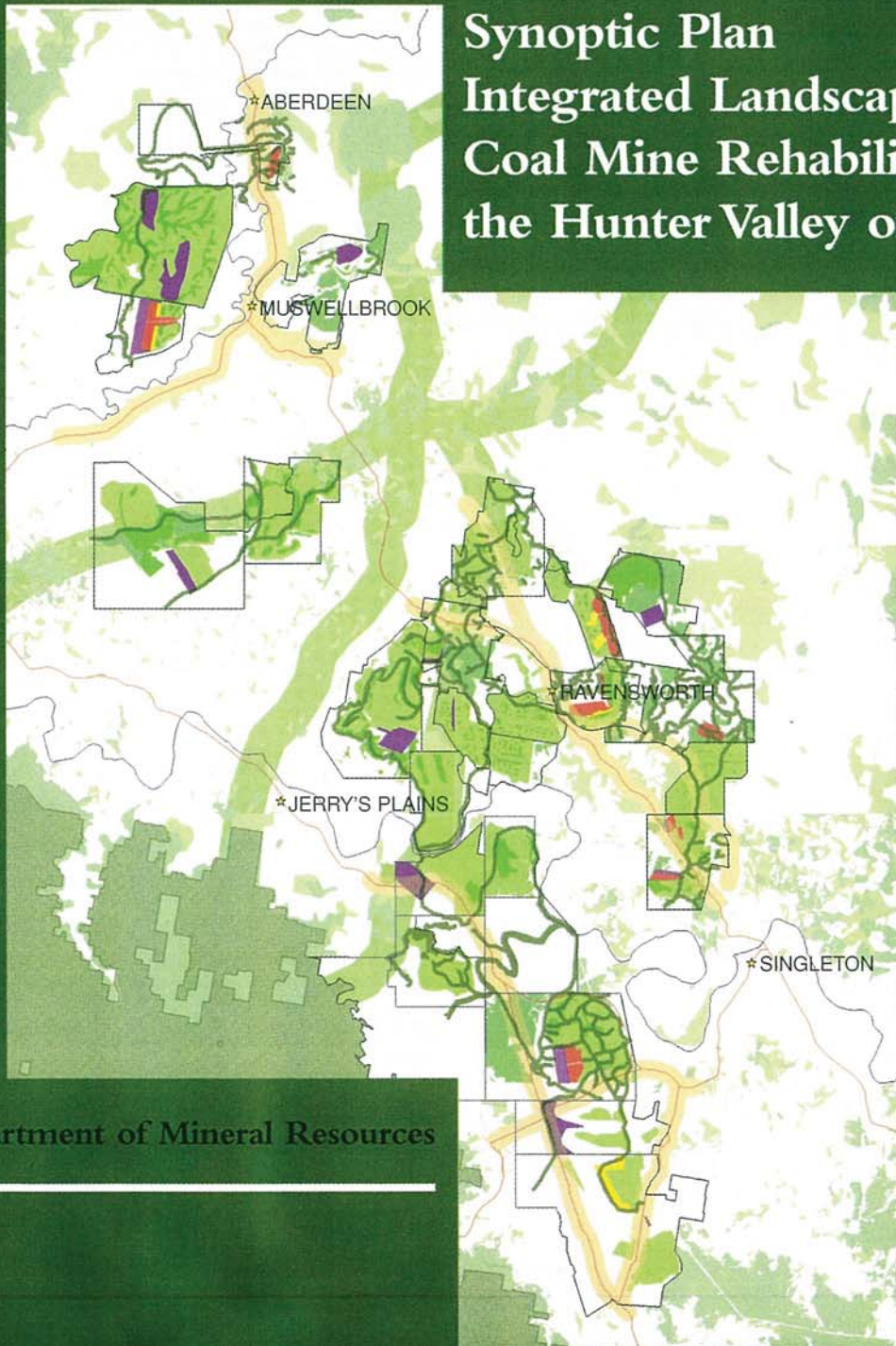
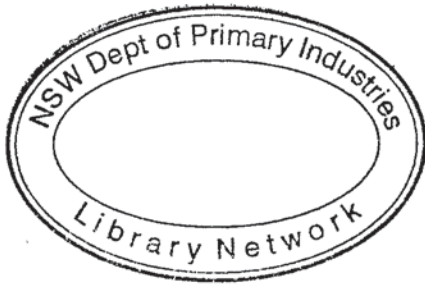




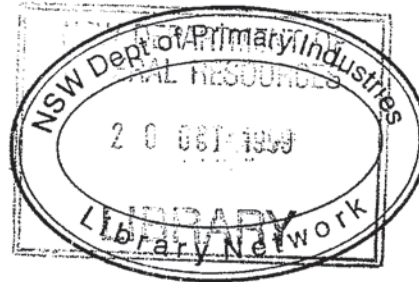
Synoptic Plan Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW



