Chapter 18

Extractive Industries

18 Introduction

18.1 Objectives of this chapter

1. Ensure that extractive industries do not adversely impact on the environment and surrounding land uses;
2. Identify and protect mineral and extractive resources of significance and associated extractive industries;
3. Identify preferred haulage routes and desired road standards;
4. Ensure continued efficient, appropriate and responsible operation of extractive industries of regional and local significance;
5. Provide for adequate "buffer areas" around quarries and resources of significance, so as to prevent encroachment of inappropriate land uses such as residential and rural-residential development and to minimise land use conflicts;
6. Identify quarries which have been exhausted of resource, or are no longer required and encourage effective rehabilitation of these sites;
7. Outline requirements and information needed for obtaining development consent to establish new quarries and extend or intensify existing quarries;
8. Provide guidelines for preparation and implementation of management plans for operating and rehabilitating quarries, so as to minimise adverse environmental impacts.

18.2 Definitions

A word or expression used in this chapter has the same meaning as it has in LEP 2012 unless it is otherwise defined in this chapter.

buffer area means the area around an extractive industry which may be affected by quarrying activities e.g. noise, dust visual intrusion etc and which is created for the purposes of mitigating these impacts on adjoining land uses of a residential nature.

extractive industry means the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing of extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming.

extractive material means sand, soil, gravel, rock or similar substances that are not minerals within the meaning of the *Mining Act 1992*.

mineral means any substance prescribed by the regulations under the *Mining Act 1992* as a mineral for the purposes of the definition of ***mineral*** in that Act, and includes coal and oil shale, but does not include uranium or petroleum.

primary haulage route means a road which carries in excess of 10,000m^2 of extractive material annually.

secondary haulage route means a road which carries between 2,000m^3 and 10,000m^2 of extractive material annually.

18.3 Extractive and Mineral Resources in Lismore

Extractive and mineral resources are of fundamental importance to the development of our community, particularly in areas of high growth such as the North Coast and Gold Coast regions. The potential pressures of this high population growth and development will result in an increasing need for road base etc, a large proportion of which is likely to go outside our area.

The exploration, discovery, assessment and viable economic extraction of a mineral or extractive material basically hinges upon its potential commercial value at any particular time. The physical nature (ie bulk, mass, weight) and locational nature (access and distance to markets in relation to transport costs) of the resource, the actual costs of extraction, as well as the existence and strength of the market, are factors determining the commercial value of a resource commodity.

A substantial component of the price of construction material is the cost of transporting the material from the site where it is extracted, to the site where it is used. Hence it is imperative to minimise the distance between the resource and end-user construction sites. Where resource sites are sterilised by the encroachment of inappropriate development, construction projects in that area will have to rely on resources from less accessible extraction sites, with a consequent increase in costs. Transport of resources over longer distances also increases road construction and maintenance costs, because of extra wear and tear on roads.

The identification and assessment of mineral and extractive material is intimately tied in with the geology of the area. Geological survey is an ongoing process, managed in NSW by the relevant State Government Agency. It is beyond the scope of this chapter to describe in detail, the geology of the City of Lismore.

Production of extractive material varies considerably from year to year generally following highs and lows in the economy and the construction industry. The Lismore area on average, produces about 300,000 tonnes of extractive material per annum, the bulk of which comprises construction materials. In the busier years production has exceeded 400,000 tonnes per annum. The relevant State Government Agency estimates that average production levels will steadily increase by 1% to 5% per annum, over the next ten to fifteen years, as demand increases.

There are a number of quarry and resource sites in Lismore which are of regional significance and a further 30 or 40 sites which are of local significance, some of which may also become regionally important in the future.

18.4 Extractive Industries – Haulage Routes

Efficient and safe movement of extractive material from the source of supply to the end user is of critical concern to the quarry operator, consumer, community and Council. The impact of quarry trucks on road surfaces (particularly when loaded), the safety of other road users and the amenity of residents living along haulage routes are of particular concern to Council.

