mine rehabilitation options
- Suggest potential role of Government to implement rehabilitation options
- Carry out stakeholder consultation

2. Mine Rehabilitation Principles & Practices

To commence this study a number of rehabilitation principles and practices were researched to provide input into the designed framework.

2.1 Enduring Value

The Minerals Council of Australia (MCA) has embraced "Enduring Value" as the Minerals Industry Framework for sustainable development. Enduring Value was based on the UN World Commission on Environment and Development (Our Common Future, 1987 - also known as the Brundtland Commission) that defined sustainable development as "A system of development that meets the basic needs of all people without compromising the ability of future generations to meet their own life sustaining needs" (Ref **d**). The future of the Australian minerals industry is seen by the Australian Mining Industry as inseparable from the global pursuit of sustainable development. Through the integration of economic progress, responsible social development and effective environmental management, the industry is committed to contributing to the sustained growth and prosperity of current and future generations (Ref **e** and Ref **f**), and providing an Enduring Value.

Within the ten Principles established by the MCA for Enduring Value, a number are directly relevant to mine rehabilitation:

Principle 1 Implement and maintain ethical business practices and sound systems of corporate governance.

Principle 2 Integrate sustainable development consideration within the corporate decision-making process.

Principle 3 Uphold fundamental human rights and respect cultures, customs and values in dealing with employees and others who are affected by our activities.

Principle 4 Implement risk management strategies based on valid data and sound science.

Principle 5 Seek continual improvement of our health and safety performance.

Principle 6 Seek continual improvement of our environmental performance.

Principle 7 Contribute to conservation of biodiversity and integrated approaches to land use planning.

Principle 8 Facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products.

Principle 9 Contribute to the social, economic and institutional development of the communities in which we operate.

Principle 10 Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders.

2.2 Industry Code for Environmental Management

The Code for Environmental Management was launched in December 1996 as an initiative of the Minerals Council of Australia on behalf of the Australian minerals

industry. It was a significant step by the industry to address its environmental performance and public accountability. At that time the industry made a commitment to review the code in three years. The revised Code is a result of the review undertaken in 1999. The Code for Environmental Management is a key tool in achieving those aims. It encourages companies to adopt a continually improving standard of environmental performance and, through leadership, the pursuit of environmental excellence.

The 2000 Code Principles (Ref Ag) are as follows:

1. Accepting Environmental Responsibility for All our Actions

Driving environmentally responsible behaviour throughout the organisation by:

- Demonstrating management commitment.
- Allocating clear roles, responsibilities, accountabilities and resources.
- Providing necessary information, performance targets, training, resources and management support.

2. Strengthening our Relationships with the Community

Engaging the community about the environmental performance of our operations by:

- Fostering openness and dialogue with employees and the community.
- Respecting cultural and heritage values and facilitating cross-cultural awareness and understanding
- Consulting with the community on the environmental consequences of our activities
- Anticipating and responding to community concerns, aspirations and values regarding our activities

3. Integrating Environmental Management into the Way We Work

Ensuring environmental management and related social issues are high priorities by:

- Establishing environmental management systems consistent with current standards.
- Incorporating environmental and related social considerations into the business planning process along with conventional economic factors.
- Applying risk management techniques on a site-specific basis to achieve sound environmental outcomes over the life of the project.
- Developing contingency plans to address any residual risk.
- Ensuring resources are adequate to implement the environmental plans during operations and closure.

4. Minimising the Environmental Impacts of our Activities

Responsibly managing immediate and longer-term impacts by:

- Assessing environmental and related community effects before and during exploration and project development.
- Evaluating risks and alternative exploration and mining project concepts, taking into account community views and subsequent land use options.

- Adopting a proactive and cautious approach to environmental risks throughout the life of each operation.
- Applying ecological principles that recognise the importance of biodiversity conservation.
- Planning for closure in the feasibility and design phases of a project and regularly reviewing plans to consider changes in site conditions, technology and community expectations.

5. Encouraging Responsible Consumption and Use of our Products

Pursuing cost-effective cleaner production and product stewardship by:

- Employing production processes that are efficient in their consumption of energy, materials and natural resources.
- Minimising wastes through recycling, and by reusing process residues.
- Safely disposing of any residual wastes and process residues.
- Promoting the safe use, handling, recycling and disposal of our products through an understanding of their life cycle.

6. Continually Improving our Environmental Performance

Continually seeking ways to improve our environmental performance by:

- Setting and regularly reviewing environmental performance objectives and targets that build upon regulatory requirements and reinforce policy commitments.
- Monitoring and verifying environmental performance against established criteria so that progress can be measured.
- Benchmarking against industry performance and addressing changing external expectations.
- Researching the environmental aspects of our processes and products and developing better practices and innovative technologies.

7. Communicating our Environmental Performance

Being open and transparent in the effective disclosure of our environmental performance by:

- Identifying interested parties and their information needs.
- Providing timely and relevant information including publication of annual public environment reports on our activities and environmental performance.
- Encouraging external involvement in monitoring, reviewing and verifying our environmental performance.
- Continually reviewing and evaluating the effectiveness of our communications.

2.3 Environmental Management Standard

The ISO AS/NZS 14001:2004 Standard, which specifies requirements for an environmental management system (EMS), enables an organization to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organization subscribes, and information about significant environmental aspects. It applies to those environmental aspects that the

organization identifies as those which it can control and those which it can influence. It does not itself state specific environmental performance criteria.

2.4 Mining Industry Strategic Framework for Mine Closure

The Australian and New Zealand Minerals and Energy Council in conjunction with the Minerals Council of Australia have defined a Strategic Framework for Mine Closure (Ref Ah). It is designed to provide a broadly consistent framework for mine closure across the various Australian jurisdictions and is relevant to any new brown coal mine identifying an effective mine closure framework. The Strategic Framework is not a detailed set of guidelines for mine closure.

The Strategic Framework is designed to cover a broad range of mining and mining related activities. Exploration (which entails lower levels of impact and is often transitory in nature) and mineral processing are considered part of the broader mining function. While it is acknowledged that the focus of the Strategic Framework is primarily on improving closure related activities at operating mines, the principles are relevant to a broad range of activities, viz:

- Stakeholder Involvement – To enable all stakeholders to have their interests considered during the mine closure process.
- Planning – To ensure the process of (progressive rehabilitation and) closure occurs in an orderly, cost-effective and timely manner.
- Financial Provision - To ensure the cost of (rehabilitation and mine) closure is adequately represented in company accounts and that the community is not left with liability.
- Implementation – To ensure there is a clear accountability, and adequate resources, for the implementation of the mine closure plan.
- Standards – To ensure a set of indicators, which will demonstrate the successful (progressive and) completion of the closure process.
- Relinquishment – To reach a point where the company has met agreed completion criteria (for progressive rehabilitation and mine closure requirements) to the satisfaction of the Responsible Authority

2.5 Mine Rehabilitation Practices

A series of booklets prepared by the Commonwealth of Australia in 2002 were designed to:

- Demonstrate best practice environmental management in Australian mining
- Assist the mining industry by providing benchmarks for environmental performance and access to Australian expertise.

Relevant booklets in the series were:

Landform Design for Rehabilitation - This booklet demonstrates how mine planning can integrate ongoing landform reshaping works throughout the operational phase at minimal cost so that the prospects of achieving desirable post-mining land use objectives to the satisfaction of regulators and the community are maximised.

Rehabilitation and Revegetation - The booklet emphasises the rehabilitation of natural ecosystems, particularly the re-establishment of native flora. Topics covered include rehabilitation objectives; land clearing, soil handling, storage and replacement; landform design and erosion control earthworks; species selection, seed collection and treatment, and application techniques; the use of fertilizers and soil amendments; nutrient building and cycling; maintenance; and monitoring and measuring revegetation and rehabilitation success.

Mine Decommissioning – This booklet discusses planning for decommissioning, specific issues associated with decommissioning, best practice principles and presents case studies for investigation.

More recently further series of handbooks provide contribution to mine rehabilitation design on "Leading Practice Sustainable Development Program for the Mining Industry" (Ref **i**) developed for the Department of Industry, Tourism and Resources, in conjunction with the mining sector. These Handbooks provide examples of the practices of rehabilitation of mines across Australia are completed for:

- Community Engagement and Development
- Mine Rehabilitation
- Mine Closure and Completion
- Biodiversity Management
- Managing Acid and Metalliferous Drainage
- Tailings Management
- Working with Indigenous Communities
- Cyanide Management
- Water Management
- Hazardous Materials Management
- Particulate, Noise and Blast Management
- Monitoring, Auditing and Performance
- Risk Assessment and Management

2.6 Rehabilitation of Agricultural Land Subject to Mining

DPI, have also issued the "Principles for Rehabilitation of Agricultural Land Subject to Mining" (Ref **k**) with the support of the Victorian Farmers Federation (VFF) and the Minerals Council of Australia (MCA). Here it is proposed that the rehabilitation of land subject to mining would be to return it back to an agreed long-term sustainable use for other agreed purposes.

Further discussion is currently taking place to implement the Victorian government policy of Native Vegetation management (Ref **l**). "Native Vegetation Management Framework" focuses on mine rehabilitation, which is an essential part of sustainability within the mining industry.

3. Mine Rehabilitation Practices in the Latrobe Valley

3.1 SECV Mine Rehabilitation Practices

For more than 80 years the Latrobe Valley mines were operated by the State Electricity Commission of Victoria (SECV). Whilst it is more than 10 years since the Latrobe Valley coal mines have been privatised, the practices developed and used by the SECV are relevant for examination.

Progressive rehabilitation has been practiced for many years in the Latrobe Valley mines. This is most easily seen in overburden dumping practices. There are many examples of external dumps that have been shaped, rehabilitated and returned to other uses at Yallourn, Yallourn North, Hazelwood and the Loy Yang mines. In general, overburden dump rehabilitation practice has been to flatten and shape external batters, add sub and top soil and revegetate with grasses, shrubs and trees.

Figure 2 Photo of External O/B Dump …….

3.1.1 Early Rehabilitation of Mine Sites

There are also a number of examples of SECV rehabilitation activities in Latrobe Valley open cuts. Three examples of whole of mine strategies relating to this period are cited here: -

- The Yallourn North mine ceased operation about 50 years ago. Trees were re-established over all of the overburden dumps and within the mine. When driving on the road from Yallourn to Yallourn North it is difficult to identify where these dumps start and stop. The trees also provided an excellent visual barrier of the

old mining workings that have not been refilled. In the bottom of the mine ash dumping and water storage are still carried out today.

- For the approval of the Loy Yang Project, the SECV prepared a Statement of Environmental Effects for submission to the Parliamentary Public Works Committee Inquiry – a forerunner of current EES Panels. In this assessment the SECV submitted the design of the external dump, indicating that the slopes would be sculptured to blend with the existing topography and progressively planted with grasses, shrubs and trees. The statement also considered how to minimise the visual impacts during the dump construction. Within the mining area, as it would not be possible to backfill the mine to the original natural surface, substantial low level areas would be available for water storage or revegetation areas.
- The Yallourn North Extension open cut mine (YNX) was a small mine operated as part of the Yallourn mine and located between Yallourn North and Tyers adjacent to the Yallourn monocline. The coal is much drier that that produced in the Yallourn mine. Mining ceased in 1989 as its only customer had converted to natural gas. Before privatisation of the Latrobe Valley mining and power assets, YNX was rehabilitated. The YNX mine area contained unmined coal resources that could be utilised in the future and so the mine was only partly rehabilitated to allow a start-up at some time in the future. The first priority of the YNX rehabilitation strategy was to reduce the stormwater runoff and vegetation was effectively used to reduce erosion and landfill depressions used as wetland storage and filter areas (Ref Aq). Worked out mine faces were flattened and topsoiled and working faces were left essentially intact. There was limited topsoil available for rehabilitation and YNX remains a good example of how the Latrobe Valley mines could be rehabilitated and returned to other uses.

3.1.2 SECV Mine Rehabilitation Policy

In 1985 the SECV carried out a major review of rehabilitation policy and practices associated with their coal winning activities in the Latrobe Valley. A key element of this review was a comprehensive public consultation process.

The stated SECV Rehabilitation Objective at that time (Ref o) was: -

> *"to ensure that land disturbed by coal winning activities is returned to an agreed stable land form at the earliest practicable time."*

This objective was to be achieved through the: -

- Development of comprehensive cost effective rehabilitation programs and plans for all coal winning projects;
- Provision for public awareness and involvement in the development of rehabilitation proposals;
- Minimisation of adverse effects on the environment by ensuring that policies and procedures have the agreement of responsible Government

agencies and rehabilitation is implemented progressively and as soon as practicable; and

- Assessment of land capability, land form and landscape character type analysis, opportunities available and the interests of the community.

Planning for rehabilitation works took into account factors that affect coal winning reliability, safety, efficiency and cost as well as factors that influence the final land shape and its ability to be vegetated. These influencing factors affect the choice of rehabilitation strategies. Although the recovery of coal must inevitably result in lasting changes to the original land form, the opportunity remains for the creation of new landscapes, land uses and community benefits. The operational life of SECV open cut developments is usually more than 50 years. This time span means it is only practicable to identify indicative final rehabilitation proposals at the planning stage. The SECV endeavoured to develop a rehabilitation program to allow maximum flexibility in the choice of land use nearer to the time the land is put to other uses. This approach allowed for changing community expectations to be considered.

There was considerable community involvement in developing this policy whilst reviewing the design options (Track Consultants Report) for the external dump at the Morwell (now called Hazelwood) mine. Dump location options, dump heights, shape, slopes and end use were debated before the current dump design was finalised. The external dump at the Morwell mine has been completed for some years and the mixed grass and tree landscape is considered to fit well within the local environment. The land is used for grazing.

A Consultative Review Committee, involving community and government representatives, initially set-up to review the rehabilitation plans for the Morwell external dump also reviewed the Yallourn East Field and Loy Yang strategies.

Since that time, the approval of Mine Work Plans include Mine Closure and Rehabilitation Plans.

3.1.3 Rehabilitation Policy – Land Affected by Coal Mining Difficulties

A rehabilitation policy review was carried out by Generation Victoria, a corporitised entity of the SECV, in 1993 (Ref Ap) and is shown here as a lead-in to the appropriate framework for use in the current Latrobe Valley mines.

> ***"Selection of Final land Form and Use***
>
> ***Changing expectations:***
>
> *It should be recognised that open cut mines have very long operative lives during which community expectation, government policy and possible mining techniques could be expected to change. Yallourn, for example has been in operation for more than 70 years and is expected to operate for a further 20 years or more. Morwell is in its 35th year and Loy Yang its 10th. In addition, new projects to further utilise the coal resource could impact on the rehabilitation plans of existing mines.*
>
> *It is therefore difficult to say with absolute certainty at this point in time what will be the final rehabilitated form and use of worked out open cuts and their attendant disturbed areas.*

With respect to operating open cuts the objective should be to rehabilitate land in a manner that provides stability of landform, soil structure and vegetation, and to provide land use decision makers with maximum flexibility nearer the time of mine closure.

Backfilling mines:

The extreme thickness of Latrobe valley coal seams and the shallowness of the overlaying overburden layer must inevitably result in lasting changes to the original landscape. This is an inescapable consequence of mining in the Latrobe valley setting.

The quantity of overburden material removed to allow coal mining falls well short of the quantity of material needed to back-fill the worked out mines. In addition, because of the thickness of the coal seams, it is many years before sufficient worked out space is available on the mine floor to backdump overburden materials within the mine. During this time there is no option but to dump very large quantities of overburden material outside the mines. The cost of transferring this overburden back into the worked out mine areas as they (the mine space) becomes available is prohibitive, partly because of the volume to be moved and partly because the material, once disturbed by its original excavation, has altered physical soil structure that requires greater effort and cost to move a second time.

Whilst coal mining results in lasting change to the original landform, the opportunity still remains for the creation of new landscapes and land uses; compatible with the surrounding land, which will have community benefits.