NSW Department of Mineral Resources



Department of Mineral Resources



**SYNOPTIC PLAN
INTEGRATED LANDSCAPES
FOR COAL MINE
REHABILITATION IN THE
HUNTER VALLEY OF NSW**

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Executive Summary

Progressive integrated landscape management of the Hunter Valley has recently focused on policy formation to assess and control cumulative environmental impacts of current land uses. To this end, policy agreements between governments, industry and the community have been developing although an appropriate focus on design and technology has been lacking. This document attempts to redress this inadequacy by combining the expertise and knowledge of recent advances in the management of the Hunter Valley mines in addition to the objectives of broader federal, state and regional environmental and economic objectives. In doing so, policy formation outlined in previous documents, including the Upper Hunter Cumulative Impact Study (UHCIS), is advanced to the imperative stage of implementation, monitoring and evaluation.

Restoration of mined areas to achieve visual amenity, biodiversity conservation and land management practices for ecologically sustainable development emerge as important completion criteria. Determining and quantifying the final land use during the progression of mining is a requisite for meeting such criteria. The need to undertake reassessment of rehabilitation outcomes in the coalfield has stemmed from the perception identified in the UHCIS, of a subtle paradigm shift. This is a shift in focus from agricultural land use to habitat/biodiversity restoration, and from traditional land uses to more innovative integrated land uses. These innovative land uses include the development of timber plantations with potential financial returns from both timber and carbon sequestration.

The Action Strategy nominated the Department of Mineral Resources (DMR) as the lead agency to establish a demonstration program for mine site rehabilitation and prepare an integrated landscape master plan for the Upper Hunter Coalfield. Such a brief extends beyond the traditional paradigm of environmental assessment associated with single developments as required under the Mining Act 1992.

The DMR undertook this work by the facilitation of a steering committee comprising representatives of:

- NSW Minerals Council.
- Singleton and Muswellbrook Shire Councils.
- Department of Land and Water Conservation (DLWC).
- NSW State Forests.

The collation and drafting of mining data, based on current approved mine sequencing and planned rehabilitation was fundamental to this work.

The study provides an overview of:

- Current practices and trends in mine rehabilitation.
- Regional initiatives in vegetation management.
- Emerging environmental issues and their implications on mine rehabilitation.
- A comparative analysis of mine rehabilitation plans at 1998 and 2020.
- Principles for an integrated approach towards landscape management for the coalfield.

Coal mining in the Hunter Valley has matured, over more than two decades, as a land use fundamental to socioeconomic development and as an industry capable of meeting the environmental expectations of the community. Coal mining has a dynamic but relatively short tenure of land occupancy. At this juncture, there is need for a strategic direction to lead into the next century. The broad application of integrated landscape principles, as addressed by the Synoptic Plan, can significantly enhance the outcomes of mine site rehabilitation for the lasting benefit of all stakeholders.

The mining industry is well positioned to achieve this progression through the regulatory procedures adopted in the Department of Mineral Resources' Mining, Rehabilitation and Environmental Management Process (MREMP).

The purpose of this study is to provide a basis for development of a long term integrated strategy for the rehabilitation of mines. This initiative will hopefully encourage adjacent landowners, government and the broader community to contribute in planning and land management terms to a region-wide landscape strategy.

The study is confined to an area of 260,900 hectares comprising 14.5% of the study area of the Upper Hunter Cumulative Impact Study. The study area comprises the coalfield of the Upper Hunter Valley extending from south west of Singleton to north of Muswellbrook. It is defined by the extent of the eight 1:25,000 topographic maps, Aberdeen, Muswellbrook, Dawson's Hill, Jerrys Plains, Camberwell, Doyles Creek, Singleton and Bulga. Mine holdings cover approximately 61,045 hectares or 23.4% of the study area.

The initial stage in the preparation of the Synoptic Plan was the collation of mining and rehabilitation data and drafting of two plans of the coalfield onto a Geographic Information System. The first plan shows the status of current mine development and rehabilitation at 1998. Whereas the second plan shows mine development at 2020 based on current approved mine sequencing and planned rehabilitation. The fundamental benefit to the community and other stakeholders is in the presentation of snapshot plans of the coalfield at the two points in time. The 2020 Synoptic Plan is conceptual and proposes opportunities for revegetation across the coalfield in an integrated approach that considers biodiversity,

agroforestry for amenity and commercial return, catchment protection, and bioengineering of mined landforms.