Generally Council requires that primary haulage routes and routes servicing larger quarries (production greater than 10,000m^3 per annum) have a sealed road width of 6 metres. Where average daily traffic rates are less than 500 vehicles and quarry production is of an intermittent nature, a seal width of 5.5 metres for a haulage road to larger quarries would be acceptable. Where average traffic counts exceed 1,000 vehicles per day, a minimum road seal width of 6.5 metres should be provided along the haulage route.

In the case of secondary haulage routes and routes servicing smaller quarries (with annual production in the range of 5,000m^3 to 10,000m^3 per annum), Council requires a sealed road width of at least 3.6 metres, where average daily traffic counts are less than 150 vehicles, increasing to a seal width of 5.5 metres where such traffic exceeds 500 vehicles per day. An unsealed gravel road formation may be acceptable to Council where quarry production is intermittent, and traffic counts are less than 150 vehicles per day, with few dwellings located along the haulage route.

The change in classification of a non-haulage road to become a secondary haulage road, or a secondary haulage road to become a primary haulage road can only be dealt with upon the receipt of a development application for either the establishment of, or the enlargement of, an existing extractive industry.

Classification of haulage routes may change if a large new quarry or major expansion of an existing quarry is proposed. A significant increase in haulage may, for example, require a

secondary haulage route to be upgraded to a primary haulage route. The EIS or Statement of Environmental Effects accompanying a development application shall include an assessment of the need for, and impact of, additional secondary haulage routes or reclassification of secondary haulage routes to primary routes.

Development applications must specify the haulage routes to be utilised and the expected number of laden and unladen truck movements on each route. Where haulage routes do not meet Council's road standard requirements, a development application may be refused, or a levy applied, either in a lump sum or by quarterly payment per tonne of production, to fund upgrading of the haulage road. The amount of the levy will be assessed in relation to the amount of quarry production and the extent of road upgrading works required.

All quarries will be levied a road maintenance levy to fund additional road maintenance costs associated with extra wear and tear created by quarry trucks on local roads. Road maintenance levies are payable quarterly and are calculated as a rate per tonne per kilometre of material extracted. The larger the tonnage and the longer the distance hauled on local roads, the greater is the amount that is payable to Council for road maintenance. Council may consider negotiating an "average levy" applying to material hauled from a quarry, based on the average distance that material is hauled.

Calculation of the levy is based on a percentage of the Roads and Maritime Services' Standard Truck Hire Rates multiplied by the tonnage and distance (calculation of road levies for quarries are identified within Council's Section 94 Contribution Plan). As a guide, the current recommended maintenance levy charge is around 4.0 cents per tonne kilometre for a main road. A quarry producing 10,000 tonnes of material and hauling this material over a distance of 10 kilometres, would pay an annual road maintenance levy of $4,000 in four quarterly instalments, each of $1,000. Production figures may be described in cubic metres provided that the nature of the material is identified, so that a tonnage calculation may be made.

18.5 Buffer areas around Extractive Industry sites

Extractive industries involve the use of an extensive range of plant and equipment which creates noise, dust and even odour, as material is won from the quarry face and then crushed and screened for loading and transport. In come cases blasting is necessary to extract the material. Quarrying activities are incompatible with many land uses, particularly those of a residential nature. Even some farming activities may also experience problems, when located close to a quarry. It is therefore desirable to provide a buffer area around quarries to minimise land use conflicts.

In fast growing and intensively settled areas like Lismore, extractive industries and resources may be sterilised as a result of the encroachment of residential land uses. It is therefore desirable to identify significant quarries and resources and provide an appropriate buffer to prevent encroachment of residential and other land uses, which may sterilise a resource or lead to community pressures to restrain or cease production.

The extent of buffer required depends on the size of the quarry, whether blasting is utilised, nature of production methods, extent of crushing and screening operations, topography and site conditions and the intensity of surrounding development and land uses. A two level buffer standard has therefore been implemented, with a primary and a secondary buffer area established.