Mine Rehabilitation Policy

With respect to land disturbed by coal winning and associated activity Generation Victoria' policy is as follows:

Operational phase

- *Where physically practical to screen work areas during the operational phase to minimise visual intrusion, and*
- *Minimise disturbance to waterways, vegetation and landforms in non-operational areas.*

Post Operational Phase

- *During the life of the project, progressively, and at the earliest opportunity after land is no longer required for operations, appropriately shape, landscape, revegetate and return disturbed land to its pre-mined land capability for agriculture and silvicultural uses in order to: -*
    - *Stabilise slopes,*
    - *Manage water run-off to control erosion,*
    - *Provide a sustainable landform and vegetation pattern that blends into or complements the existing natural features of the region,*
    - *Provide ultimately for other sustainable beneficial uses, and*
    - *Fit into the rehabilitated Master Plan.*

Mine Closure Phase

- *With mine closure imminent consolidate activities of the post operational phase and liaise with agencies and the public to ensure that: -*
    - *Sustainable beneficial land uses have been achieved, and*
    - *Rehabilitated land is safe to return to public or private holding.*

Rehabilitation Policy Implementation

The policy will be implemented through the achievement of the following objectives: -

- *Community Consultations and Information*
- *Development of Rehabilitation Plans*

- *Works Program*
- *Performance Monitoring*

(Details of the Implementation phase not included as dated)

Contents of Long Term Rehabilitation Master Plan

Purpose of the Master Plan

Master plans are to provide sufficient detail that: -

- *Will allow the community to appreciate generation Victoria's*
    - *Objectives for minimising the visual impact and the impact on water quality of mining operations prior to the commencement of rehabilitation works, and*
    - *Objectives and vision for the overall rehabilitation of the finally work-out mine and associated surrounding disturbed areas; the vision may afford protection to a number of final land use options in order to allow a final choice nearer the time of the completion of rehabilitated works.*
- *Will allow the mine manager to budget for an on-going program of works which moves towards the final rehabilitation objectives for the mine site.*
- *Outlines the allocation of responsibilities for rehabilitation planning and its implementation, and the role of consultation with the community, local government and government agencies.*

Master Plans are to include as a minimum requirement: -

Screening of Operations

- *Plans showing plantings or screening for softening, or lessening, the visual intrusion of mining and associated operations during the operational phase,*

Final land use

- *Identification of potential future land-use opportunities for each segment of rehabilitated land based on the return of land to its pre-mined land capability for agricultural and silvicultural uses, or agree alternative uses,*
- *An indication of the flexibility of the master plan to adapt to changing needs whether they be due to altered coal mining requirements, government or community expectations.*

Water management

- *Indicative plans showing planned major drainage patterns, wetlands or pondages and their interaction with surrounding areas,*

Visual management

- *Indicative contour plans of the final planned landform and its relationship to surrounding values'*
- *Indicative plans of the broad vegetation type planned for each segment of the rehabilitated areas and the relationship to surrounding areas.*

Ecological management

- *Objectives for the re-establishment of a substantial ecological regime for the area,*
- *Indication of areas that may offer practical potential, after fire management consideration, for the establishment of protected habitat.*

Fire protection

- *An explanation of the way in which fire protection for both ongoing mining operations and community well-being has been taken into account.*

Timetable

- *An indicative timetable for rehabilitation works required to ensure that the mine and its associated disturbed areas are returned to other beneficial uses at the earliest opportunity after the cessation of mining operations, and*

Critical decision points

- *A listing of any decisions, and their approximate timing, that may be required during the life of the rehabilitation program and that may have a significant effect on the direction of the rehabilitation program.*

Contents of Rolling Five Year Implementation Plans

(not reproduced here)

3.2 Privatisation of the Latrobe Valley Mines

The three active Latrobe Valley mines (Yallourn, Hazelwood and Loy Yang) were privatised by the Victorian Government in the early to mid 1990's.

During the sale process, long term Mine Rehabilitation Plans were developed by the SECV for the three active mines. These rehabilitation plans required full rehabilitation of the external dumps according to the standards developed by the SECV. The rehabilitation plans also included flooding of the remnant mine pits as part of their closure arrangements. Progressive rehabilitation was required. Rehabilitation Bonds at that time were based on these plans.

3.3 Environmental Effects Assessments

Since privatisation, Panels have been set-up under the provision of the Environmental Effects Act to consider major changes to mine developments proposed by Yallourn and Hazelwood. For these hearings, Environmental Effects Statements have been prepared for submission to the Panel, whose role is to make recommendations to the Minister. The Statements need to include detailed description of the proposed mine development and any environmental impacts, and the rehabilitation plans for the mining operation and dumps.

For the Yallourn mine expansion into East Field requiring the relocation of the Morwell river, a Work Plan variation was sought. Even with backfilling of all mined overburden, the mine was expected to contain several large interconnected voids at closure (Ref At). A large lake created with using water from the Latrobe or Morwell rivers was proposed to flood the mine to river level. This concept was seen to provide beneficial uses for the community compared with other options and was accepted within the approved Work Plan. Above the flooded water level rehabilitation of exposed overburden and coal batters was planned with steep batters reshaped to a manageable and stable form at an overall slope of about 3:1 - the generally preferred slope for sustainable management of rehabilitated areas; topsoiled and grassed. Beyond the crest of the mine, areas were identified for wetlands development and other areas suited to vegetation plantations or improvements to provide net gains. Progressive rehabilitation was planned.

For the Hazelwood mine an expansion into West Field also required relocation of the Morwell river and an EES was carried out. The section relating to Mine Closure and Rehabilitation (Ref Av), included a number of issues relating to the rehabilitation of the mine, including:

A. Consideration of the risk of heave in the final mine shape from the rebound pressure level of deep aquifers when pumping ceases after mining. As the overburden planned to be placed in the mine was predicted to be insufficient to reduce heave some stored water was determined to be required in the base of the closed pit. Hazelwood plan to source just sufficient water from aquifer pumping to secure mine stability, and then to close down the pumps and allow the pond to find its natural level (depends on catchment area, rainfall levels and evaporation rates). Hazelwood predict the final water storage level would be about RL-22, or more than 70m below the level of the crest of the mine.

B. Consideration of batter stability of coal faces above the water level, which may require horizontal bores or other drainage paths to keep pore pressures low.

C. Overburden faces in the West Field development and exposed dump batters are to be flattened and grassed.

D. Options for the treatment of exposed coal batters include using overburden to cover coal benches and leaving exposed coal faces to revegetate; or flattening the batters and using overburden and topsoil to cover the final surfaces.

   It is understood that the agreed Work Plan for the new West Field batters is to flatten the coal batters, using a retreat dig operation with the mine conveyors to transport recovered coal out of the mine. In some of the older parts of the mine, Hazelwood is also progressively using overburden to cover exposed coal faces and reduce the fire risk.

International Power Hazelwood (IPRH) regularly report progress on Mine Rehabilitation (Ref Ay) to their Environmental Review Committee. In 2007, IPRH reported that a total of 595 Ha of disturbed land had been rehabilitated to date. Some 45,000 native trees, shrubs and ground covers of local provenance have been planted in the Overburden Dumps and Mine since Privatisation. 3,350 of these were planted on the external Overburden Dump during 2007. To date 2.3 million Native Grass “viro cells” have also been planted on the Eastern Overburden Dump.

IPRH also reported activity on their Replacement Wetlands Project (Ref Az). These wetlands, located outside of the Mining Licence boundary were set-up to replace existing wetlands that covered coal areas. Land was purchased and the wetlands design was presented to the Environmental Review Committee and after minor changes was approved. Earthworks construction was completed in 1999 and upper storey native tree planting completed by 2001. The replacement wetlands were awarded “Land for Wildlife status by the DSE in May 2001. Since that time maintenance has been undertaken including a further planting of Eucalyptus strzeleckii so that a total of up to 4000 of these rare species are included in some 80,000 upper storey and 60,000 under storey trees and shrubs and 47,000 Native Grasses in the Morwell river wetlands.

There are a number of examples of rehabilitation at the Loy Yang mine. Progressive rehabilitation of the external dump is in ready view of the public. Around the mine final overburden faces are flattened and grassed and lands surrounding the mine are

actively farmed. Loy Yang mine have also examined mine closure options (ref Au). Using a multifactorial assessment of a wide range of end use options within the Loy Yang mine site, three scenarios have been developed for inclusion in their long term vision as follows: -

- Multiple land use with an agricultural focus;
- Multiple land use with an environmental focus; and
- Multiple land use with an industrial focus.

The scenarios are neither final nor preferred options and do not take into account the lengthy timeframe of decades (or potentially longer) over which the process of closure and rehabilitation will take place at the Loy Yang site. However each option includes a stable lowered landscape within the mine void

Figure 3 Upper Mine Batter Rehabilitation Trials

Figure 4 External Overburden Dump Rehabilitation

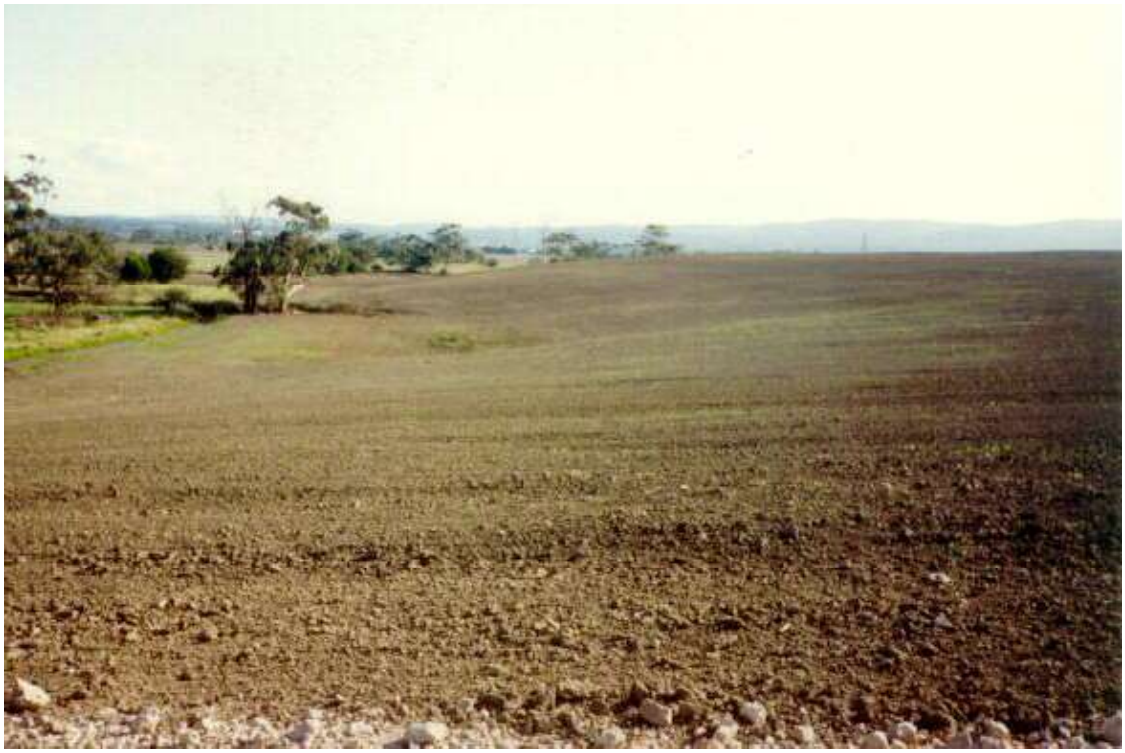


Figure 5 Existing Exposed Coal Batters

Figure 6 Drainage Management inside Mine

Figure 7 Treatment Option for Coal Batters (IPRH West Field EES)

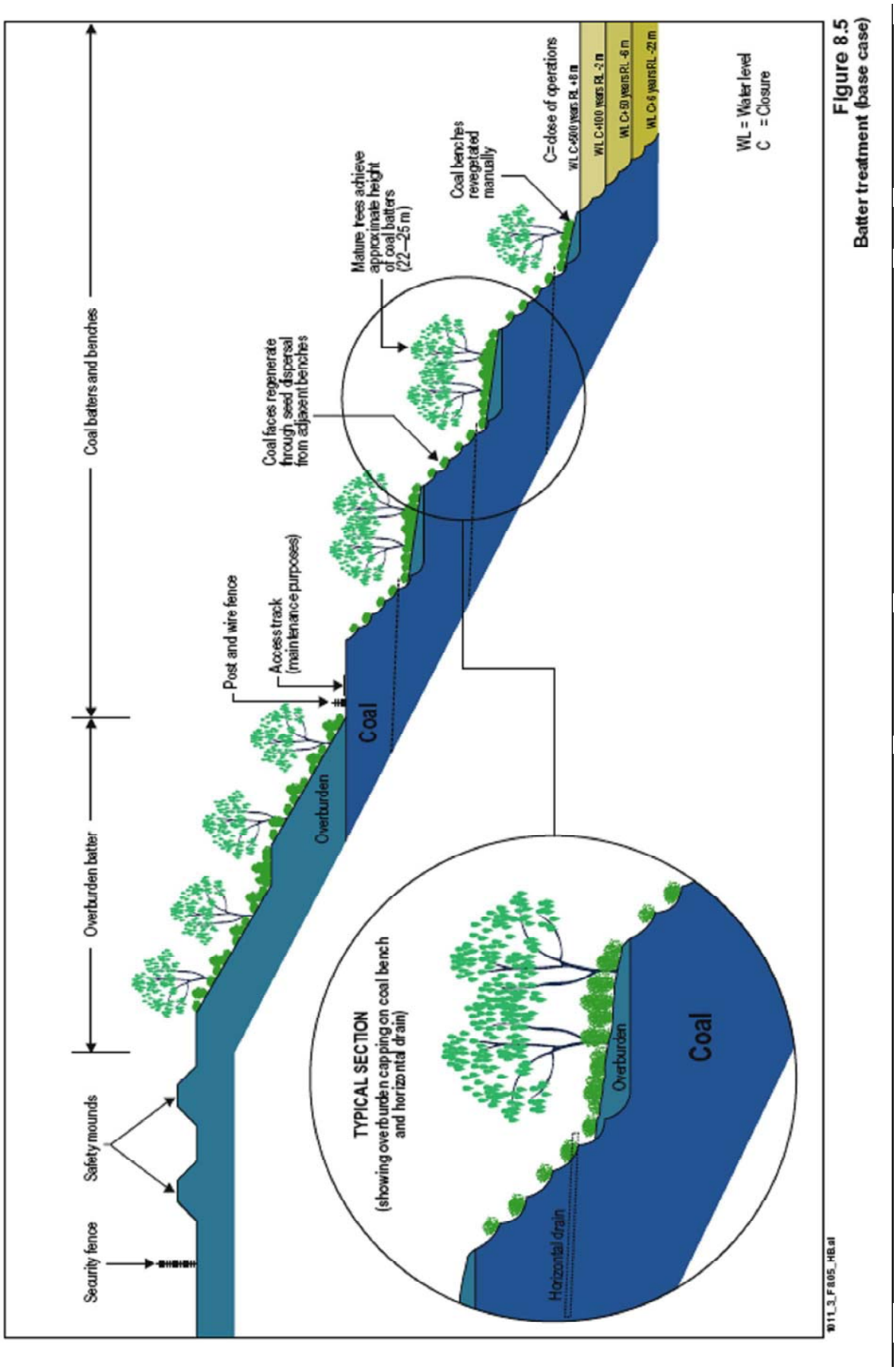


Figure 8 Coal Batters Visualisation (IPRH West Field EES)

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Figure 8.6
Closure visualisations

3.4 Rehabilitation Examples from Other Provinces

Mining in the Latrobe Valley is quite different from most other mining provinces. The Latrobe Valley mines operate in a geological setting with thin overburden and very thick coal layers that extend further than the Mining Licence boundaries. Mining limits are often determined by rivers, roads or towns rather than the economics of mining. The mines are of large scale, have long lives and, due to the small quantities of overburden, leave large void areas.

In both the Hunter Valley and Bowen Basin the higher value black coal can be mined to higher overburden to coal strip ratios that allows near filling of the mined out areas.

In Germany there has been extensive brown coal open pit mining with many similarities to mining in the Latrobe Valley. As in the Latrobe Valley mines the brown coal is used to produce electricity, dried coal and other products and the mining methods are also similar. However, the coal seams are deeper than in the Latrobe Valley and higher overburden to coal strip ratios are needed which allows these mines to be nearly completely back-filled. In Germany the coal area near Cologne has very thick topsoil layers (loess) and rehabilitation mine areas are used for agriculture, forestry and water storages. Boating opportunities and walking tracks have been developed for community use. In the south-east of Germany where the brown coal seams are closer to the surface, mines leave voids that have been flooded on mine closure by diversion of local rivers and streams through the worked out mine. This has been very successful with benefit to local fish, birds and aquatic life (Figure 9).

Figure 9 Filling Markkleeberg mine with water for closure

3.5 Environmental Review Committees

The Victorian Government encourages an economical, viable mining industry, which makes the best use of mineral resources in a way that is compatibles with the economic, social and environmental objectives of the state (Ref Aaa).

Victorian communities have also expressed their desire to be involved in decisions relating to the mining sector and Environmental Review Committees are part of the required licence conditions for the brown coal mines in the Latrobe Valley. Representatives from the local community, non-government organisations and government departments can provide opportunities for a broad range of input into rehabilitation plans.