The papers in Part 2 of the Synoptic Plan have been compiled by academics, consultants and government agencies with expertise in the fields mentioned above. The Strategy Matrix of the Synoptic Plan presents key issues of contemporary mine site rehabilitation, the status of policy/procedure/practice and strategic actions to achieve the desired outcomes. These strategic actions will involve policy change, continued best practice, quality improvement, focused research and, perhaps most significantly, consensus on renewed activity in order that

environmental and socioeconomic outcomes are realised. There is still much to learn about ecological processes in the Hunter Valley and specifically the interaction of soils, vegetation and fauna with natural and constructed landforms. The experience from nearly 20 years of tree establishment on mine spoil in the Hunter Valley indicates that while natural processes may be complicated, the physical solutions can often be simple and parallel the natural processes.

This sets the opportunity for achieving the goals integral to success of the Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Upper Hunter Coalfield of NSW.

Strategy Matrix

The principles and concepts embodied in this Strategy recognise the need for flexibility to meet inevitable changes in mine planning and development. In addition, as improved base data becomes available from the Hunter Remnant Vegetation Survey, and a Vegetation Management Plan is developed for the Hunter Region, there will be a need for review and refinement. Continued research, ongoing development of mine rehabilitation techniques, incorporation of emerging technologies and opportunities created by waste water reuse, bio solids, tradable carbon credits and the potential for commercial forestry will all influence implementation of the Strategy. The treatment of final voids as utility assets within rehabilitated mine landscapes will become progressively apparent as currently active mines are decommissioned and value adding after mining uses are developed.

The strategy is ambitious and will require a long-term commitment from the industry, regulators and the broader community. The matrix highlights key actions that need to be progressed to implement the Synoptic Plan.

This Synoptic Plan has identified a number of peripheral issues which can energise and provide initiative to fundamental landscape planning for mine site rehabilitation. These issues; biodiversity, remnant vegetation enhancement, commercial forestry, greenhouse challenge and carbon credits therefore appear in the Strategy Matrix and Vision Statements for the coalfield.

Much of the success of the Strategy will be contingent upon the cooperation of private landholders outside the mine holdings. The continuity of vegetated corridors along and across waterways, agricultural lands and transport corridors is a catchment wide challenge. The mining industry's contribution to this challenge can be significant, but limited in extent.

STRATEGY MATRIX

Vision Statement No 1		
By application of the <i>Synoptic Plan Integrated Landscapes for Coal Mine Rehabilitation for the Hunter Valley of NSW</i> , the mining industry, together with local and state government, will demonstrate an integrated approach to natural resource management of lasting benefit to the region.		
Issues	Status	Strategy
<ul style="list-style-type: none"> There is no comprehensive vegetation management plan for the Upper Hunter. 	<ul style="list-style-type: none"> DLWC has initiated stakeholder forums for the development of a Hunter Vegetation Management Plan. The Upper Hunter Catchment Management Trust is compiling a database of remnant vegetation for the Upper Hunter Region. 	<ul style="list-style-type: none"> A regional approach for areas outside mine holdings is required to enable integration of mine rehabilitation plans with a strategic approach to landscape management for the Upper Hunter.
<ul style="list-style-type: none"> Rehabilitation within existing mine holdings has been dealt with on an individual basis without due regard to regional opportunities. The Upper Hunter Cumulative Impact Study identified a need for a regional (synoptic) plan for mine site rehabilitation. Numerous stakeholders are involved in the management of vegetation throughout the region. 	<ul style="list-style-type: none"> A compilation of mine rehabilitation plans for 1998 and 2020 has been completed. Recent EISs have begun to address issues of cumulative change. However, landscape and vegetation management are still largely dealt with on an individual mine basis. DUAP is implementing various actions including further work on indicators and future development scenarios as part of a Sub-regional Plan for the Upper Hunter. Consultation has begun with NSW State Forests, local councils and other community and industry groups. 	<ul style="list-style-type: none"> The Mining Operations Plans for individual mines can be enhanced in light of this Synoptic Plan. This Synoptic Plan should be used as a guide for landscape outcomes for environmental impact assessment of new mining proposals. The Synoptic Plan should not be used as a prescriptive planning instrument. The viability of corridors proposed in the Synoptic Plan needs to be confirmed at the completion of the Hunter Vegetation Management Plan. DMR will facilitate ongoing coordination between mine holdings, local government and other agencies. Consensus of stakeholders is necessary to realise a paradigm shift in revegetation objectives on mines.