Urban/village-residential and rural-residential development is excluded from both the primary and secondary buffer area. Farmhouses on agricultural holdings may be permitted in the secondary buffer area (but generally not in the primary buffer area), if no alternative suitable location is available. All other non-residential land uses are permitted in the secondary buffer area. As a general rule only bushland, rural industries, or agricultural and forestry uses and rural outbuildings will be permitted in the primary buffer area. The following table summarises the minimum radii of buffer areas required by Council around extractive industries and resources:

Quarry Size	Primary Buffer Zone	Secondary Buffer Zone

Large Quarries ($10,000m^3$ pa)	500 metres	800 metres
Medium Quarries ($5,000m^3$ – $10,000m^3$ pa)	400 metres	600 metres
Minor Quarries (< $5,000m^3$ pa)	300 metres	400 metres

Buffer areas may be reduced where topographic, climatic, site conditions or production techniques are favourable to reducing distance separation. For example a quarry located within a confined and enclosed basin, or a quarry which operates only on an intermittent basis, may enable a reduction in the extent of the buffer. Very small quarries, essentially used only as borrow pits, and minor quarries with intermittent use may require a buffer of only one or two hundred metres. A section of buffer zone could be reduced where a hill or ridge separates the quarry from a potential development area, or where the quarry is downwind of the development area (ie less affected by noise and dust).

In some cases buffer zones may need to be increased where, for example, the topography is very flat or a development site is located upwind of a quarry. Where blasting is utilised at a quarry, a primary buffer zone of at least 800m – 1,000m is desirable. This buffer could be reduced to 400m – 500m, or even less, depending on blasting technique and where blasting is infrequent and/or only small "staggered" blasts are used.

Whilst buffer zones are not required along haulage routes, Council will encourage a maximum building setback to haulage roads, to reduce noise and dust nuisance. Residential and rural-residential development will generally not be approved along or near unsealed quarry haulage routes. Such development should even be discouraged along or near sealed haulage routes servicing major quarries (production in excess of $50,000m^3$ with 50 truck movements daily) unless an adequate buffer can be provided to the haulage road. Individual dwellings fronting unsealed haulage roads should be setback at least 50 to 60 metres from the road and be provided with a planting buffer to minimise dust nuisance.

18.6 Rehabilitation of Quarries

Extractive industries are acknowledged as 'temporary' land uses, and controls as imposed by conditions of consent indicate the life expectancy of a quarry. The imposed conditions require that at the end life of the quarry, appropriate rehabilitation measures are carried out within 12 months.

Quarries should be progressively rehabilitated by initially removing and storing topsoil for replacement onto worked out areas. These worked areas should be reshaped, stabilised, topsoiled and replanted to prevent erosion and sedimentation and enable the land to be returned to agricultural or other appropriate uses. Stock should not have access to areas being rehabilitated.

Exhausted and disused quarries **must not** be left in an unrestored state. Such quarries can result in land and water degradation because of increased incidence of erosion and sedimentation and they may become a danger to both humans and stock. Quarries that have ceased operation prior to this DCP coming into force and which did not have a requirement for rehabilitation, may apply to Council to permit removal of additional extractive material from a disused quarry to finance its restoration. Owners of unrestored, disused quarries may also be eligible for specific Federal or State environmental grants to assist in the cost of rehabilitation.

Guidelines for the rehabilitation of quarries are included with the Rehabilitation Guidelines and Environmental Management Plans for Extractive Industries Section attached as Annexure 1. Further advice is obtainable from the relevant State Government Agency.

18.7 Obtaining Development Consent for Extractive Industries

All extractive industries without a current valid development approval from Council are required to obtain Council's development consent for an increase in production or for any lateral extension of the area quarried. Existing unauthorised quarries and new extractive industries require submission and approval of a development application and environmental impact statement prior to any site works commencing, or production continuing in the case of unauthorised quarries.

Development consent may not be required where material is extracted for 'on farm' use on the property on which material is extracted (ie for purposes ancillary to the agricultural use of the land eg stockyards driveways etc). In this regard, should the farmer be of the opinion that the extractive activities are wholly ancillary to the agricultural pursuits of the land, then Council should be advised, in writing, that the extractive activities are for agricultural purposes only with material not removed from the farm and justification for this conclusion provided. Should Council be of the opinion that those extractive activities do not require development consent, the Council will supply written verification of that fact.