The Environmental Review Committee review the mine rehabilitation work plan, progressive rehabilitation works and completed areas. The committee should provide input into potential Land Uses prior to the closure of the mine.

4. Rehabilitation Issues in Latrobe Valley Mines

4.1 Mine Size, Depth, Strip Ratio and Life

Finding the appropriate rehabilitation solution for the Latrobe Valley mines requires consideration of a number of issues. The mines typically contain large coal resources of great benefit to the State, communities and industry. Mining disturbs large land areas, are very deep and often contain more than 75% coal so are impossible to fully backfill. The mines also have an operating life of many decades. Table 1 provides an indication of the potential size, strip ratio and life of current and typical future mines.

Table 1 Indicative Size of Typical Latrobe Valley Mines

Mine Area	Approximate Mine Area (sq km)	Approximate Mine Depth (m)	Approximate Strip Ratio (coal : waste)	Potential Mine Life (years)
Yallourn*	100	120	4:1	125
Hazelwood*	100	180	4:1	100
Loy Yang*	200	250	5:1	120
Driffield	50	180	4:1	60
Flynn	200	350	4:1	150
Maryvale East	50	180	4:1	50
Traralgon Creek	160	350	3:1	150
Churchill North	40	120	2:1	20

* Yallourn mine commenced in about 1925

* Hazelwood mine commenced in about 1960

* Loy Yang mine commenced in about 1980

Appropriate rehabilitation solutions must be considered within a regional context because of the mine size, depth and impacts beyond the Mining Licence boundaries. Important framework considerations include:

- Regional land planning
- Utilisation of coal resources
- Aquifer pumping
- Earth movement and land subsidence
- Local communities
- The environment

4.2 Regional Land Planning

Because of the value of the resource to the future of Victoria appropriate land planning needs to be in place both to protect future mining areas and local communities. The 1980's planning document "Framework for the Future", based on predicted coal use by

the SECV, informed a long term land planning arrangement. The three main goals of the Framework were:

- To protect Victoria's coal resources and maximise the efficiency of development of the coal resource for the benefit of all Victorians;
- To improve the quality of life for the region's population by promoting better planning in the region; providing greater security of tenure for residents and compensating those affected by coal development; and
- To maximise the retention of land throughout the region in productive use.

The framework set out a response to community concerns, determined coal boundaries and after the "Land Over Coal and Buffer Study" set buffer zones to local communities. Both the Latrobe City and Wellington Shires have policies and strategies within their Planning Schemes:

- To facilitate orderly coal development so that the resource is utilised in a way which is integrated with the State and local strategic planning;
- To ensure the use and development of land overlying the coal resource having regard to the need to conserve and utilise the coal resource in the context of overall resources having regard to social, environmental, physical and economic consideration in order to ensure a high quality of life of residents; and
- To provide a clear understanding within the regional community of the implications of designating land for future coal resource development or of buffer areas in the future use of the land.

The Planning Schemes include the use of zones - Special Use (Brown Coal) Zone 1 (SUZ1); overlays - Special Resource Overlay (SRO1); and buffers - Coal and Urban Buffers to protect important coal resources and local communities.

More recently, the LV 2100 Coal Resources Project reviewed the land planning schemes and supported their continuance. Some changes were suggested to improve protection for high ranked coal resource areas, and a reduction in other coal protection areas where development was less likely to happen. The LV2100 study also considered external dumping, backfilling of mines, mine flooding, lowered landscapes, mine sequencing opportunities and reviewed concerns about the use of extensive volumes of water to rehabilitate worked out mines. The LV 2100 Coal Project report recommendations included:

- Industry and government agencies need to identify the key issues and constraints of alternative strategies and contingency plans for water-constrained pit closure
- A working party review and facilitate State Government policy and legislation relating to opportunities for work across Mining Licence boundaries including mining, overburden dumping and rehabilitation practices.

Regional Land Planning should assume that land occupied by mining would be progressively rehabilitated and returned to other uses and that at the end of mine life the mine would be stable, safe, and be returned to an agreed sustainable land use.

4.3 Utilisation of Coal Resources

The Latrobe Valley contains extensive brown coal resources. They are well defined as extensive drilling programs have been carried out by the SECV, by mining companies and exploration tenement holders. The coal geology within the Latrobe Valley has been modelled using 3D software and these are available from the DPI (Ref x). These studies identified 53,000 Mt of potentially 'economically winnable' coal with the most economic coal contained within protective planning zones or overlays. There are further coal resources within the Latrobe Valley that are deep, located near or beneath population centres or would require the relocation of rivers or highways that are less economic to mine.

Companies seeking access to the coal resources need an approved Mine Plan that identifies the resources to be mined. The most economic coal resources for mining by open cut methods are likely to be close to the surface with a good coal to overburden strip ratio and contain coal with acceptable quality.

As well as identifying the coal to be mined, another critical issue will be where to place the overburden and interseam materials. This decision will have a major impact on the final rehabilitated Land Form design, its long term stability and the Land Use options. Normally all initial waste material has to be dumped outside of the mine area until the base of the mine has been reached. These overburden and interseam materials are normally put into an external dump or could potentially be discharged into an adjacent mine. Once the base of the mine is sufficient in size, placement of waste materials within the mine should proceed to maximise the amount of backfilling in the mine.

4.4 Rehabilitation and Future Mining Operations

Not all coal resources within the Licence Area will be mined within the planned life of the mine. The coal may have deleterious properties, may require the removal of thick interseams, or may be too deep to be economically mined. There may also be coal trapped on the Mining Licence boundary, between separate mines that cannot be recovered until the two mines join and this may not be able to be agreed at the Work Planning Stage. Hence at the end of the planned mine life there could be coal resources that could be recovered by a subsequent mining development. To win the additional coal resources the mine may require deepening, or extending and potentially joining into another mine to make a Super Pit.

Rehabilitation to allow recovery of Future Coal Resources

If further mining is planned, then rehabilitation of the mine faces needed in the extended mine could probably be deferred until after the new mine development is completed. However, in cases where the future mining is not planned or approved, then it is probably unrealistic to delay mine rehabilitation until all coal has been extracted because it may be many some time before the remaining coal resources are economic.

A question to be asked if the rehabilitation of the mine faces are deferred is: -

- If the final coal faces are not rehabilitated who takes responsibility for environmental issues resulting from exposed batters, from coal fires, for water collection and discharge etc. ?

Unless there is certainty to the expansion plans, the government may not be prepared to release their Bond on the mining company.

The decision about leaving coal faces in a situation where they are able to enable future mining to proceed should take into consideration the cost of rehabilitation and the cost of restoration of mining benches for the new mine operator.

Instead of fully rehabilitating the mine faces that would be used for a future mine development, and raising the cost of the start-up of the new mine, it is possible that interim rehabilitation works could be carried out. This might result in some flattening of faces but leaving the benches needed for transport on those faces needed for the expansion of the mine.

Changes to Overburden Dumping

A related question is when to commence internal dumping if there are unmined coal resources beneath the base of the mine that are not within the mine plan. This is aside from the short term practical and cost implications on the commencement of internal dumping. Delaying internal dumping commencement is expected to increase the mine disturbance footprint for external dumping. In the long term if overburden is not dumped within the mine concurrently with the mining operation, the final result could be an extremely large mine void that would be very difficult to make safe and stable from heave or batter instability, let alone find Land Uses that can be sustainable into the future.

Whilst it is possible that by allowing internal dumping to occur, some of this currently uneconomic coal may become even less economic in the future (i.e. need to pre strip internal overburden dumps to access deeper coal), the impacts of delaying backdumping into the mine also needs to be considered. Unless mining of the deeper coal is considered viable in the short term it is probably better to proceed with internal dumping according to the current mine Work Plan to assist providing a rehabilitated mine site with long term stability. If a change to the Mine Plan is sought to access the deeper coal then relocation of parts of the internal dump would be a consideration in the economics of that option, as would the ability to mine the coal safely and to rehabilitate the worked out area.

In the case where the future coal resources are in an expansion of the mine internal dumping should proceed as planned, or with minor modifications to facilitate a later interconnection of the mines, without affecting mine stability, even though there isn't yet an agreement to interconnect to a neighbouring mines,

4.5 Limitation of Land Form Design

The final Land Form for the rehabilitated mine should be defined in the Mine Plan. In most cases the shape of the Final Land Form and the rehabilitated area will predominantly result from:

- the shape of the mine required to remove the coal;
- the quantity of overburden and interseam waste that can be dumped within the void to stabilise the floor; and
- the shape, slope and locations of batters.

However refilling of the mine back to natural surface with overburden is unlikely to be possible due to the limited quantity of overburden in comparison to the coal won. The rehabilitated mine is also likely to require a water storage in the base of the mine as it is extremely difficult to place dump material in the final part of the mine and to collect and manage water collected within the rehabilitated mine area.

Whilst the Land Form needs to be defined in the Work Plan, there will be many Land Use options. An initial assessment of the Final Land Use may be made at the time of the Work Plan application, but due to the length of time from the mine starting to its closure the Final Land Use would be refined closer to the completion of mining.

4.6 Mine Safety Implications for the Final Land Form

The Latrobe Valley mines are extremely large and deep and their safe operation depends on appropriate management of mine stability. The main issues for management include:

- Control of potential floor heave as a result of uplift pressure from deep aquifers. Pumping bores are used to extract water from these aquifers to reduce the aquifer water pressure sufficiently to allow safe mining to be carried out. Internal dumping is also used to put weight back onto the base of the worked out sections of the mine to reduce the risk of floor heave.
- Design of the mine and dump batters to maintain their stability. Overburden, coal and interseam face stability is particularly affected by coal joints, faults, weak layers, and pore pressure. Face and batter stability is achieved by controlling the height and slope, monitoring for weak layers and controlling pore water pressure. Horizontal bores are often used in the coal batters around the perimeter of the mine to combat rising pore water pressure or sudden inrush from leaking pipes, drains or floods. If needed in the rehabilitated mine keeping the horizontal bores in place and functional could be a required maintenance task.
- Control of fire risk on exposed coal surfaces. During mining in Latrobe Valley there are extensive areas of exposed coal on benches, batters and along conveyor corridors. Mine management requires a comprehensive fire control system using piped water for spraying to lessen the risk of ignition and to control the spread of fire, trained fire crews and CFA back-up resources. As areas are worked out it is good practice to cover coal benches and rehabilitate areas to reduce the fire risk. However it may be difficult to cover all exposed coal with some mine rehabilitation options. Recent fires in the operating mines (Figure 12) indicate how difficult they can be to extinguish.
- Avoidance of flooding. Levee banks and other civil structures are used to minimise the direct ingress of floodwater from local streams and rivers. Within the mine area collection drains, storage ponds and dewatering pumps are used to cater for heavy rain events. In addition to managing surface water inflows, water recovered from deep aquifers has to be collected and pumped from the mine.

After mining has finished, the safety for those utilising the rehabilitated mine areas remains of equal concern. Closure planning should ensure that the agreed Land Form provides long term safety by ensuring the stability of the base of the mine and all faces and batters and that the risk of fire and flood is similarly controlled.

This does not mean that all risks can be eliminated in the rehabilitated land areas. For example as discussed in Section 4.7, it is possible to continue to use pumping bores to keep aquifer pressures at safe levels after mine closure. Obviously this would be at an on-going cost and solutions using the weight of an internal dump or an internal pond are likely to provide a lower cost option for land users following mine closure.
Whatever solution is chosen to reduce heave risk, consideration should be given to the potential rebound of the aquifer pressure as aquifer pumping is reduced.