Vision Statement No 2 Rehabilitation and land management practices in relation to coal mining can provide significant regional contributions to the Government biodiversity initiatives and Greenhouse emission reduction targets.		
Issues	Status	Strategy Actions
<ul style="list-style-type: none"> Clearing of remnant vegetation through past land uses has led to a reduction in biodiversity. Current emphasis on mine site rehabilitation to exotic pasture grass, while sustainable, has limited benefits for biodiversity. 	<ul style="list-style-type: none"> Various initiatives have been undertaken including: <ul style="list-style-type: none"> Bushcare: the National Vegetation Initiative. The Farm Forestry Program. Plantations for Australia: the 2020 Vision. Bush for Greenhouse, and Greenhouse Challenge for the mining industry. Mount Owen Mine is undertaking rehabilitation to create natural ecosystems and wildlife corridors Research into the use of native understorey plants in mine rehabilitation is proceeding 	<ul style="list-style-type: none"> Results of field trials and research on native forest systems on mines can be applied as best practice rehabilitation and land management procedures. Rehabilitation practices should consider the potential for creating diverse habitats in appropriate areas on mine sites. Native vegetation corridors between mine holdings and adjoining remnant vegetation areas should be incorporated into rehabilitation planning so far as practical with adjoining landholders' cooperation.
<ul style="list-style-type: none"> Rehabilitation and land management practices relating to coal mining have the potential to improve performance in relation to Greenhouse gas emission targets 	<ul style="list-style-type: none"> Current mine practices have generally been aimed at restoring grazing land with 14% of rehabilitated land planted to native trees Potential for tradable carbon credits is being investigated as a factor in determining rehabilitation programs for mined areas and for land management by power utilities. 	<ul style="list-style-type: none"> Accelerated tree planting, in anticipation of tradable carbon credits, should be realised as a <i>no regrets</i> strategy by the mining industry. The feasibility of commercial forestry as a basis for carbon sequestration needs to be examined in broadacre demonstration programs.
Vision Statement No 3 By integrated planning, mine site rehabilitation can realise a diversity of post mining landscapes based on sustainable land use including commercial timber plantations and management of biodiversity and visual amenity.		
<ul style="list-style-type: none"> Mine rehabilitation policy has focused on returning mine land back to its pre-mining land use. This has delivered landscapes lacking variety, with limited potential for biodiversity 	<ul style="list-style-type: none"> There is now an increasing emphasis on achieving a higher proportion of native forest vegetation cover as opposed to grazing pasture. Opportunities for other forms of post mining use, e.g. waste management facilities, ash disposal, commercial forestry and wildlife habitat have been undertaken or are under consideration on specific mine holdings. 	<ul style="list-style-type: none"> An integrated approach can determine optimum end land use strategies for mine holdings with regard to the location and characteristics of the particular mine site. The potential for Farm Forest Agreements over mine holdings should be investigated as a means of achieving improved economic, environmental and landscape outcomes.

Vision Statement No 4 Given fundamental criteria of stability, safety and sustainability, rehabilitated mine sites and their surrounding mine holdings can provide alternative land uses integrating with and contributing to regional economies.		
Issues	Status	Strategy Actions
<ul style="list-style-type: none"> • Mine holdings represent a considerable land resource. There is need to optimise feasible beneficial uses of this resource. This relates to interim land uses on mine holdings as well as after mining uses. • Stable, vegetated landforms engineered for safe, sustainable land use capability is a prime objective of mine site rehabilitation. • Final voids impose many constraints on after mining land use options. However, they also provide potential resources for certain land uses such as mine and power generation residues, waste management, industrial use, forestry, water storages, recreation and wildlife conservation. 	<ul style="list-style-type: none"> • Integrated uses on mine holdings include traditional agriculture (dairying, beef grazing, horse husbandry) and industrial uses/infrastructure. In a number of cases, the potential uses of final voids as a positive resource has been achieved, <i>e.g.</i> backfilling from adjoining mining operations, disposal sites for ash generated by power stations, local and regional waste management facilities and water storages. • The potential for alternative treatments of final voids has not been given due consideration because of the long term nature of mining operations and potential for changes in the location and shape of the final void as mining proceeds. 	<ul style="list-style-type: none"> • Rehabilitation and adaptive re-use of final voids for appropriate land uses needs to be given increasing priority by mine planning engineers with sufficient lead times in mine operating plans as mine closure is approached. • The application of contemporary legislation (Mining Act and EP&A Act) can provide for stakeholder input to active and passive land uses after mining. This is to be facilitated through the DMR's Mining Operations Plans and Annual Environmental Management Reports. • Further evaluation of implementation and maintenance costs in terms of decommissioning completion criteria should be progressed by the DMR.
Vision Statement No 5 A coordinated approach amongst stakeholders to the monitoring of vegetation management will provide the necessary evaluation of vegetation reforms generally in the Hunter region, and particularly in the coalfield.		
<ul style="list-style-type: none"> • Methods of describing and mapping vegetation types are inconsistent between individual mine holdings. Consequently the ability for analysis and planning in Mining Operations Plans has been limited. • At present, the objectives and outcomes of rehabilitation to native tree systems (<i>e.g.</i> Habitat, forestry, landscape amenity, catchment protection) are unspecified. • Lack of appropriate performance targets and indicators limit the ability to monitor progress. 	<ul style="list-style-type: none"> • Overall notional targets have been established to increase the percentage of tree cover on mine holdings as part of rehabilitation programs. • The 1998 and 2020 composite mine plans provide a valuable tool for monitoring reforestation progress. • Mount Owen Mine has established a management plan for native flora and fauna providing a useful model for other mines. 	<ul style="list-style-type: none"> • Quality improvement in best practice for mine rehabilitation can be achieved having regard to broader regional objectives identified in this Synoptic Plan. Particular procedures are needed for monitoring rehabilitation progress on mined areas in relation to these regional objectives. • Methods of classifying vegetation type need to be refined to ensure consistency between mine rehabilitation and broader Hunter vegetation reforms • The industry in conjunction with the community needs to establish targets and indicators in relation to the use of native plants in rehabilitation and in catchment management generally.