In the above situation, Council reserves the right to require the farmer to use and operate the extractive area in an environmentally sensitive manner, and implement such rehabilitation works as may be required by Council.

Guidelines for the Preparation of a Development Application are available on Council's website. The guidelines list Council's requirements for preparation and submission of a development application and Statement of Environmental Effects. Some extractive industries are classified as Designated Development (Schedule 3 - EP&A Regulation 2000) in which case an Environmental Impact Statement (EIS) is required. Even when an EIS is not required, a thorough assessment of potential environmental impacts must be made and details of protection measures included. Extractive industries if not properly designed and managed, can create erosion, degrade water quality, create noise and dust nuisance, damage roads, destroy habitat and leave a scar on the landscape.

Guidelines on preparing an EIS for proposed quarries are contained in the Department of Planning and Infrastructure's "EIS Guidelines - Extractive Industry – Quarries".

18.8 Extractive Industry Management Plans

An extractive industry management plan is a document which describes how extractive activities are to be carried out, machinery, processes and methods to be utilised, staging of quarrying and rehabilitation, transport of materials, site management, and measures by which adverse environmental impacts are to be minimised.

Council, as a condition of development approval for all extractive industries, requires the developer to prepare a management plan for the continuing operation and rehabilitation of the extractive industry and site. This management plan must be consistent with the EIS or Statement of Environmental Effects and development consent, and must be approved by Council prior to any site works commencing.

The management plan should be prepared in consultation with Council and relevant government agencies. Council will require submission of a rehabilitation bond (as a bank guarantee) as part of the approval of the Management Plan. Management Plans shall also provide for periodic site inspection (every one to five years depending on quarry size) by Council Officers, to ensure compliance with the management plan. Council's requirements for the form and content and preparation of management plans are summarised in Annexure 1.

LISMORE CITY COUNCIL

REHABILITATION GUIDELINES AND ENVIRONMENTAL MANAGEMENT PLANS FOR EXTRACTIVE INDUSTRIES

ANNEXURE 1

CONTENTS

1. INTRODUCTION

The environmental impacts of quarrying operation are will recognised and include visual intrusion, air, water and noise pollution and soil erosion. The major environmental aims of the quarry operation and rehabilitation therefore are to reduce or repair the disturbance created by these operations, produce a stable ground surface for revegetation purposes and to prevent the pollution of the environment surrounding the site. These aims can only be achieved by the careful planning or extraction operations prior to the commencement of operations at the site.

This planning should encompass the initial selection of the quarry site and the development of the quarry itself. Site selection should include the examination of such factors as alternate sites, the planning of road access, potential visibility and nearby present and future residential development.

Following site selection it is essential that the site be developed in a planned and logical manner from an environmental, safety, economic and social viewpoint. This development should include, where possible, the planning or operations such that the site may be excavated progressively to enable the rehabilitation of worked out areas concurrent with extraction operations, thereby minimising the total area disturbed at any one time.

The rehabilitation of these worked out areas will be aided by the planned location of topsoil, vegetation and overburden stockpiles, drainage lines and internal access roads. Further, consideration of the potential air, water and noise pollution problems which are likely to be encountered during the operating life of a quarry will allow the planning of methods and procedures to minimise the effects of such pollution. These include careful location of internal access roads, the method of operation and the location and selection of plant and equipment.

Thus, if an extraction operation is carefully sited and planned and well operated, adverse environmental effects should not occur.

Because of the wide range of factors which may affect the operation and rehabilitation of a particular quarry site, such as climate, soil and rock type, slope and land use, it is impossible to prescribe specific operational and rehabilitation methods for all sites. It is, however, possible to provide broad principles and practices for the operation and rehabilitation of quarry sites which have a general application and it is with this aim that these guidelines have been produced.