Figure 10 Mine in Operation – Examples of some Mine Safety Issues

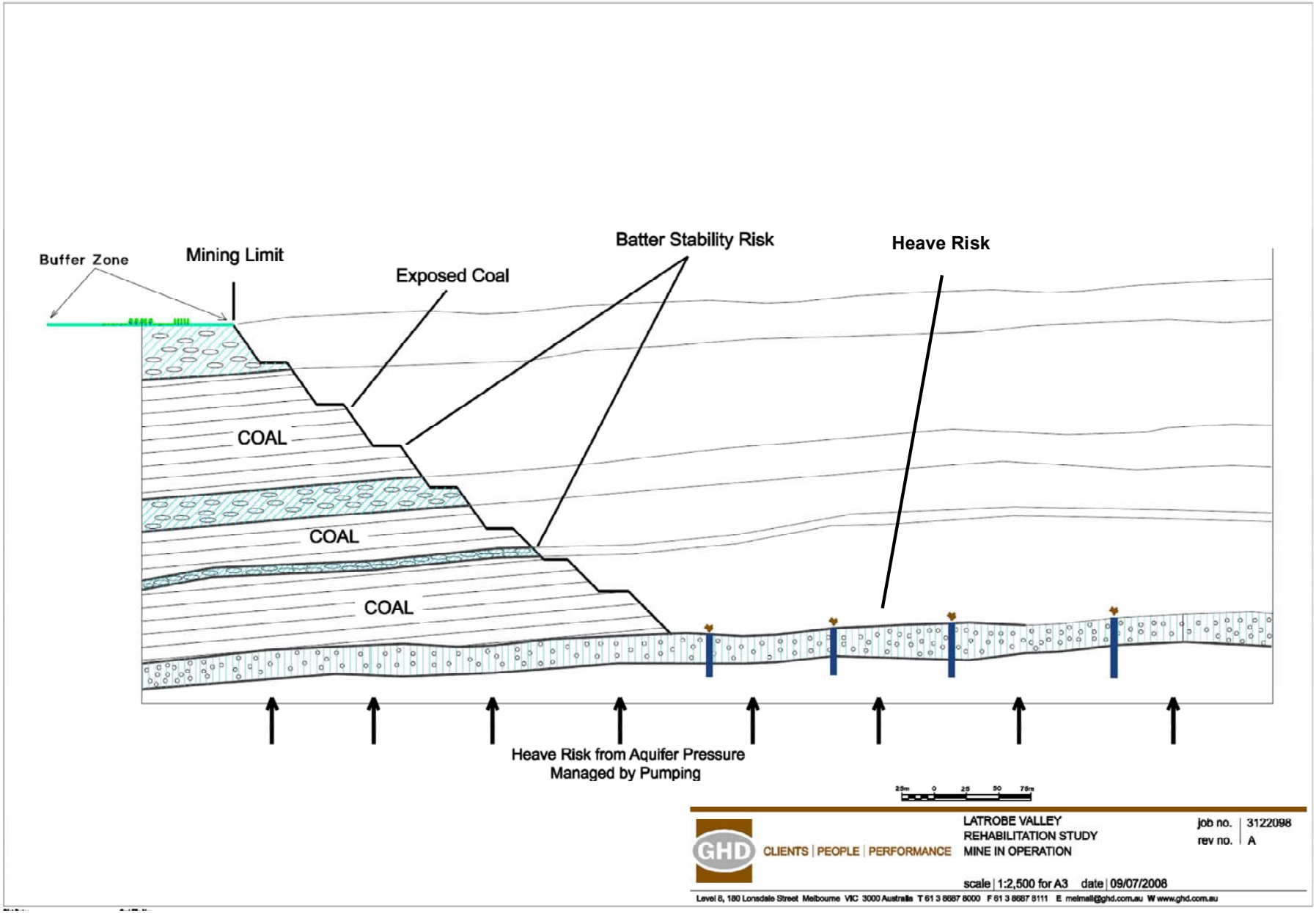

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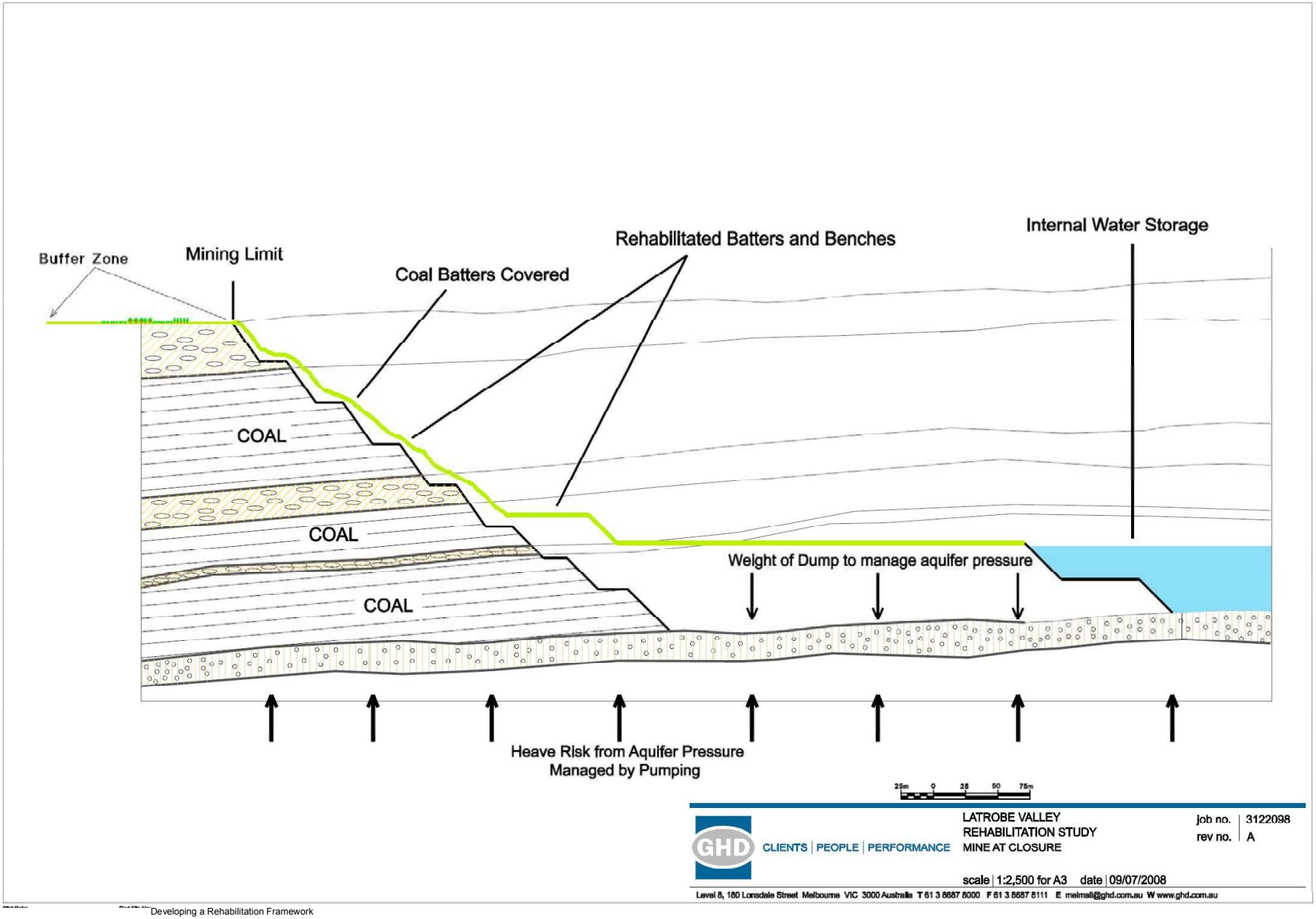
Figure 11 Closure Land Form – Examples of Safety Management Issues



4.7 Aquifer Pumping, Earth Movement and Land Subsidence

The safe operation of mines in the Latrobe Valley is expected to continue to require the depressurisation of aquifers to prevent leakage into the mine and to reduce the risk of heave. In an open cut mining operation the progressive removal of overburden and coal results increases the risk of heave (Figure 10) without adequate depressurisation of the aquifers. By pumping some water from the aquifer, the aquifer pressure can be reduced within the mine area, lessening the instability risk.

The aquifer systems in the Latrobe Valley are very complex in terms of lithologic variability, hydraulic properties and groundwater flow. Some aquifers extend over large areas, and, partly through complex structures, into the offshore part of the Gippsland Basin. Other aquifers are only of local extent. As many of the aquifers that need depressurisation extend regionally, any environmental effects can also be of regional extent. With the aquifer pumping activity since the 1970s and the increased pumping during the drought conditions, aquifer pressures have been substantially lowered and regional subsidence has extended some distance from the mining area.

Whilst this is an issue for mine approval and mine operation rather than mine closure, rehabilitation instability issues from heave may still exist at the end of mining. This depends on the Final Land Form (Figure 11). In mine closure-planning consideration of the risk of heave failure is critical to enable the most appropriate Land Form to be constructed during normal mining operation. A number of options to maintain stability of the rehabilitated mine area can be anticipated. These include: -

- Continued pumping to keep pressure below critical balance levels;
- Backdumping of overburden and the use of small ponds to create a landscape, mainly lower than the pre-mining levels, that provides sufficient weight to counteract aquifer pressure; and/or
- Flooding the mine to levels above that necessary to provide sufficient weight to counteract aquifer pressure and potentially interconnect with adjacent rivers.

In the stability assessment for the rehabilitated mine, consideration needs to be given to the potential rebound of aquifer pressures in cases where neighbouring mines continue pumping and in cases where pumping from all mines is stopped. Where aquifer pumping at neighbouring mines continues, some aquifer pressure rebound will still occur within the rehabilitated mine area. When mining ceases in the Latrobe Valley the rebound of aquifer pressures will be greater but it is considered that they are unlikely to return to pre-mining levels.

Because of the large size and depth of the mines in the Latrobe Valley significant earth movement occurs within the mining area and in the lands adjacent to and around the mine. Most of the movement occurs during mining and a buffer zone is normally applied from the crest of the mine (Figure 11) to minimise impacts on others. After rehabilitation, providing the mine is stable, much smaller movements are likely to occur and once the mine is closed new buffer arrangements may be possible.

4.8 Rehabilitation Options using Stored Water

4.8.1 Fully Flooded Option

It is not generally possible to totally backfill the large and deep Latrobe Valley Mines with overburden or interseam. Another rehabilitation option is the 'flooding' option. In this option the mine is flooded with water to about river level - expected to be adequate to balance rebounding aquifer pressure even if mining in the Latrobe Valley ceases. This arrangement could allow interconnection with nearby river systems or be used to regulate river flood flows during extreme events.

However, there are a number of significant issues with this option that need to be considered. A number of these are outlined below.

How much water would be needed to fill a mine?

For a typical large mine located in the Latrobe Valley, the total coal removed over its life is likely to amount to about 1500 to 2000 Mt. Even after allowing for internal overburden dumps, filling the mine with water to river level is likely to require very large volumes e.g. as much as 1,000 Mm^3 of water (about 1 million ML or about 5 times the total volume in the Blue Rock Dam (when full)). It is possible that a rehabilitated mine could be filled from an adjacent creek or river by using flows above environmental flow minimums or taking flood peaks. Estimates of filling a mine from this source vary from 10 to 50 or more years.

Is there sufficient water to fill a mine?

At first glance, if using surface water resources, the answer is no. Currently with the changing weather patterns and following a long drought period the quantity of available water for industry, power generation, and agriculture are at record lows. Diverting water from rivers and streams would probably reduce flows below environmentally sustainable levels. River Catchment Authorities are unlikely to support taking water from normal river flows in this manner and see disadvantages of taking peak flows that would limit floods because natural flood events are important to the river ecology. Even after filling the mine to river level, unless the mine has a large catchment area there is likely to be more evaporation than rainfall water collection and replenishment would be a continuing issue.

It is possible that future weather patterns may change again and adequate river water could be available, or the rehabilitated mine(s) could be used for flood retention, however this is not the current situation.

Aquifer water could be another source of water for the rehabilitated mine, however filling a mine following closure is likely to take many decades of groundwater pumping and have a significant and continuing impact on the aquifer environment.

Could a flooded mine be connected to the local river system?

Even after the mine had been filled with water, issues for consideration before any local rivers were connected into the mine storage would include:

- How much river water per annum would be taken from the river to maintain the mine water levels (e.g. to counter evaporation loss) ?
- Will the water stored in the mine have altered water quality preventing overflow water to be directly discharged into the river (e.g. water colour, pH, turbidity, oxygen levels) ?
- Due to the depth of the water storage within the mine, will the pond turnover at different times of the year changing water quality ?

Is this an option for mine rehabilitation ?

From discussions with a number of key stakeholders it is apparent that this will be a difficult solution to use for mine rehabilitation in 2009 (Ref Aw) with recent droughts reducing river flows and dam levels to record lows. The effect of global warming may mean that insufficient water is available in the future for this rehabilitation option. However it is difficult to predict weather patterns and future communities may see a rehabilitated mine as an ideal water storage facility in the future. A rehabilitated mine could source water following treatment or coal water recovered from coal drying, even if river water was unavailable for use. It is recommended that this option should be retained as a potential end use for a rehabilitated mine.

Currently two mines have approved Work Plans for rehabilitation using the fully flooded option. Fortunately neither are planned to close in the near future - aside from the unexpected effect of the introduction of carbon tax. In any case alternate rehabilitation options are being considered for these mines. It is not recommended that mine rehabilitation strategies for new mines should be based on the fully flooded option.

4.8.2 Mine Partly Filled with Water

It is most likely that each mine will need a storage dam in its base, if only to fill the last part of the mine where coal mining has occurred. For the last few years of a mine operation, overburden mining will have stopped and it becomes impracticable to place dumps where the last coal is mined. This last mined area would still be affected by uplift pressures from deep aquifers, and the use of small storage water may be necessary to balance the uplift force and prevent heave. The volume of water, the surface area of the lake, and the amount of evaporation will be much smaller than for the fully flooded option. The storage pond could be used for water collection, for water treatment, for irrigation during the initial revegetation stages or to support farming, fishing, forestry or ecological activity.

4.9 Lowered Landscape Options

An alternative to fully flooding the mine as a rehabilitation strategy is to create a lowered landscape within the rehabilitated mining area (Figure 13). Backfilling with overburden and with associated small water storages, sufficient to ensure long term mine stability, may result in a landscape 50m or 70m below natural surface. As the mines are extremely large, following rehabilitation it is possible this lowered landscape could fit into the overall Latrobe Valley landscape of rolling hills, valleys and lakes. On the base of the mine, internal dumps could be shaped and rehabilitated to provide for agricultural or tree plantings and ponds. The lowered landscape could potentially be used for agricultural cropping, grazing or plantations and small lakes could be similar to land use in other parts of the Latrobe Valley.

There are a number of options for rehabilitation of the mine batters that are above the dumps and flooded areas. In some mine situations the mine batters could be quite shallow and require little rehabilitation effort to make sustainable for a number of uses. In other parts of the mine the exposed batters could be quite steep, contain extensive coal and be much more difficult to rehabilitate. Exposed coal could be subject to the risk of fire (Figure 12) or provide unsatisfactory public risk situations.

As can be seen in Figure 8, one option for the rehabilitation of the exposed coal batters in the mine, above internal dumps or pondages, is to allow natural revegetation of the coal batters and to use overburden to cover the benches. Another example is the rehabilitation of the Yallourn North open cut mine where the coal batters have been left in this way for more than 50 years and now contain many large trees and could be considered a successful rehabilitation in its own way. However in the Yallourn North mine the benches are narrow and the batters steep, and may not meet requirements for public safety that would be expected in current or new mines. For this solution to be acceptable a risk assessment would be needed to demonstrate how the fire risk in exposed coal batters could be managed. It is likely that the government preference would be for all exposed coal benches and batters to be covered.

Alternatively, exposed batters could be dozed to flatter angles and covered with a thin layer of overburden sub soil and top soil. Flattening batters can be quite expensive unless designed to be accomplished as part of the mining operation, and in some situations this will be difficult to achieve. This solution may also not be feasible after mining has been completed if the mine crest is close to the Licence Boundary or adjacent to a buffer zone, road or river. If carried out after mining has been completed the crest would have to be pushed back quite a long way to flatten the batters. For example a 50m high batter that has an overall slope of say 45 degrees, the crest would have to be pushed back 100m to achieve a 3 (horizontal) to 1 (vertical) slope. If the rehabilitation strategy is to flatten the batters for rehabilitation, mine planning can allow for the final rehabilitated crest position and restrict some of the coal mining that could be achieved with a steeper batter system. This could mean the reduction of the coal recovery, affect mining economics and result in sterilisation of coal resources.

A further option to cover the exposed steeply mined coal faces could be to use the internal overburden dump (Figure 14). This is a normal method used in mining operations where backfilling can completely fill the mine. Whilst theoretically possible for the Latrobe Valley mines, this option is unlikely to be possible due to: -

- the large deep of the open cuts;
- the need to stabilise the worked out mine from earth movements;
- the limited amount of surplus overburden after overburden has been deposited in the base of the mine sufficient to reduce the heave risk in the mine for the long term; and
- if dumped material is placed near the top of the mine in order to cover the exposed coal faces, rather than in the base of the mine, it would need very high faces that are likely to be unstable.

As each mine is different, it is difficult to prose a preferred solution. The challenge for mine planners and for government is to find appropriate solutions for each situation rather than being prescriptive.

Figure 12 Recent Open Cut Fire in Coal Batters

Figure 13 Lowered Landscape Concept for a Large Mine

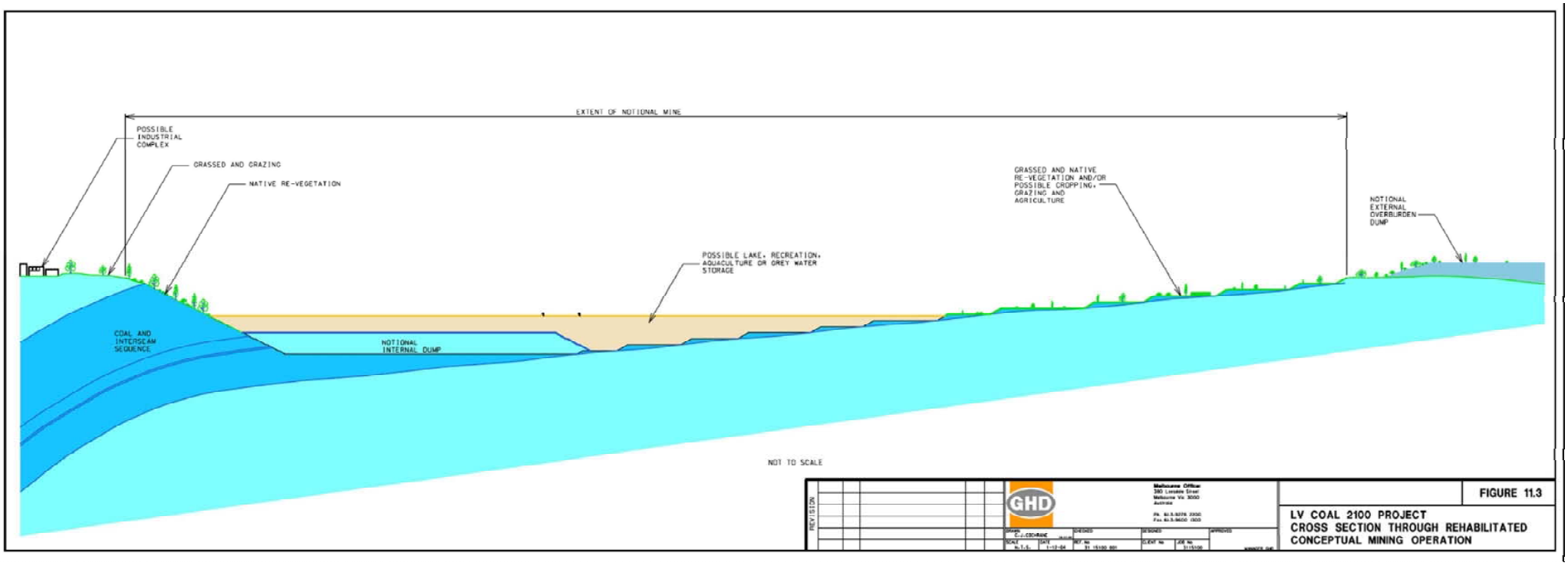


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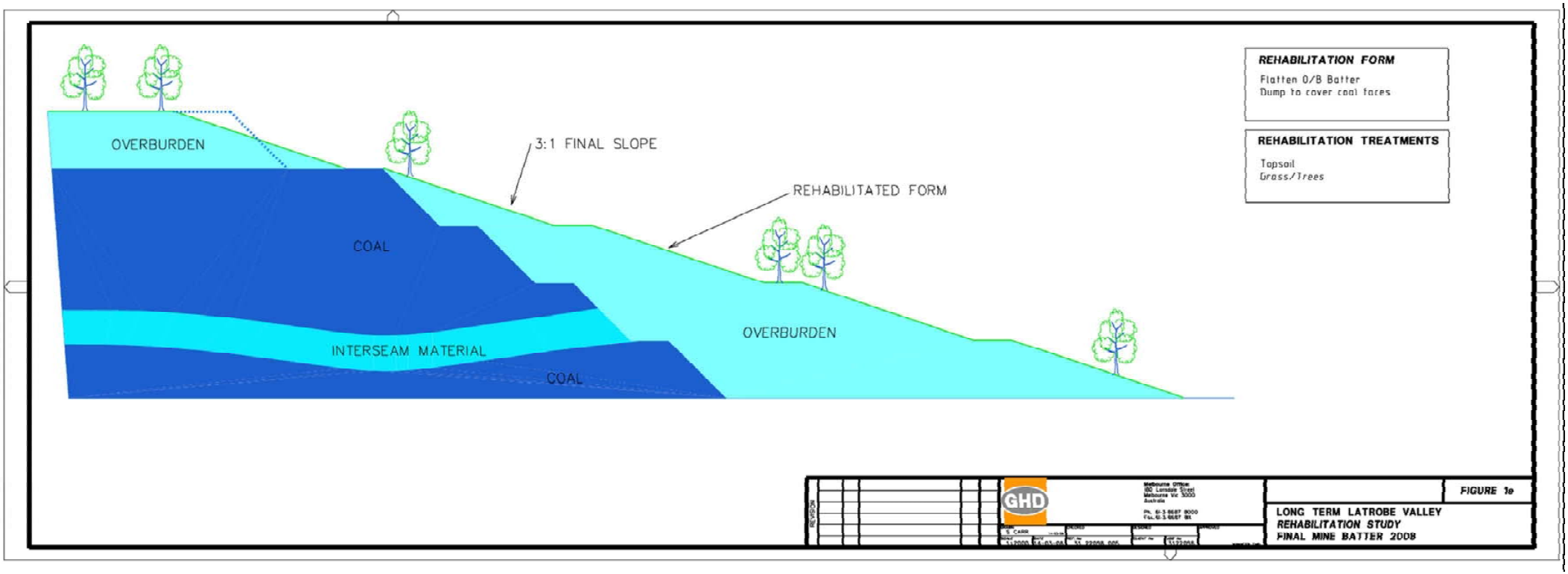
Figure 14 Using Overburden to Rehabilitating Mine Batters



4.10 Overburden Dumps

Overburden dumps are an important part of open cut mining in the Latrobe Valley. Early in the life of the mine all waste overburden and interseam materials have to be dumps external to the mine until the base of the mine is reached.