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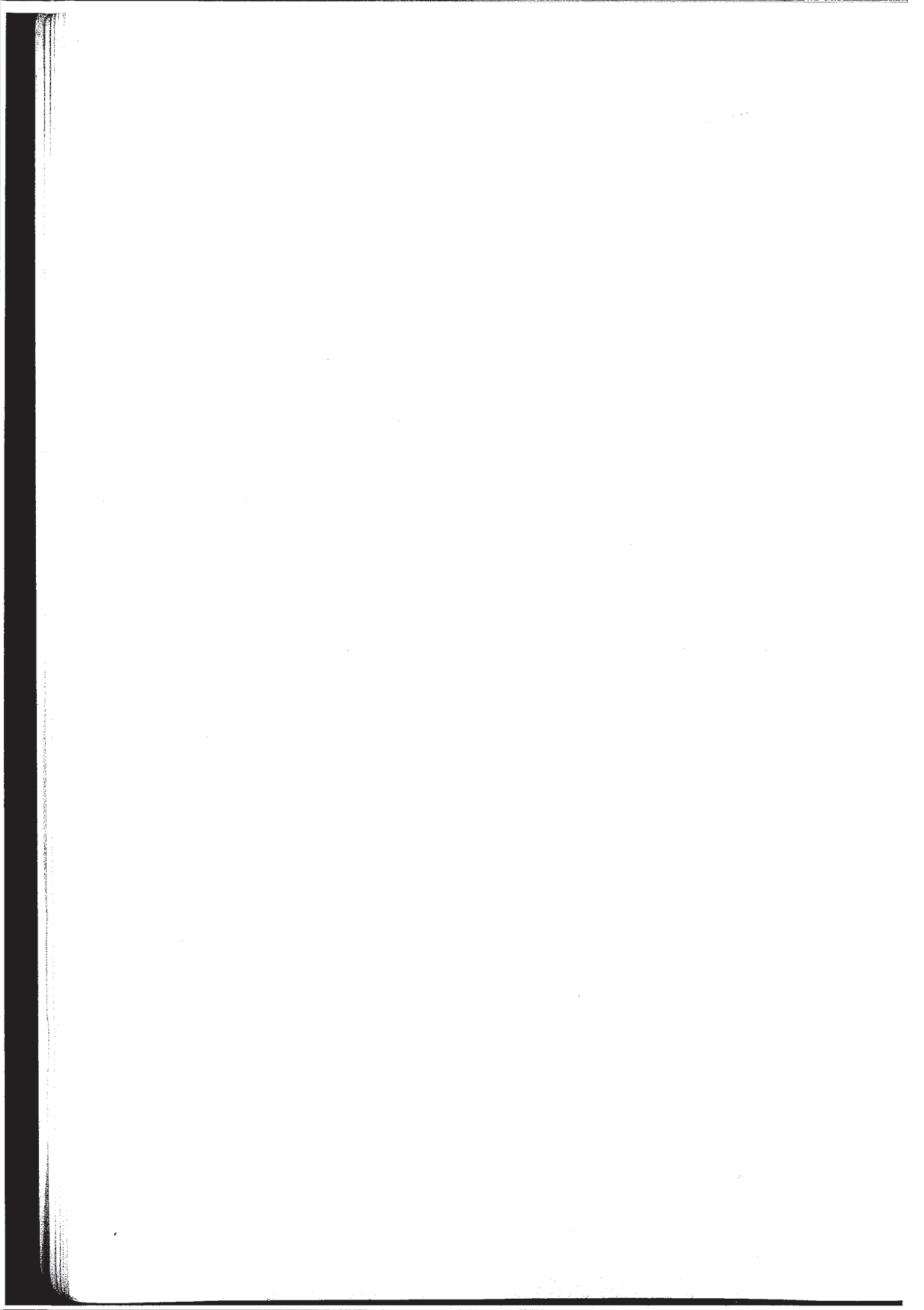
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Credits

Unless otherwise noted, all photographs in Part 1 of the Synoptic Plan provided by Andrews.Neil and the Department of Mineral Resources. Illustrations, maps and digital terrain renderings provided by Andrews.Neil.