The design of the overburden dump has to consider a number of factors. These include appropriate placement of materials, stability and surface water runoff control. Placement of different waste materials within the dump can be crucial to their long term sustainability. Wet and weak materials, materials likely to cause acid drainage, hard rubbish dumps, ash and poor quality coal are likely to be found within an overburden dump. The design of the dump needs to adequately consider how these materials are placed to ensure the final dump is sound and stable, does not impact the surrounding environment and that rehabilitation methods includes to use of subsoils or topsoils that enable revegetation.

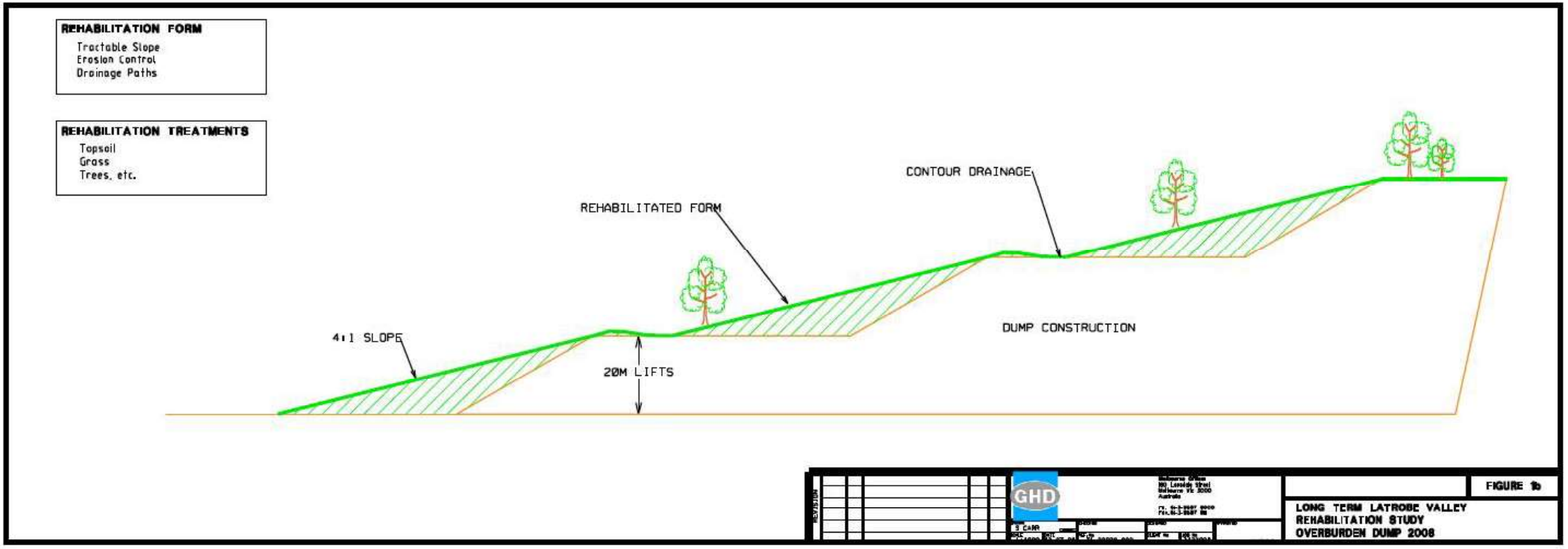
From a visual perspective, especially external dumps could become an eyesore so attention needs to be placed on how the dumps are to be shaped and rehabilitated to blend into the local landscape and be used for agriculture, forestry of other End Uses. A typical cross section through a dump is given in Figure 15. There are a number of rehabilitated dumps examples around the open cut mines in the Latrobe Valley. Where done well these rehabilitated dumps are difficult to detect against the backdrop of adjacent agriculture land.

4.11 Rehabilitation Bonds

Each of the Latrobe Valley mines provides a rehabilitation bond to enable the state to rehabilitate a mine if the mine owner did not complete appropriate rehabilitation. The bond level for the current mines was set at Privatisation and is subject to 5 yearly reviews. Bonds are assessed on identified rehabilitation work, even if the work is not planned for many years to come. The bond can be substantial and a financial drain on the mining operation (as the full value has to be carried on the cash liquidity).

The bond level needs to give government comfort that rehabilitation will be achieved, encourage mines to carry out progressive rehabilitation and to openly review rehabilitation options. A review to the method of bond calculation, especially when considering the long life of the mining operations, is recommended.

Figure 15 Overburden Dump Rehabilitation



4.12 Environmental Rehabilitation Considerations

Closure and the final rehabilitation of open pit coal mines in the Latrobe Valley will need to address a number of environmental compliance considerations. Many of these will be generic to this task, but others will, or could, be specifically related to the land use, or uses, to which the rehabilitated land is ultimately to be put.

Rehabilitation activities will need to comply with the relevant provisions of the Environment Protection Act 1970 (as amended), and applicable subordinate legislation in the form of State Environment Protection Policies (SEPPs), Industrial Waste Management Policies (IWMPs), Protocols for Environmental Management (PEMs), and relevant Environment Protection Regulations. In addition, EPAV publishes Technical Guidelines, Codes of Practice, Best Practice Environmental Management Guidelines and other information and guidance that may have a bearing on the rehabilitation of open pit mines and subsequent future land uses associated with these areas.

The following sections discuss the potential EPA regulatory requirements that may be relevant to the rehabilitation of open pit mining activities and future land uses.

4.12.1 State Environment Protection Policies (SEPPs)

State Environment Protection Policies (SEPPs) are regulatory policies designed to protect the beneficial uses of the environment.

Beneficial use is usually interpreted to be a use of the environment, or any element or segment of the environment, that is conducive to public benefit, welfare, safety, or health, and which requires protection from the effects of waste emissions, discharges and deposits. Furthermore, SEPPs prescribe that the following beneficial uses are to be protected throughout the state of Victoria:

- Life, health and well-being of humans;
- Life, health and well-being of other forms of life, including the protection of ecosystems and biodiversity;
- Local amenity and aesthetic enjoyment;
- Water and land-based recreational opportunities;
- Visibility;
- Production of food, flora and fibre;
- Useful life and aesthetic appearance of buildings, structures, property and materials; and
- Climate systems that are consistent with human development, the life, health and well-being of humans, and the protection of ecosystems and biodiversity.

With respect to open pit rehabilitation the following SEPPs covering the following environmental aspects are potentially relevant:

- Ambient Air Quality;
- Waters of Victoria;
- Groundwaters of Victoria;

- Prevention and Management of Contamination of Land;
- Siting and Management of Landfills receiving Municipal Wastes; and
- Control of Noise from Industry, Commerce and Trade.

An analysis of the relevant elements, criteria to be applied and practical examples can be found in Table 5.

4.12.2 Industrial Waste Management Policies (IWMPs)

There are regulatory-based Industrial Waste Management Policies (IWMPs) administered and enforced by EPAV. Those that are potentially relevant to open pit mine rehabilitation include:

- Prescribed Industrial Waste;
- Waste Acid Sulphate Soils; and
- Classification of Contaminated Soil;

An analysis of the relevant elements, criteria to be applied and practical examples can be found in Table 5.

4.12.3 Protocols for Environmental Management

A Protocol for Environmental Management (PEM) is an incorporated document evolving from a regulatory requirement within a SEPP.

Two PEMs are potentially relevant in the rehabilitation of open pit coal mines. They are the PEMs for:

- Mining and Extractive Industries (from SEPP – Air Quality Management); and
- Greenhouse Gas Emissions and Energy Efficiency in Industry (from SEPP – Air Quality Management).

Both PEMs provide guidance on relevant aspects of the SEPP (AQM) and its requirements for the management of mining and extractive industries, and greenhouse gas emissions and energy consumption. The protocols specify the steps that will need to be taken by businesses to demonstrate compliance with the policy principles and provisions of SEPP (AQM) relating to potential impacts of emissions arising from mining and extractive industries on the air environment, and energy efficiency and greenhouse gas emissions.

An analysis of the relevant elements, criteria to be applied and practical examples can be found in Table 5.

4.12.4 Environment Protection Regulations

A range of environmental regulations has been produced under the heads of power contained in the Environment Protection Act 1970 (as amended). Those regulations that are potentially applicable to open pit mine rehabilitation, or land uses associated with this, include:

- Environment Protection (Prescribed Waste) Regulations 1998;

- Environment Protection (Scheduled Premises And Exemptions) Regulations 2007.

An analysis of the relevant elements, criteria to be applied and practical examples can be found in Table 5.

4.12.5 EPA Guidelines

A range of environmental guidelines have been produced by EPA, some of which may be relevant to rehabilitation activities and/or interim, or future, land uses associated with rehabilitated land.

The EPA guidelines and information bulletins that may be relevant include:

- Acid Sulphate Soil and Rock (August 1999, Publication No. 655);
- A Guideline for Submitting a Voluntary Neighbourhood Environment Improvement Plan Proposal (May 2002, Publication No. 847);
- Best Practice Environmental Management (BPEM) – Construction Techniques for Sediment Pollution Control (May 1991, Publication No. 275);
- Best Practice Environmental Management (BPEM) – Requirements for Landfills receiving Category C Prescribed Industrial Wastes (April 2008, Publication No. 1208);
- Best Practice Environmental Management (BPEM) – Siting, Design, Operation and Rehabilitation of Landfills (October 2001, Publication No. 788);
- A Framework for Alternative Urban Water Supplies: Managed Aquifer Recharge (December 2006, DSE 0602A); [note: this document developed in conjunction with DSE, and others, and originally published by DSE. Note that this is also a discussion paper.]
- Carbon Management Principles (June 2008, Publication No. 1106.3);
- Classification of Wastes (May 2007, Publication No. 448.3);
- Control of Arsenic in Mine Tailings, Sand and Rock (March 2005, Publication 545a);
- Environmental Guidelines for Major Construction Sites (Feb 1996, Publication 480);
- Hydrogeological Assessment (Groundwater Quality) Guidelines (Sept 2006, Publication 668); and
- Interim Guidelines for Control of Noise from Industry in Country Victoria (April 1989, Publication N3-89);
- Noise Control Guidelines (July 1992, Publication TG302/92).

An analysis of the relevant elements, suggested key criteria to be applied and practical examples can be found in Table 5.

4.12.6 National Greenhouse Regulatory Developments

The National Greenhouse and Energy Reporting System (NGERS) was introduced as an Act of Parliament in 2007, and the NGERS regulations came into force on 1st July 2008. The system will be further developed to accommodate a national emissions trading scheme by 2010. It will require the measurement and reporting of greenhouse gas discharges to atmosphere, such as methane (although this is an unlikely by-product from Victorian brown coals) and to encourage its capture and utilisation as an

energy source. Potential impacts on the rehabilitation of a mine site include assessment of

- Backfilling Materials and required precautions
- Groundwater Aquifers
- Soil Preservation and Planting

Ref the Native Vegetation Management Framework: Discussion Paper that suggests the rehabilitation must meet DSE standards to be considered for offsets even though these standards are not included in Work plan requirements.

4.13 Regional Requirements

When considering the scale of the brown coal mines, their area and depth it is apparent that each will have regional impacts beyond their boundaries and issues of regional importance need to be a consideration of the accepted Mine Work Plan and the Mine Rehabilitation Work Plan.

5. Mine Rehabilitation Framework

This study has identified that mine rehabilitation planning for a typical Latrobe Valley open pit mine could be considered in 2 distinct stages.

- **Land Form Design**

The first stage is to identify an achievable and acceptable **Land Form** that meets the prime requirement of being stable for rehabilitation of the mine site.

When planning for a new mine, and when application is made for a Work Plan, the planned mine rehabilitation is an essential consideration. In these early planning stages, assessment is made of the coal to be won, the mine size and depth, as well as the quantities of overburden & interseam that have to be removed and dumped. Mine size, remnant voids as well as the external and internal dumps are important in the assessment of the requirement to rehabilitate disturbed areas. Rehabilitated areas must also be stable in the long term and safe batter slopes and the need for aquifer depressurisation should also be assessed. Other aspects also critical for early planning of the long term overall rehabilitation plan, include minimising fire risk in exposed coal and effective management of critical coal, water and other resources.

It is proposed that the rehabilitated **Land Form** should be designed with the primary objective to provide mine stability, minimise risk from coal fire and optimise the use of critical resources – coal, water and cost.

The decisions on the Land Form can logically be carried out in discussions between the proponent and government in application for the Work Plan and tested in any EES panel set-up to approve the project. There may be no need to change the design of the rehabilitated land form for the life of the mine. However, where significant changes to the Mine Plan are contemplated, then this would require the same process of attention to identify an achievable and acceptable **Land Form** for rehabilitation of the mine site.

- **Land Use Design**

The second stage is to identify the Final **Land Use** and the treatment of rehabilitated areas. Although a **Land Use** may need to be defined for initial approval and EES environmental assessment purposes, finalisation of the long term **Land Use** is not necessary until much later in the life of the mine. For any final **Land Form** design there are likely to be many possible **Land Use** options. Mine areas could be grassed, treed, or provide places for water storage; they could be used for flora or fauna specialist habitats, for forestry, agriculture, industry; or even for tourism - concerts, rock climbing or trail biking. Storage ponds could be used for water storage, water treatment, or fish farming etc. As the Latrobe Valley mines normally span 30 to 60 years, final decisions for the **Land Use** are not necessary until shortly before rehabilitation is carried out. Over the mine life the opportunities for the use of rehabilitated areas and community needs are likely to significantly change so that early decisions on the Land Use for the rehabilitated mine and dump area may not be satisfactory at the end of the mine life. This does not mean that all Land Use planning

can be deferred to the end of the life of the mine. Decisions will need to be made throughout the life for progressively rehabilitated mine areas as well as the final uses following mine closure. The Environmental Review Committee (ERC) can assist assessing the appropriate Land Use as disturbed areas are progressively rehabilitated.

Assuming the rehabilitated Land Form is stable, fire safe and efficiently utilises resources, the key criteria for evaluation of appropriate Land Uses are public safety, and environmental, social and economic related.

5.1 The Mine Rehabilitation Framework

To guide design and decision-making for mine rehabilitation pertinent to the future Latrobe Valley mines, this report recommends a Staged / Gate Approach.

A short Workshop was run with mine operators, mine developers and DPI representatives to discuss this concept to check that this framework was rational and practical. A number of issues of significance to Latrobe Valley mine rehabilitation such as steep coal batters, external dumps for new mines and prospective interconnection of pits were discussed. A number of possible Land Forms, taken from previous, current and future mine rehabilitation examples, were used to test the Stage/Gate model and the evaluation process.

The proposed Stages reference Land Form Design and Land Use Design. Within each of the Stages, Gates define the key criteria for evaluation of options and set priorities in decision making / evaluation. The Stages and Gates are outlined below.

There are two stages and five Gates:

Stage 1 the final mine Land Form design

LF1 mine stability, safety and sustainability,

LF2 resource utilisation,

LF3 environmental assessment of Land Form design, and

Stage 2 the rehabilitated mine Land Use Design – this should be subject to progressive review as the mine is rehabilitated and before the Final Closure planning for the mine.

LU1 environmental assessment of Land Use design, and

LU2 public safety, social, sustainability and economic benefits of Land Use design.

A Guide for the Mine Rehabilitation Framework is outlined in Tables 2 to 5.

Table 2 Guide for Mine Rehabilitation Framework – Stage 1 Gate LF1

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
Stage 1 Land Form Design	**Gate LF1 Identification of an Overall Mine Land Form Design that ensures Mine Safety and Stability**	When considering final proposed Land Form Design, there is the need to assess its adequacy to provide a safe and stable mine for long term use after mining with prime check points of relevance to the Latrobe valley Brown Coal Mines: • Stability of the Base of the final Mine; • Batter Stability; • Fire risk in exposed coal faces; and • Flooding and associated erosion	Demonstrate how the Land Form of the rehabilitated mine provides long term stability, minimises extensive fire risk in exposed coal batters and minimises the risk of flooding. There would be the need to carry out a Risk Assessment that identified the appropriate management strategy. The expected key criteria would be: - • Factors of safety for stability of the bottom of the mine and batters; • Batter slopes and heights; • Reliance on continued aquifer pumping or Horizontal drains; • Exposed coal areas and fire prevention arrangements; • Flood levees and flood risk; • etc.	**Stability Risk of the Base of the final Mine**: For a Latrobe Valley mine the Final Land Form is likely to be determined mainly from this factor. In order to keep the base of the mine stable during mining, pumping water from bores in deep aquifers is carried out to reduce heave pressure. To assess the final rehabilitation Land Form there appears to be 3 ways to maintain the stability of the base of the mine: - • Continued pumping to keep pressure below critical levels; • Backdumping of overburden and the use of small ponds to create a lowered landscape that provides sufficient weight to counteract aquifer pressure; and • Flooding the mine to a level necessary to provide sufficient weight to counteract aquifer pressure. In stability assessment, consideration needs to be given to the potential rebound of aquifer pressures even if neighbouring mines continue aquifer depressurisation, and long term when mining in Latrobe Valley ceases. **Batter Stability Risk**: In developing Final Land Form rehabilitation solutions need to ensure all batters are stable. There are likely to be overburden, coal and waste dump faces exposed or beneath water in most designs. Instability may result from high faces, steep slopes, weak layers, high pore pressure, etc. Generally, batter stability could be controlled by using toe dumps or flatter batters in the Final Land Form. Where horizontal drains are a critical component of the long term stability, consideration to their long term viability is required. **Fire Risk in Exposed Coal**: Coal resources in the Latrobe Valley extend for large distances so the limits of mining will be defined by factors other than the presence of coal seams. As a consequence the Final Land Form batters are likely to contain significant proportions of unmined coal. Whilst fairly steep coal batters are likely to be stable, there is a risk from fire unless these batters are fully sealed. During mine operation the fire risk is tolerated and the use of fire service pumps and pipelines provides an on-going capacity to extinguish coal batter fires. Unless this fire protection and fire fighting system is maintained following mine closure, this risk needs to be managed. **Flooding Risk**: Other than for the flooded mine option, the Final Land Form must protect the rehabilitated area from external flooding and ensure lowered landscape areas are not subject to flooding as this could cause extreme erosion and flood working areas in the base of the mine.

Table 3 Guide for Mine Rehabilitation Framework – Stage 1 Gate LF2

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
Stage 1 Land Form Design	**Gate LF2 Assessment of the Utilisation of Resources**	When considering Land Form Design assess the utilisation of resources with prime check points: - • Coal Utilisation + Protection • Water, surface and underground • Costs	Show how the rehabilitated mine optimally utilises the coal and water resources within the Mining Licence Areas. Where there are further coal resources beyond the planned mine, indicate how these could be won in the future by a mine extension or deepening. Key criteria are likely to be: - • Coal resources included in mine plan and those beyond mine plan; • Source of water for flooding options; • Continued pumping of aquifers; • The economic justification of plan.	**Coal Utilisation Protection**: The Mine Operator should maximise the recovery of coal resources within their Mining Licence Area. However each Mining Licence Area contains coal seams that are too deep, too thin, have poor quality or are just uneconomic. Furthermore, as the coal seams normally extend beyond the final mine crest, the mine slopes will contain significant coal resources that cannot be mined by conventional methods. Where Mining Licences abut there may be a future opportunity for mines to join and this could reduce the "loss" of coal. When the Final Land Form is being developed at the Work Plan design stage, in discussion with government, the accepted limits of practicality and economics of mining coal is critical. After the Final Land Form has been defined, changing the plan at a later date to access deeper coal seams will be more difficult, especially following the commencement of internal dumping. However as the internal dump is such a critical part of the stability of the mine after closure, delaying the introduction of the internal dump to allow future access to deeper coals is a high risk strategy if the deepened mine does not go ahead. An acceptable strategy might be to defer the decision to mine deeper seams until a later time even if this requires re-excavation of the internal dump material. **Water Resources**: As outlined in Gate LF1, ground water pumping is necessary, at least during the mining phase, to ensure the stability of the base of the mine. Surface water is also collected from rain and runoff. Following the completion of mining there may be a need to continue aquifer pumping and there will still be a large catchment within the rehabilitated mine area collecting water. The rehabilitated mine design needs to consider water collection, treatment and use as an integrated component of its long term future. **Costs**: There will be a need to balance the cost of producing the Final Land Form with potential benefits. The Land Form should be developed as part of the operation of the mine to avoid major re-shaping at the end of the mine life. Progressive rehabilitation should be carried out to allow return of land to other uses.

Table 4 Guide for Mine Rehabilitation Framework – Stage 1 Gate LF3

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
Stage 1 **Land Form Design**	**Gate LF3** **Environmental Considerations on land Form Design**	Rehabilitation of a final land form is part of the Mine's initial operating licence. At least one land use option needs to be considered and examined against relevant environmental criteria Land form design can influence the possible range of land uses. The anticipated land uses then determine the applicable environmental criteria and standards (refer Table 5 below)	The Criteria to be applied depends on the proposed or possible range of land uses.	Possible Land Uses include: • Agricultural, fisheries or forestry • Rural Residential • Waste Management and Recycling/Recovery Facilities • Industrial/Commercial • Recreational Parkland • 'Bush/Forest' Parkland • Water Storage and/or local Flood Mitigation • Other.

Table 5 Guide for Mine Rehabilitation Framework – Stage 2 Gate LU1

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
Stage 2 Land Use Design	**Gate LU1 Environmental**	The proposed End Form meets environmental licence guidelines with prime points:	Show predicted impacts and net gains on the environment	
		SEPP (Ambient Air Quality)	Particles as PM_{10} (max. conc.) 50 $\mu g/m^3$ (daily average)	Various earthworks over a large area involved in rehabilitation could generate excessive dust emissions
		SEPP (Waters of Victoria)	Policy applies to all surface waters and the catchments that supply them. Environmental 'Water' Quality Objectives prescribed in Schedule A. Subject area is classified as 'Cleared Hills and Coastal Plains'.	Turbid and/or contaminated runoff from earthworks could result in pollution of streams and rivers. Potential discharges will need to be properly managed and controlled.
		SEPP (Groundwaters of Victoria)	Groundwater classification based on TDS levels that then define potential beneficial uses to be protected. Groundwater in Latrobe Valley near open cut mines is classified as A1 (best quality), therefore all beneficial uses are to be protected.	Rehabilitation activities may give rise to contamination of groundwater, and/or affect groundwater recharge or discharge in region.
		SEPP (Prevention and Management of Contamination of Land)	Beneficial uses to be protected depend on intended land use. Standards and contamination levels allowable for different land uses defined in the *NEPM (Assessment of Site Contamination).*	Some assessment of land contamination required if sensitive land uses (e.g. Residential areas and zones (whether occupied or not), hospitals, schools, caravan parks and other similar uses involving the presence of individual people or extended periods, except in the course of their employment or for recreation) are expected or possible. Certificate or Statement of Environmental Audit required for sensitive land uses.
		SEPP (Siting and Management of Landfills receiving Municipal Wastes)	All criteria to be applied and all beneficial uses to be protected due to A1 quality groundwater.	Relevant if a pit is to be developed as a landfill for waste. A landfill could potentially assist in re-establishing appropriate land forms.
		SEPP (Control of Noise from Industry, Commerce & Trade – N1)	Depends on the use of the open pit rehabilitation areas.	Noise limits applicable to residential areas, may place restriction on rehabilitation activities during evening, night and early morning.
		IWMP (Prescribed Industrial Waste)	Applicable if a pit is to become a containment facility for prescribed industrial wastes.	

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
	Gate LU1 Environmental **(Continued)**	IWMP (Waste Acid Sulphate Soils)	Applicable if rehabilitation activities uncover or require movement of acid sulphate soils.	Inter-seam materials below water table may be acid sulphate generating soils/rock
		IWMP (Classification of Contaminated Soil)	Criteria to be applied during environmental site contamination assessment.	Status of contamination (if any) to be established prior to rehabilitation and future land use planning takes place.
		PEM (Mining and Extractive Industries)	Relevant to air emissions arising from mine closure and rehabilitation. Requires monitoring of emissions and air quality downwind.	Earthworks, traffic, excavation, deposition involved in rehabilitation works and/or from land use will generate emissions to air.
		PEM (Greenhouse Gas Emissions and Energy Efficiency in Industry)	May not be applicable to open pit rehabilitation.	May require the quantification of methane discharge from rehabilitation and encourage strategies to collect it post rehabilitation (as per landfill).
		Environment Protection (Prescribed Waste) Regulations 1998	Responsibilities for waste generator, transporter, receiver/disposer, use of permitted vehicles and waste transport certificates and Schedule 4 premises.	Management of any PIW generated or discovered during rehabilitation must be managed in accordance with regulations and other criteria.
		Environment Protection (Scheduled Premises And Exemptions) Regs 2007	Dependent on 'scheduled' activity.	Depending on scale of rehabilitation, remediation and/or proposed land uses, EPA works approval and licensing may be required, also for waste management activities (e.g. landfill, composting, waste to energy, waste treatment)
		Acid Sulphate Soil and Rock (August 1999, Publication No. 655);	Testing criteria for determination of acid sulphate generating potential of soil, sand and rock is applicable.	Inter-seam material below water table may have acid sulphate generating potential and require testing.
		A Guideline for Submitting a Voluntary Neighbourhood Environment Improvement Plan Proposal (May 2002, Publication No. 847)	A neighbourhood environment improvement plan (NEIP) is a plan developed by a local community to address environmental issues in their neighbourhood. It is an action plan designed to tackle potential issues that are important to the health, safety and enjoyment of local areas, by the people who live, work and play there.	A NEIP could be required as part of a major rehabilitation program. NEIPs are broad reaching and can be adapted to a range of environmental issues that different neighbourhoods and communities face.

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
	Gate LU1 Environmental **(Continued)**	Best Practice Environmental Management (BPEM) – Construction Techniques for Sediment Pollution Control (May 1991, Publication 275)	A stormwater management plan for site rehabilitation will need to be prepared.	Sediment and stormwater runoff that could pollute surface waters during rehabilitation must be controlled.
		Best Practice Environmental Management (BPEM) – Requirements for Landfills receiving Category C Prescribed Industrial Wastes April 2008, Publication 1208	All criteria to be applied at highest standards due to Class A1 groundwater.	Applicable if a Category C Landfill were to be developed as a desired land use for a pit to help create the future desired land form.
		Best Practice Environmental Management (BPEM) – Siting, Design, Operation & Rehabilitation of Landfills (Oct 2001, Publication 788)	Relevant if a landfill land use is to be considered in pit. Section on "Best Practice Rehabilitation and Aftercare may be particularly relevant to open pit rehabilitation.	Applicable if a landfill were to be developed as a desired land use for a pit to help create the future desired land form.
		Recommended Buffer Distances for Industrial Residual Air Emissions (Pub. No.AQ2/86, July 1990)	Buffer distance criteria for a range of industrial activities and their separation from sensitive land uses.	If mixed land uses were to be established such as an industrial estate/technology park and rural residential then the recommended buffer distances are applicable for land use planning purposes.
		Carbon Management Principles (June 2008, Publication No. 1106.3)	Application of Carbon Management Principles to rehabilitation will require quantifying methane discharge issues and a strategy for collection and use.	Rehabilitation should include a methane collection and use strategy if this is viable.
		Classification of Wastes (May 2007, Publication No. 448.3)	Criteria applicable to classification of contamination during rehabilitation and remediation.	Some materials and soils in pits may be classified as wastes due to contamination status and require appropriate management, remediation and disposal.
		Control of Arsenic in Mine Tailings, Sand and Rock (March 2005, Pubn 545a)	Applicable if >30ppm As in soil, sand, rock, inter-seam material, etc. May not be placed at surface.	Unlikely that naturally occurring Arsenic is a potential issue in pit rehabilitation in Latrobe Valley.

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
	Gate LU1 Environmental **(Continued)**	Environmental Guidelines for Major Construction Sites (Feb 1996, Publication 480)	Applicable requirements (air, water, land, noise, waste) to be incorporated into the Environmental Management Plan for pit rehabilitation.	Rehabilitation of pits can potentially create emissions to air, water and land and generate wastes that will need to be appropriately managed.
		Framework for Alternative Urban Water Supplies: Managed Aquifer Recharge (Dec 2006, DSE 0602A)	Framework applicable for water storage and/or MAR.	If a land use for a pit were to be water storage and/or 'Managed Aquifer Recharge' then this 'framework' is relevant
		Hydrogeological Assessment (Groundwater Quality) Guidelines (September 2006, Publication No. 668)	Assessment guidelines relevant to assessment of groundwater characteristics. Baseline study required.	Potential groundwater impacts from rehabilitation must be assessed.
		Industry Standard for Contaminated Construction Sites (June 2005, WorkSafe, 1st edition)	Applicable to OH&S Management Plan for rehabilitation of pits where contamination maybe or is present.	Workers may be exposed to contaminants during rehabilitation and remediation of pits.
		Interim Guidelines for Control of Noise from Industry in Country Victoria (April 1989, Pubn N3-89)	May be relevant to pit rehabilitation activities, although SEPP – N1 often used instead (by default)	Noise limits applicable to residential amenity may place restrictions on rehabilitation activities during evening, night and early morning.
		Noise Control Guidelines (July 1992, Publication TG302/92)	Road repair and track maintenance, and construction and demolition criteria relevant to pit rehabilitation.	Noise will be generated during pit rehabilitation.
		National Greenhouse and Energy Reporting System (July 2008)	Methane quantification and control may be required under NGERS.	Pit rehabilitation may create an opportunity for methane collection and use.

Table 6 Guide for Mine Rehabilitation Framework – Stage 2 Gate LU2

Stage	Gates	Relevant Elements	Criteria to be Applied	Practice Examples
Stage 2 Land Use Design	**Gate LU2 Social**	During mining the activity has a significant social impact on local communities that has to be addressed in the EES. Uses of land needs to ensure Public safety. Similarly for the rehabilitated mine, there is a need to demonstrate sustainability (not being a liability on local communities), providing opportunities for community benefit (jobs, recreation, commerce or environment), social benefits and low impacts.	An assessment of • Public Safety • The sustainability of the proposed land use for the rehabilitated mine (e.g. is self sustaining or if rehabilitated area needs continued management). Assessment needs to determine how these costs are to be funded; • Benefits to the local community for jobs (e.g. employment within the rehabilitated mine area), recreation (e.g. opportunities for waking, hiking, abseiling, fishing etc. within the rehabilitated mine area) commerce (e.g. business opportunities within the rehabilitated mine area) or environment (e.g. development of habitat areas for flora or fauna); • Impacts on the local community (e.g. noise, dust, safety risk, maintenance or other costs of management etc.).	Possible Land Uses include: • Agricultural, fisheries or forestry • Rural Residential • Waste Management and Recycling/Recovery Facilities • Industrial/Commercial • Recreational Parkland • 'Bush/Forest' Parkland • Water Storage and/or local Flood Mitigation • Other.
Stage 2 Land Use Design	**Gate LU3 Economic**	The mine rehabilitation area could be subject to a significant number of uses. However each will have different economic costs to construct or to operate or produce products that depend on market forces as to their viability.	An assessment of the costs to set-up. An assessment of the long term economic sustainability, costs and risks associated with the proposed land use for the rehabilitated mine.	To be sustainable the final mine rehabilitated land use should be self sustaining. There may be on-going costs but ideally these should be funded by the land use. Farming of forestry land would need working but should be able to profitably be managed. Tourism could pay for road maintenance or facilities operation.