PART 1: REVIEW



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1.0 Introduction

The Upper Hunter significantly contributes to state and national economies through activities including mining, agriculture, energy production, service industries and urban and rural developments. The Hunter Coalfield is the largest coal producing area in New South Wales.

In rural areas such as the Upper Hunter, the main drivers of regional economies are mining, agriculture and tourism. Some key indicators for the Upper Hunter region are shown in Table 1.

Expanding development of coal resources in the region has generated environmental concerns that have been the subject of various studies over the past two decades. The Upper Hunter Cumulative Impact Study and Action Strategy (UHCIS) released by the Department of Urban Affairs and Planning (DUAP) in 1997 is a pioneering document assessing cumulative impacts of developments in the Upper Hunter. Amongst other things, the study identified three objectives, which were to:

- Establish cumulative impacts of various land uses and developments.
- Establish a regional framework of assessment of environmental impacts of development proposals.
- Assist future strategic land use planning.

The Action Strategy nominated the Department of Mineral Resources (DMR) as the lead agency to establish a demonstration program for mine site rehabilitation and prepare an integrated landscape master plan for the Upper Hunter Coalfield. Such a brief extends beyond the traditional paradigm of environmental assessment associated with single developments as required under the Mining Act 1992.

The DMR undertook this work by the facilitation of a steering committee comprising representatives of:

- NSW Minerals Council.
- Singleton and Muswellbrook Shire Councils.

- Department of Land and Water Conservation (DLWC).
- NSW State Forests.

The collation and drafting of mining data, based on current approved mine sequencing and planned rehabilitation was fundamental to this work. Mining Operations Plans for all coal mines and their coal handling facilities were collated by the DMR as hard copy and digital plans. These were then formatted by DLWC onto a central Geographic Information System (GIS) database to provide synoptic maps of the coalfield as two snapshots being year 1998 and year 2020.

Stakeholder feedback during the preparation of the Synoptic Plan was facilitated through:

- Progress reports to the Upper Hunter Cumulative Impact Study Consultative Committee.
- Progress reports to the Hunter Coal Environment Group, a representation of environmental, mining practitioners and consultants.
- A review forum at draft stages with all stakeholders.

The Department of Urban Affairs and Planning has recently commenced preparation of a Sub-regional Plan for the Upper Hunter which is also a follow on from the Action Strategy in the Upper Hunter Cumulative Impact Study. This work will involve extensive community consultation to address social, economic and environmental indicators. As such, it will provide valuable feedback to the implementation of the Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of New South Wales.

1.1 AIMS

The purpose of the study is to provide a basis for the development of a long term integrated strategy for rehabilitation of mines. Whilst the focus of the study is on land within mine holdings, from a regional perspective, there is a need to address land outside mine holdings and involve a variety of stakeholders, including government agencies and the broader community.

TABLE 1: UPPER HUNTER MINING AND RURAL ECONOMIES

Indicator	Mining	Agriculture	Tourism
Value of production	\$ 2695.7 M	\$ 160.8 M	\$ 56.0 M
Land area	61 045 Ha	1 039 000 Ha	1 830 950 Ha
% of region	3.3%	56.7%	100%
Income generated per Hectare	\$ 44 160.00	\$ 154.76	\$ 30.58

Sources: *Upper Hunter Cumulative Impact Study. 1997 DUAP*
NSW Coal Industry Profile. 1997 DMR

1.2 OUTCOMES

The "Synoptic Plan: Integrated Landscapes for Mine Site Rehabilitation in the Upper Hunter Coalfield" comprises two parts:

- Part 1 Review and Strategy Matrix.
- Part 2 Invited Papers.

The Synoptic Plan is also supported by Mining Operations Plans for 1998 and 2020 which cover the eight 1:25000 maps sheets defined in the study area.

The Synoptic Plan provides the frame work for identifying means to develop links between researchers, managers, local and state government and the general public to facilitate integrated, strategic rehabilitation of mining affected land in the Hunter Valley of NSW. Perhaps the greatest challenge which emerges is to develop dynamic methods to utilise the resources of the Hunter Valley in a sustainable manner. Such a challenge requires ongoing research and development as existing mines near the end of their economic life and new mines emerge. In particular, the study provides an overview of:

- Current practices and trends in mine rehabilitation.
- Regional initiatives in vegetation management.
- Emerging environmental issues and their implications on mine rehabilitation.
- A comparative analysis of mine rehabilitation plans at 1998 and 2020.
- Principles for an integrated approach towards landscape management for the coalfield.