6. Findings

1. Rehabilitation is a critical part of the Mine Plan and the mine operation. In the Latrobe Valley, considerable effort has been applied to develop rehabilitation policies and practices and to progressively rehabilitate mines as part of their normal operation. The practice of rehabilitation of external dumps is well established and many have been incorporated back into the natural environment. The development of wetlands and the use of appropriate native species (flora and fauna) are practiced widely. However, there are few examples of completed rehabilitated mine voids. This is due to the long life of the mines and the shortage of overburden waste to allow progressive rehabilitation. The depth of the mines, the thickness of coal in the final mine batters, the pressures in deep aquifer are challenges to be resolved in the mine rehabilitation.

2. The rehabilitation requirements for the Latrobe Valley Mines are quite different from rehabilitation of other mines in Australia due to their: -

- extremely long life;
- importance to Victoria's economy;
- size and depth; and
- that there is insufficient fill material to enable backfilling to natural surface.

3. Because of the extremely long life of these mines, mine rehabilitation should be considered in two parts: -

- Land Form design; and
- Land Use design.

Supporting Guides have been developed for use with this recommended Framework for mine rehabilitation in the Latrobe Valley coal fields. It is important that a range of solutions are considered and that the principles of Risk Assessment are used in the analysis of various options.

4. Land Form design is an integral part of the Work Plan and as well as meeting environmental considerations, the design needs to demonstrate how the mine excavation, and overburden dumping will enable the final shape to control the: -

- Stability Risk (especially in the Base of the final mine and in batters);
- fire Risk in any Exposed Coal; and
- flooding Risk:

and manages the utilisation of resources of coal; water; and cost.

5. Progressive rehabilitation to the final Land Form should be carried out.

6. Any change to the Land Form design requires a Work Plan change.

7. There are many potential final Land Uses that could be considered for any of these mines as they are so large, and multiple uses are possible. Also as the mines have such long lives (50 + years), Land Use design can and probably should be deferred to allow involvement of communities closer to the time of rehabilitation. The Environmental Review Committee, with representatives from the community,

government and non government organisations is well placed to review and contribute to the selection of Land Use(s), providing options meet environmental requirements.

8. Land Use design needs to consider: -

- public safety;
- environment;
- social; and
- economic factors.

9. In this study two final Land Form options for the mined out areas have been reviewed. These are: -

- fully flooded mine option; and
- lowered landscape option.

The fully flooded mine option is expected to be able to satisfy Land Form requirements of mine stability, coal resource utilisation, fire risk and provide a number of future uses. The main issue for this option is the availability of sufficient water to fully flood the worked out mines. As some existing mines in the Latrobe Valley have approved Work Plans for a fully flooded rehabilitated mine option, alternative rehabilitation strategies should be developed to cater for a situation where there is insufficient water available for rehabilitation. For new mines the fully flooded mine option is unlikely to be acceptable on the basis of the expected limited availability of water for this purpose.

The lowered landscape option appears likely to be able to satisfy Land Form requirements of mine safety, coal resource utilisation and could provide options for agriculture, forestry, industrial and many other future uses. In this option identifying practical options to mange potential exposed coal surfaces to minimise fire risk will be critical in the acceptability of Land Form designs.

In both cases, Land Form design needs to consider potential future mining to recover unmined coal resources and the timing or extent of rehabilitation if mining beyond the approved Work Plan is required.

10. A Rehabilitation Bond needs to give government comfort that rehabilitation will be achieved, encourage mines to carry out progressive rehabilitation and to openly review rehabilitation options. A review to the method of bond calculation, especially when considering the long life of the mining operations, is recommended.

11. There is a need to establish acceptable solutions for the mine rehabilitation issues specific to the Latrobe Valley and Gippsland coal mines. These include: -

- the use of other materials to develop an acceptable subsoil / topsoil layer;
- deposition of acid forming material within dumps;
- how to rehabilitate exposed coal batters;
- sourcing water for the full or partly flooded solution;
- interim rehabilitation for mine batters that may be needed for expansion; and
- acceptable rebound aquifer pressure levels for rehabilitation design.

7. Glossary

Reference	Meaning
ANZMEC	The Australian and New Zealand Minerals and Energy Council (ANZMEC) consists of the Commonwealth Minister for Industry, Science and Resources, State and Territory Ministers with responsibility for minerals and energy and the New Zealand Minister for Energy. The Papua New Guinea Ministers for Mining and Petroleum and Energy have observer status. ANZMEC's mission is to promote the general welfare and progressive development of the Australian mining and minerals industry, and to consult on the nation's energy needs, resources and policies.
DITR	Department of Industry, Tourism and Resources, Federal Government, Canberra
DPI	Department of Primary Industries, Victorian Government. The Minerals and Petroleum Division (M&P) is responsible for the promotion and regulation of the extractive, oil and gas, pipelines, geothermal energy, minerals exploration and mining industries in Victoria. Industry specific facilitation and development marketing services are provided, along with the maintenance of the State's historical geological database and the development of the additional state-of-the-art regional geological data.
DSE	Department of Sustainability and Environment, Victorian Government
MCA	The Minerals Council of Australia represents companies involved in mineral exploration, mining and processing of minerals. Its activities are funded entirely by its member companies which, between them, produce about 90 percent of Australia's mineral output. The Mission of the Council is to promote the development of a framework that encourages safe, profitable and environmentally responsible minerals exploration, production, processing and marketing capable of sustaining an internationally competitive minerals industry attuned to community expectations.
VFF	Victorian Farmer's Federation
MR(SD)A	The Mineral Resources (Sustainable Development) Act 1990 (MR(SD)A) provides a contemporary legislative framework for the development and regulation of the mineral exploration and mining industry. The MR(SD)A applies to all minerals, including gold, coal, and mineral sands. The MR(SD)A addresses licensing and approvals, and other issues including compensation, rehabilitation and royalties for mineral exploration and development activities. The Act seeks to encourage an economically viable mining industry which makes the best use of mineral resources in a way that is compatible with the economic, social and environmental objectives of the State. A series of Regulations and guidelines also apply to mineral exploration and development activities.
Mine closure	Mine closure refers to the period of time when the operational stage of a mine is ending or has ended, and the final decommissioning and mine rehabilitation is being undertaken (Ref 1)
Mine completion	Mine completion is the goal of mine closure. A completed mine has reached the state where mining lease ownership can be relinquished and responsibility accepted by the next land user. Mine completion ultimately determines what is left behind as a benefit or legacy for future generations (Ref 1).
Mine batters	In an open cut the operating faces are completed to a final slope. In this report the term 'mine batters' are used both for the individual faces and for the overall slope of the perimeter of the mine. The crest of the batters is the top edge of the mine batters.
Progressive Rehabilitation	Progressive rehabilitation is that carried out during the mine life to allow progressive return of lands disturbed by mining.

Mines	The following mines are referenced in this report: Yallourn North, Yallourn North Extension, Yallourn, Morwell or Hazelwood and Loy Yang. Prospective mines are located at Driffield, Flynn, Fernbank, Traralgon Creek within Latrobe Valley and nearby included Gormandale, Stradbroke and Gelliondale.
Super Pit	The concept of a 'super-pit' is that resulting from joining two or more mines. Super-pits could be made by joining Hazelwood with Driffield, Loy Yang with Flynn and Fernbank
Backdumping	This is the concept of placing overburden and interburden waste materials dug during mining back into the base of the worked out parts of the mine. It is the normal method used in strip mining techniques in other coal mining provinces, but in the Latrobe Valley there is insufficient overburden to completely backfill the void.
Strip Ratio	The strip ratio is the ration of waste to coal or coal to waste. In the Latrobe Valley because there is so little overburden, the ratio is defined as the amount of coal [tonnes] compared with the amount of overburden [bank cubic metres]. Most mining areas under consideration in the Latrobe Valley and Gippsland have a strip ratio of more than 2. This means that there is about twice as many coal removed as overburden stripped (the density of coal is close to 1). Or put it another way if all of the overburden was backdumped into the mine (impracticable) then it would only occupy about one third of the void space developed in mining.
Coal	Latrobe Valley and South Gippsland brown coal or lignite have high moisture content (between 50% and 70%), low ash levels (often less than 5%), low in ground energy (7 to 10 Ml/kg), but the dried coal have energy levels equivalent to thermal back coal (approx. 24 MJ/kg)
Overburden	Material overlying the coal seams, mainly comprising sands, silts and clays
Interseams	Layers between the coal seams, mainly comprising sands, silts and clays
Aquifers	Layers within the ground, above, between and below coal seams that contains ground water under pressure
Horizontal drains	Horizontal drains are used in permanent coal batters to provide a seepage path for water trapped in natural cracks and joints and prevent high pore pressures causing earth movement.

8. References

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c. Victorian Greenhouse Strategy Action Plan Update; Minister for Environment; April 2005.

d. Our Common Future; Brundtland; 1987

e. Enduring Value – The Australian Minerals Industry Framework for Sustainable Development; MCA; June 2005

f. Enduring Value – Guidance for Implementation - The Australian Minerals Industry Framework for Sustainable Development; MCA; June 2005.

g. Australian Minerals Industry Code for Environmental Management (February 2000); www.enviro-code.minerals.org.au

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i. Leading Practice Sustainable Development Program for the Mining Industry; Resources Division, Department of Industry, Tourism and Resources, Federal Government, Canberra; Second print October 2006. Includes Overview and Handbooks on: -

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- Mine Rehabilitation
- Mine Closure and Completion
- Biodiversity Management
- Managing Acid and Metalliferous Drainage
- Tailings Management
- Working with Indigenous Communities
- Cyanide Management
- Water Management
- Hazardous Materials Management
- Particulate, Noise and Blast Management
- Monitoring, Auditing and Performance
- Risk Assessment and Management

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l. Earth Resources and the Native Vegetation Management Framework: Discussion Paper; DSE; 2007

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w. Latrobe Valley 2100 Coal Project; GHD 2005

x. Latrobe Valley Geological Model ; GHD, published by DPI; 2006

y. IPRH Mine Rehabilitation Progress Report 2007; International Power Hazelwood; 2007.

z. Replacement Wetlands Project Progress Report 2007; International Power Hazelwood; 2007.

aa. Draft Community Engagement Guidelines for Mining in Victoria; Department of Primary Industries; December 2007.

Appendix A

Statutory Environmental Requirements

Relevant Extracts From Legislation or Regulations

Mineral Resources (Sustainable Development) Act 1990

Part 1

2A Principles of Sustainable Development

(1) It is the intention of Parliament that in the administration of this Act regard should be given to the principles of sustainable development.

(2) For the purposes of this Act, the principles of sustainable development are—

(a) community wellbeing and welfare should be enhanced by following a path of economic development that safeguards the welfare of future generations;

(b) there should be equity within and between generations;

(c) biological diversity should be protected and ecological integrity maintained;

(d) there should be recognition of the need to develop a strong, growing, diversified and internationally competitive economy that can enhance the capacity for environment protection;

(e) measures to be adopted should be cost effective and flexible, not disproportionate to the issues being addressed, including improved valuation, pricing and incentive mechanisms;

(f) both long and short term economic, environmental, social and equity considerations should be effectively integrated into decision-making;

(g) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation and decision making should be guided by—

(i) a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and

(ii) an assessment of the risk-weighted consequences of various options;

(h) development should make a positive contribution to regional development and respect the aspirations of the community and of Indigenous peoples;

(i) decisions and actions should provide for community involvement in issues that affect them.

Part 3 – WORK UNDER A LICENCE

39A Licensee's duty to consult with community

A licensee has a duty to consult with the community throughout the period of the licence by—

(a) sharing with the community information about any activities authorised by the licence that may affect the community; and

(b) giving members of the community a reasonable opportunity to express their views about those activities.

Part 7 – REHABILITATION

78 Licensee must rehabilitate land

(1) The holder of a mining licence must rehabilitate land in accordance with the rehabilitation plan approved by the Department Head.

(2) The holder of an exploration licence must rehabilitate land in accordance with the conditions in the licence.

(4) The owner of land may request the licensee to enter into a written agreement as to the rehabilitation plan.

79 Rehabilitation plan

A rehabilitation plan must—

(a) take into account—

(i) any special characteristics of the land; and

(ii) the surrounding environment; and

(iii) the need to stabilise the land; and

(iv) the desirability or otherwise of returning agricultural land to a state that is as close as is reasonably possible to its state before the mining licence was granted; and

(v) any potential long term degradation of the environment; and

(b) be prepared by the licensee after consultation with—

(i) the owner of the land, if the land is private land and the licence is a mining licence.

79A Rehabilitation liability assessment

(1) The Minister may require a licensee to undertake an assessment of the licensee's rehabilitation liability under section 78 (a rehabilitation liability assessment) for the purpose of determining the amount of a rehabilitation bond or reviewing the amount of a rehabilitation bond entered into or to be entered into by the licensee.

(2) A rehabilitation liability assessment must—

(a) be undertaken in a manner and form determined by the Minister; and

(b) take into account works required to be undertaken to rehabilitate the land in accordance with the requirements of section 78.

(3) The Minister may require a licensee to engage an auditor to certify that a rehabilitation liability assessment has been prepared in accordance with subsection (2) and that it is accurate.
(4) An auditor who has given a certification under subsection (3) must forward a copy of the certificate to the Minister within 21 days after giving that certification.

80 Rehabilitation bond

(1) A licensee must enter into a rehabilitation bond for an amount determined by the Minister.
(2) If land covered by a mining licence is private land, the Minister must, before determining the amount of a rehabilitation bond, consult with—
(a) the council in whose municipal district the land is situated; and
(b) the owner of the land.
(3) The condition of a rehabilitation bond is that the licensee rehabilitates the land as required by section 78 to the satisfaction of the Minister.
(4) The Minister may, at any time after a rehabilitation bond is entered into and after consultation with the licensee, by notice served on the licensee require the licensee to enter into a further rehabilitation bond for an amount determined by the Minister if he or she is of the opinion that the amount of the bond already entered into is insufficient.
(5) The Minister may serve on a licensee who has not complied with a requirement under subsection (4) within 1 month after service of notice of the requirement, a notice prohibiting the licensee from doing any work until the licensee has entered into the further rehabilitation bond.
(6) The licensee must comply with a notice under subsection (5).

81 Rehabilitation

(1) The licensee must rehabilitate land in the course of doing work under the licence and must, as far as practicable, complete the rehabilitation of the land before the licence or any renewed licence ceases to apply to that land.
(2) If the rehabilitation has not been completed before the licence or renewed licence ceases to apply to the land the former licensee must complete it as expeditiously as possible.
(3) Section 47A continues to apply to the land while rehabilitation is completed as if the former licensee were still a licensee.

81A Certification that land has been rehabilitated

(1) The Minister may require that a licensee or a former licensee engage an auditor to certify that land has been rehabilitated as required by section 78 for the purpose of deciding whether to return any rehabilitation bond under section 82.
(2) An auditor who has given a certification under subsection (1) must forward a copy of the certificate to the Minister within 21 days after giving that certification.

82 Return of bond if rehabilitation satisfactory

(1) The Minister must return the bond or bonds to the licensee or former licensee as soon as possible if the Minister is satisfied—
(a) that the land has been rehabilitated as required by section 78; and
(b) that the rehabilitation is likely to be successful.
(2) If the land is private land the Minister must not return the bond or bonds to the holder or former holder of a mining licence until after the owner of the land and the council in whose municipal district the land is situated have been consulted.
(3) The Minister may, as a condition of returning a bond or bonds to a licensee or a former licensee, require that person to enter into a further rehabilitation bond if any land or part of the land to which the bond relates has not been rehabilitated, or requires further rehabilitation.

83 Minister may carry out rehabilitation

(1) The Minister may take any necessary action to rehabilitate land if he or she—
(a) is not satisfied that the land has been rehabilitated as required by section 78; or
(b) is satisfied that further rehabilitation of the land is necessary; or
(c) is requested to do so by the owner of the land.
(2) The Minister must, if he or she refuses to act on a request under subsection (1)(c), inform the owner of the land of the reasons for that refusal.
(3) The Minister may only take action under subsection (1) if he or she has requested the licensee or former licensee to rehabilitate the land and the licensee or former licensee has failed to do so within a reasonable period after the request.
(4) The Minister may recover as a debt due to the Crown in a court of competent jurisdiction any amount by which the cost incurred under subsection (1) exceeds the amount of the bond or bonds.
(5) The Minister must, if satisfied that no further rehabilitation of the land is likely to be necessary, return to the licensee or former licensee as soon as possible any balance of the bond or bonds after any cost incurred under subsection (1) is deducted.
(6) In making a decision under subsection (5), the Minister must take into account the possibility that some of the damage caused to the land by the licence activities may not become evident for some time.

84 Payment out of Consolidated Fund

Any money required by the Minister under this Part is payable out of the Consolidated Fund, which is appropriated to the necessary extent.

Mineral Resources Development Regulations 2002

SCHEDULE 13

Regulation 25 INFORMATION REQUIRED IN WORK PLAN FOR A MINING LICENCE

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.

Environment Review Committees for mining and extractive industries (DNRE), 2001

An Environmental Review Committee (ERC) is a review body created by the Department of Natural Resources (now DPI) as a condition for selected mines and extractive industry sites. The role of the ERC is one of consultation, not consent. An ERC cannot approve a Work Plan, agree to variation of an Environment Effects Statement (EES) or discharge any other legislated authority. Recommendations from the ERC can assist the regulator in the assessment of proposed changes to the operation and can influence the licensee in its management of the operation. However, the ERC and it's members are not legally liable for any actions of the company or a Government agency.

The core membership of most ERCs is:

- Regional Inspector and/or Environment Officer from Minerals petroleum Victoria (MPV);
- NRE land manager;
- Environment Protection Authority;
- Shire Council;
- water authority;
- company; and
- community.

The key role of the committee is to review the performance of the operator against the requirements of legislation, the licence and the Environmental Management Programme (EMP)

Rehabilitation Bonds for the Mining and Extractive Industries, DPI 2007

This document presents the Department of Primary Industries' policies for the establishment and management of rehabilitation bonds and outlines the methods to be used in assessing rehabilitation liability for mining and extractive operations.

In particular the guidelines:

- explain the Department's directions in determining rehabilitation bonds which involve industry self-assessment of rehabilitation liability;
- outline the administrative and consultative process for the establishment, review and retirement of rehabilitation bonds (Part A);
- and describe rehabilitation liability estimation methods for use by both the Department and industry (Part B) - specifically the use of a Rehabilitation Bond Calculator and the use of standard rates for simple operations (≤ 5 ha disturbed and ≤ 5 m deep).

Environment Protection and Biodiversity Conservation Act 1999

"The Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act) is the Australian Government's central piece of environmental legislation. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance."

The seven matters of national environmental significance to which the EPBC Act applies are:

- world heritage sites
- national heritage places
- wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- nationally threatened species and ecological communities
- migratory species

- Commonwealth marine areas
- nuclear actions.

In addition, the Act confers jurisdiction over actions that have a significant environmental impact on Commonwealth land, or that are carried out by a Commonwealth agency (even if that significant impact is not on one of the seven matters of 'national environmental significance')."

Part 1 Section 3A Principles of ecologically sustainable development

The following principles are principles of ecologically sustainable development:
(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
(c) the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;
(e) improved valuation, pricing and incentive mechanisms should be promoted."

Victoria's Native Vegetation Management–A Framework for Action (2002)

The framework provides a means for establishing what level of revegetation is required in the rehabilitation plan. The rehabilitation requirements depend on the pre-mine condition of the land and involves ensuring that there is a net gain in the quality and quantity of native vegetation.

The framework' is the State Government's strategy to protect, enhance and revegetate Victoria's native vegetation. It:

- focuses on catchments as a whole;
- addresses critical issues on private land where native vegetation has been cleared or fragmented;
- provides a strong focus on protection and improvement of higher conservation significance vegetation; and
- provides a flexible but accountable approach for lower conservation significance vegetation, enabling landholders to move towards more sustainable land use options.

The Main Goal: Net Gain

The Framework's main goal is to achieve a reversal, across the entire landscape of the long-term decline in the extent and quality of native vegetation, leading to a net gain.
Net gain is where overall gains in native vegetation are greater than overall losses and where individual losses are avoided where possible. This recognises that although it's better to retain existing native vegetation, it is possible to partially recover both amount and quality by active work and therefore improve the result as a whole. Net gain will be achieved as a result of landholder and government-assisted efforts to protect and improve native vegetation. In addition, permitted clearing must be offset in a way that adequately addresses the future impacts of such clearing. The framework has four guiding principles:
1. Retention and management of remnant native vegetation is the best way to conserve biodiversity
2. Conservation of native vegetation and habitat depends on the maintenance of catchment processes.
3. Costs should be equitably shared according to benefits that the landholder, community and region.
4. A landscape approach to planning native vegetation management is required and priorities should be based on bioregions within Catchment Management Authority regions.

The Three Step Approach - Avoid, minimise and offset

In applying the policy, there are three key steps for land managers and owners to address when considering vegetation clearing:
1. Avoid adverse impacts, particularly through vegetation clearance;
2. If impacts cannot be avoided, minimise impacts by careful planning, design and management;
3. If clearing must occur, the clearing must be offset*

A planning permit is required to remove native vegetation and the three-step approach is an integral part of the decision making process relating to such permits.

Quality versus Quantity

Most concern for native vegetation is focused on clearing, but maintaining good quality native vegetation is just as important for conserving plants and animals and for maintaining our land in good condition. DSE has developed a standard approach for estimating the quality of an area of vegetation. Known as habitat hectares, it measures a site's condition and landscape context.

Site condition measures how much the site has changed from a 'benchmark' that describes the average characteristics of the vegetation if it were mature and undisturbed for some time, by looking at:

- presence of large old trees (for woodlands and forests)
- amount of tree canopy cover (for woodlands and forests)

- the amount of logs (for woodland forests)
- the cover and diversity of the understorey
- presence of appropriate regeneration
- how weedy the site is
- how much leaf litter there is

Landscape context considers how well the patch of vegetation can cope with natural fluctuations and disturbances events, such as old trees dying, bushfires and floods. It is measured by: how big the area of vegetation is that the site is within; and links to, and amount of, neighbouring patches of vegetation

Flora and Fauna Guarantee Act 1988

Part 1 Section 4

Objectives

(1) The flora and fauna conservation and management objectives are—
(a) to guarantee that all taxa of Victoria's flora and fauna other than the taxa listed in the Excluded List can survive, flourish and retain their potential for evolutionary development in the wild; and
(b) to conserve Victoria's communities of flora and fauna; and
(c) to manage potentially threatening processes; and
(d) to ensure that any use of flora or fauna by humans is sustainable; and
(e) to ensure that the genetic diversity of flora and fauna is maintained; and
(f) to provide programs—
(i) of community education in the conservation of flora and fauna; and
(ii) to encourage co-operative management of flora and fauna through, amongst other things, the entering into of land management co-operative agreements under the Conservation, Forests and Lands Act 1987; and
(iii) of assisting and giving incentives to people, including landholders, to enable flora and fauna to be conserved; and
(g) to encourage the conserving of flora and fauna through co-operative community endeavours.
(2) A public authority must be administered so as to have regard to the flora and fauna conservation and management objectives.

Environment Protection Act 1970

The Victorian Environment Protection Act 1970 was at its inception only the second Act in the world to deal with the whole of the environment in a systematic and integrated way. The Act is outcome oriented, with a basic philosophy of preventing pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them. Over the years the Act has evolved to keep pace with the world's best practice in environment protection regulation and to meet the needs of the community.

Key aims of the Act include sustainable use and holistic management of the environment, ensuring consultative processes are adopted so that community input is a key driver of environment protection goals and programs and encouraging a co-operative approach to environment protection.

To help achieve these aims, the following Principles of Environment Protection were added to the Act in 2001:

- integration of economic, social and environmental considerations;
- precautionary principle;
- intergenerational equity;
- conservation of biological diversity and ecological integrity;
- improved valuation, pricing and incentive mechanisms;
- shared responsibility;
- product stewardship;
- wastes hierarchy;
- integrated environmental management;
- enforcement; and
- accountability.

Such concepts parallel those included in the National Strategy on Ecologically Sustainable Development and the Intergovernmental Agreement on the Environment (IGAE).
Changes made to the Act by the Environment Protection (Resource Efficiency) Act 2002 were designed to help all sectors of the Victorian community to continue to find innovative ways of using resources more efficiently and to reduce the ecological impact.

The Act establishes the powers, duties and functions of EPA. These include the administration of the Act and any regulations and orders made pursuant to it, recommending State Environment Protection Policies (SEPPs) and Industrial Waste Management Policies (IWMP) to the Governor in Council, issuing works approvals, licences, permits, pollution abatement notices and implementing National Environment Protection Measures (NEPMs).

EPA's statutory functions under the Environment Protection Act 1970 include:

- works approvals;
- licences;
- research development and demonstration approvals;
- pollution abatement notices;
- waste transport permits and certificates; and
- appeal rights that exist in certain statutory processes.

State environment protection policies (SEPPs) are subordinate legislation made under the provisions of the Environment Protection Act 1970 to provide more detailed requirements and guidance for the application of the Act to Victoria. Subordinate legislation is law made by a body that has been delegated the power to create law by an Act of Parliament. It is used to implement the policies outlined in the primary legislation (or Act) and its powers cannot exceed those provided in the primary Act.

SEPPs aim to safeguard the environmental values and human activities (beneficial uses) that need protection in the State of Victoria from the effect of pollution and waste, SEPPs express in law the community's expectations, needs and priorities for using and protecting the environment. They establish the uses and values of the environment that the community wants to protect, define the environmental quality objectives and describe the attainment and management programs that will ensure the necessary environmental quality is maintained and improved. Under the Environment Protection Act 1970, the requirements in environmental regulations, works approvals, licences and other regulatory tools, must be consistent with SEPPs.
Industrial waste management policies (IWMPs) were one of the measures introduced into the Environment Protection Act 1970 by the Environment Protection (Industrial Waste) Act 1985 to improve the management of industrial wastes.
In 2002 the Environment Protection Act 1970 was amended by the Environment Protection (Resource Efficiency) Act to allow the Authority scope to develop waste management policies (WMPs). This change means that policies that deal with municipal waste can also be developed, thereby complementing existing arrangements and ensuring that a comprehensive framework of statutory policy can be maintained and strengthened.

WMPs cover the:

- generation
- use
- storage
- treatment
- transport
- handling
- disposal
- recovery
- recycling
- reclamation
- re-use

of waste.

WMPs may also allocate responsibility for industrial waste management operations and disposal, and establish the level of technology that should be applied to processes involving wastes.

The Act contains general requirements in relation to water, air, litter, noise, solid waste and land pollution. The Act also sets out the powers and functions of the EPA.

Part I – Introduction,
1A Purpose of the Act

(1) The purpose of this Act is to create a legislative framework for the protection of the environment in Victoria having regard to the principles of environment protection

Part V – Clean Water
38 Discharges etc. to comply with policy

The discharge or deposit of wastes into waters of the State of Victoria shall at all times be in accordance with declared State environment protection policy or waste management policy specifying acceptable conditions for the discharge or deposit of wastes into waters in the environment and shall comply with any standards prescribed therefore under this Act.

39 Pollution of waters

(1) A person shall not pollute any waters so that the condition of the waters is so changed as to make or be reasonably expected to make those waters—
(a) noxious or poisonous;
(b) harmful or potentially harmful to the health, welfare, safety or property of human beings;
(c) poisonous, harmful or potentially harmful to animals, birds, wildlife, fish or other aquatic life;
(d) poisonous, harmful or potentially harmful to plants or other vegetation; or
(e) detrimental to any beneficial use made of those waters.

(2) Without in any way limiting the generality of subsection (1) a person shall be deemed to have polluted waters in contravention of subsection (1) if—
(a) that person causes or permits to be placed in or on any waters or in a place where it may gain access to any waters any matter whether solid, liquid or gaseous which—
(i) is prohibited by or under this Act; or
(ii) does not comply with any standard prescribed for that matter; or
(b) that person causes or permits the temperature of receiving waters to be raised or lowered by more than the prescribed limits.
(3) A person shall not cause or permit waste to be placed or left in any position whereby it could reasonably be expected to gain access to any waters in circumstances where if access was gained the waste would be likely to result in those waters being polluted.
(4) A person shall not cause or permit waste to be discharged or deposited onto the dry bed of any waterway in circumstances where if the waterway had contained waters the discharge or deposit would be likely to result in those waters being polluted.
(5) A person who contravenes any of the provisions of this section shall be guilty of an indictable offence against this Act and liable to a penalty of not more than 2400 penalty units and in the case of a continuing offence to a daily penalty of not more than 1200 penalty units for each day the offence continues after conviction or after service by the Authority of notice of contravention of this section.

Part VII—Control of Solid Wastes and Pollution of Land

44 Discharge or deposit of waste onto land to comply with policy

The discharge or deposit of waste onto land—
(a) shall at all times be in accordance with declared State environment protection policy or waste management policy specifying acceptable standards and conditions therefore; and
(b) shall comply with any standards applicable under this Act.

45 Pollution of land

(1) A person shall not pollute land so that the condition of the land is so changed as to make or be reasonably expected to make the land or the produce of the land—
(a) noxious or poisonous;
(b) harmful or potentially harmful to the health or welfare of human beings;
(c) poisonous, harmful or potentially harmful to animals, birds or wildlife;
(d) poisonous, harmful or potentially harmful to plants or vegetation;
(e) obnoxious or unduly offensive to the senses of human beings; or
(f) detrimental to any beneficial use made of the land.
(2) Without in any way limiting the generality of subsection (1) a person shall be deemed to have polluted land in contravention of subsection (1) if—
(a) that person causes or permits to be placed in or on any land or in any place where it may gain access to any land any matter whether solid, liquid or gaseous which—
(i) is prohibited by or under this Act; or
(ii) does not comply with any standard prescribed for that matter; or
(b) that person establishes on any land—
(i) a refuse dump;
(ii) a garbage tip;
(iii) a soil and rock disposal site;
(iv) any other site for the disposal of or as a repository for solid or liquid waste— so as to be obnoxious or unduly offensive to the senses of human beings or interfere with any beneficial use of any groundwater.
(3) A person who contravenes any of the provisions of this section shall be guilty of an indictable offence against this Act and liable to a penalty.

Land and Groundwater related legislation

- State Environment Protection Policy (Prevention and Management of Contaminated of Land)
- State Environment Protection Policy (Groundwaters of Victoria)
- Industrial Waste Management Policy (Waste Acid Sulfate Soils)

Appendix B

Rehabilitation Risk Rating Calculator

Assessment Method for Rehabilitation Framework

DPI Study - Latrobe Valley Rehabiliation

Risk Rating Assessment for Rehabilitation Framework

Scoring System	
0	Unacceptable
1	Poor
2	Minimum Standard
3	Satisfactory
4	Meets all Requirements
5	Exceeds Requirements

Step	Major Objective		Gate 1 : Mine Stability/Sustainability				Summary	Gate 2 : Resource Use					Summary
1	**Land Form Assessment**		**Prime Requirement for Rehabilitated Land Form**					**Better Solutions will have Effective Use of Resources**					
		issue	Heave Stability	Batter Stability	Fire Risk exposed coal	other		Coal Recovery	Surface & Groundwater Use	capital cost	Maintenance requirements	other	
		criteria	Adequacy to provide a stable land form within the mine from basal heave, batter failure or other, suitable for rehabilitation		Exposed coal fire risk for the rehabilitated mine site			Utilisation of Natural Resources	Utilisation of Natural Resources	Reasonable ? Cost solution	Minimum ongoing costs following rehabilitation		
		Target/Standard											
		score											
		weighting	0.3	0.3	0.3	0.1	1	0.25	0.25	0.2	0.2	0.1	1
		weightXscore	0	0	0	0	0	0	0	0	0	0	0

Step	Major Objective			Gate 3 : Environmental Impacts						Summary	Gate 4 : Social & Other Considerations						Summary
2	**End Use Assessment**			**Rehabilitation must meet Environmental Licence Standards**							**Community Issues are critical for inclusion in End Use Determination**						
			issue	Air	Noise	Water Qualty	Flora	Fauna	Net Gain		Public Safety	Community Wishes	Heritage	Access	Visual	Progressive Rehabilitation	
			criteria														
	Main Parts of Rehabilitated Mine																
	10%	steep mine batters	score														
	10%	flat mine batters	score														
	40%	flooded area	score														
	40%	dump rehabilition	score														
	100%		total score	0	0	0	0	0	0		0	0	0	0	0	0	
			weighting	0.1	0.1	0.2	0.2	0.2	0.2	1	0.1	0.2	0.1	0.2	0.2	0.2	1
			weightXscore	0	0	0	0	0	0	0	0	0	0	0	0	0	0

GHD

180 Lonsdale Street
Melbourne, Victoria 3000
T: (03) 8687 8000 F: (03) 8687 8111 E: melmail@ghd.com.au

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* original signed