1.3 THE STUDY AREA

The study area comprises the coalfield of the Upper Hunter Valley extending from south west of Singleton to north of Muswellbrook (Figure 1). Some sixty coal seams are developed in three measures, the Greta Coal Measures, the Wittingham Coal Measures and the Wollombi Coal Measures. Most of the coal is at comparatively shallow depths making it accessible to large-scale, multi-seam open-cut operations. A

congregation of voids (active, interim and final) occurs in the Hunter Coalfield, within the Singleton and Muswellbrook Shire areas.

The study is confined to an area of 260,900 hectares comprising 14.5% of the study area of the Upper Hunter Cumulative Impact Study. It is defined by the extent of the eight 1:25,000 topographic maps, Aberdeen, Muswellbrook, Dawson's Hill, Jerrys Plains, Camberwell, Doyles Creek, Singleton and Bulga. Mine holdings cover approximately 61,045 hectares or 23.4% of the study area. Wollemi and Yengo National Parks cover a combined area of 19,558 hectares or 7.5 percent of the study area whereas Ravensworth State Forest, the only state forest located in the study area, comprises approximately 538 hectares. Beyond the study area, numerous state forests and national parks form large expanses of continuous vegetation on the Barrington Plateau and along the Great Dividing Range.

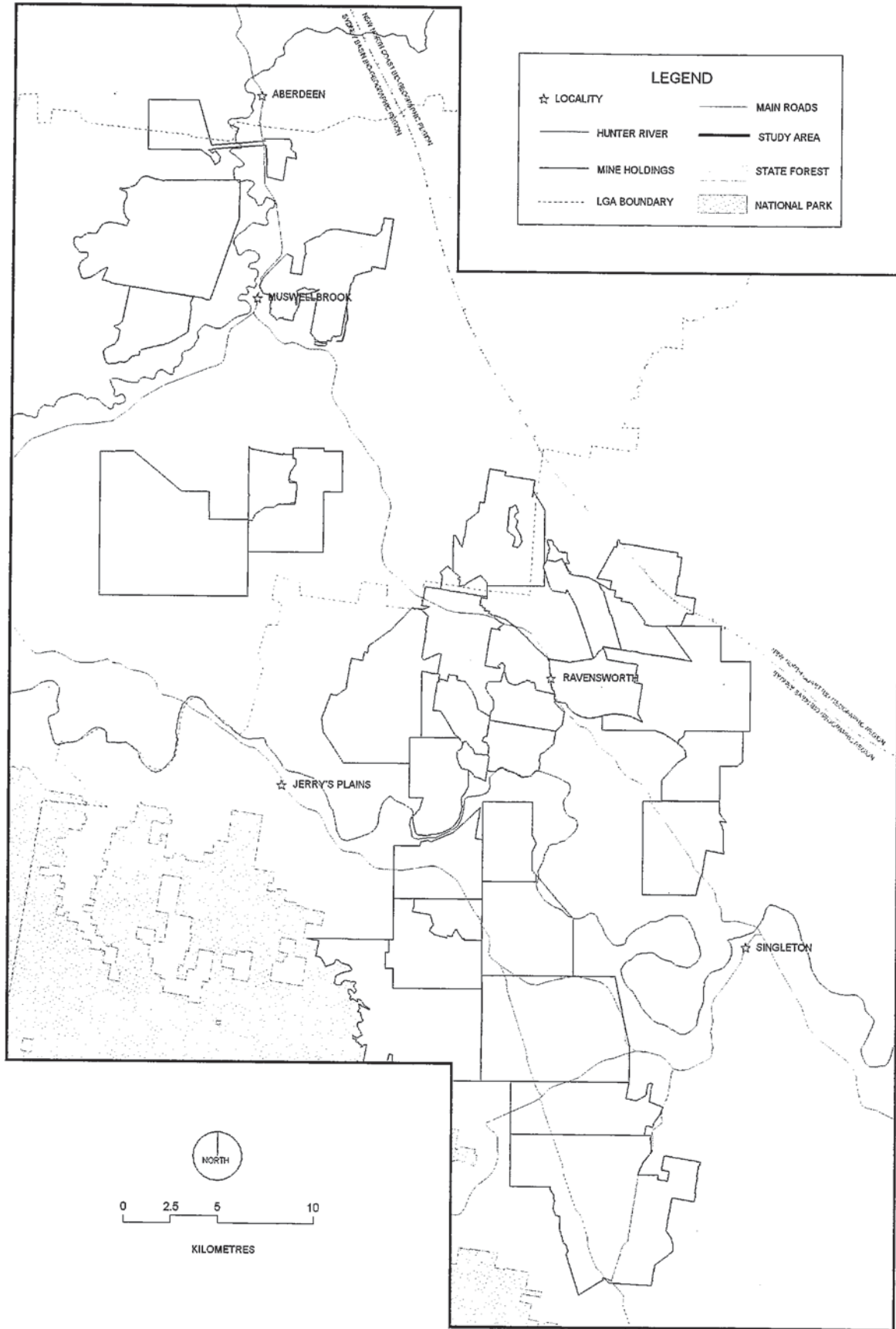
Mine (or colliery) holdings are defined for the purposes of this report as the area of mining leases identified on the Synoptic Plan map sheets. Note that in some instances areas within mine holdings are not held as freehold ownership.

The geology of the area is diverse and generally defined by a variety of landforms. For example, five main geological groups are encountered throughout the study area:

- Triassic Narrabeen Sandstone to the west and south.
- Late Permian River Sediments and Quaternary Alluvium along the valley floor with outcrops of Early Permian Marine Sediments.
- Carboniferous/Devonian Sediments to the north and east.

Regional climate is restrictive for certain types of revegetation, as evaporation is approximately double precipitation, causing moisture deficits in most months. Average annual rainfall varies from 706 mm to 619 mm from Singleton to Muswellbrook respectively.

FIGURE 1: STUDY AREA



1.4 BIODIVERSITY AND ECOLOGICAL SUSTAINABILITY

The north-eastern side of the Hunter Valley, within the study area represents the interface of the Sydney Basin and NSW North Coast Bio-geographic Regions. A distinct change in bio-geographical character occurs between the Triassic Sandstone formations on the south-western side of the valley and the Carboniferous - Devonian formations on the north - eastern side. Extensive clearing for agriculture and resource development has removed most of the native vegetation from the valley floor and caused a discontinuity between the two Regions and a subsequent loss of biodiversity.

Ecosystems that once may have occurred across the catchment have been modified, with natural habitat now mostly confined to the slopes and rugged areas where clearing has been limited. Many fauna are particularly sensitive to the size and shape of remnant vegetation patches, as well as the distance between remnants. As a result, the decreasing size and increasing distance between remnants in the valley has reduced the viability of natural ecosystems.

Global concerns in relation to greenhouse emissions and biodiversity, place a new focus on rehabilitation and vegetation management.

1.5 REGULATORY ENVIRONMENT

Numerous environmental regulations imposed on coal mines have a bearing on rehabilitation requirements and land management. Such legislation includes development consent conditions, mining lease conditions and conditional licenses or approvals from authorities such as the DMR, Environment Protection Authority (EPA), DLWC, National Parks and Wildlife Service (NPWS) and others.

The Synoptic Plan addresses environmental legislation as it affects present and future strategies for integrated rehabilitation of the Hunter Valley coal mines.

1.6 COMMUNITY EXPECTATIONS

The extent and proximity of coal mines within a discrete, socio-geographic area inevitably pose regional planning questions and responses. The community's first preference may be that mine areas show no evidence of excavation after rehabilitation.

Such preference may be moderated if:

- The community recognises that the "opportunity cost" of the mine is offset by the benefits to the community derived during the operating life of the mine.
- There is some alternate after-use identifiable for the mining area.
- The mine site does not represent a future public liability.

Increased public awareness of the planning for after mining use may be beneficial. Public consultation is part of the approval process where an after mining land use is designated and requires development consent through the environmental impact assessment procedures.

The range of potential after-mining uses offer challenges and opportunities to the mining industry and government regulatory agencies alike. Rehabilitation with native vegetation for commercial forestry and agroforestry can contribute to the local economy and provide a valuable resource. Such opportunities can diversify the rural economy and should be considered especially in areas where the long term viability and economic returns of traditional agricultural after-use is marginal. Furthermore, an integrated approach to mine rehabilitation can provide social and environmental benefits by opening up new land for active and passive recreation as well as nature and geological conservation in addition to increasing the opportunities for public access.

This report does not prescribe specific restoration practices for achieving completion criteria, nor does it prescribe land use outcomes or define preferred landscapes. Rather, it identifies constraints and opportunities between contiguous mine areas, and highlights past and proven rehabilitation techniques used within the Hunter Valley. It also provides a database from which strategic quantitative rehabilitation decisions, on a regional level, can be based. Given that the prime objective of rehabilitation is a stable final landform, the aspects in determining a rehabilitation method for each unit of the final landform begin to emerge. These are the visual landscape, biodiversity and land management for sustainable after-uses.

In this respect, the Synoptic Plan provides a basis for community and industry debate on opportunities for enhancement of the regional landscape.