The information contained within this Development Control Plan is of an advisory nature only and is intended to assist in the preparation of required plans and reports, it should be noted that, in most cases, specific information relating to details of operation and subsequent controls, are to be obtained from relevant government authorities. With regard to site specific guidelines for site selection, location of access roads, development, extraction, erosion control, dust, noise, blasting, rehabilitation and essentially all other practical site details, you are advised to contact the Department of Mineral Resources. Information in this section is a general guide only.

2. STATUTORY REQUIREMENTS

Statutory requirements may involve consultation with various State Government authorities.

These authorities are contacted in due course, as part of the Development Approval Process upon application to Council.

2.1 Development Consent from Council

All new extractive resources operations or substantial changes to method or hours of operation or plant and equipment of existing approved operations will require development consent from Council. The Development Application (DA) will need to be accompanied by an Environmental Impact Statement (EIS) and a Rehabilitation and Environmental Management Plan.

The aim of the Rehabilitation and Environmental Management Plan is to provide guidance on the day to day operation and precession operation with regard to rehabilitation and environmental management practices. It is complementary to the EIS, in that initial interpretation of the EIS may take into consideration the need for changes in operation over the life of the development.

The Rehabilitation and Environmental Management Plan is therefore a plan of intent which aims to give both Council and the operator a blueprint for development, yet with certain flexibility for changing circumstances.

Depending upon the nature and scale of operation, the Rehabilitation and Environmental Management Plan will be re-assessed according to Council's Development Control Plan No. 29, from between every 1 to 5 years.

2.2 Existing Use Rights under State Environmental Planning Policy No. 37, the Conservation Process to Development Approval and the Need for a Rehabilitation and Environmental Management Plan.

The now repealed State Environmental Planning Policy (SEPP) No.37 aimed for existing extractive resource operations to be able to continue in a legal and environmentally responsible manner.

That Policy ensured that all existing quarries would require, as part of the process of the SEPP, development consent from Council.

Under the Policy, quarries enjoying existing rights are registered and shall continue to enjoy existing use rights (within strict limitations) during the registration and moratorium period of two (2) years ending September 18, 1995. Such limitations restrict the amount of material produced and additional area which can be used during an annual period. An operator is required to submit a return to Council every three months after registration which indicates new areas used and all volumes produced during that three month period.

By the end of the moratorium period all quarries must have obtained development consent to continue operation after that period or ceased to operate.

2.3 Environmental Impact Statements

The extent of the Environmental Impact Statement (EIS), which will be needed to be submitted with the Development Application, will be determined in consultation with Council's Planning Services Division.

The types of matters which would need to be addressed in an EIS, and this as a guide to a Rehabilitation and Environmental Management Plan, are set out in Appendix 1.

2.4 Management Plan

As a general guide the types of matters which would need to be addressed in an Environmental Management Plan are set out, but not restricted to those, below:-

1. Background to the project, including details of the operator.
2. Employment and socio-economic aspects.
3. Land use and rehabilitation objectives.
4. Sensitive issues – aboriginal. Endangered species, historical or residential.
5. Overall plan and details of proposed extractive operations.
6. Topographic survey before operations and proposed topography after operations.
7. Location of supply facilities, eg roads, powerlines, water supply etc.
8. Water management on-site including ground water tables and aquifers; the prevailing drainage pattern; the impact on vegetation; creek flow; neighbouring use of creeks etc.
9. Stockpiling of ore, overburden and topsoil – including plans for containing any toxic run-off.
10. Pre-extraction flora and fauna data.
11. Post extraction objectives regarding flora and fauna.
12. Soil erosion and sediment control.
13. Buffer zone proposals.
14. Drilling and blasting times to meet statutory requirements.
15. Noise and dust to meet statutory requirements.
16. Tailings disposal including decommissioning of tailing dams.
17. Noxious weeds and feral animal survey and control.
18. Disposal of plant waste (chemicals, refuse, scrap metal).
19. Monitoring – Environmental Auditing.
20. Final Decommissioning.
21. Identification of problem soil, eg highly disbursable subsoils which may be encountered during the life of the quarry.

3. SITE SELECTION AND VISUAL IMPACT

The careful siting of surface excavations and associated facilities will greatly reduce their visual impact on the surrounding environment and the subsequent rehabilitation costs.

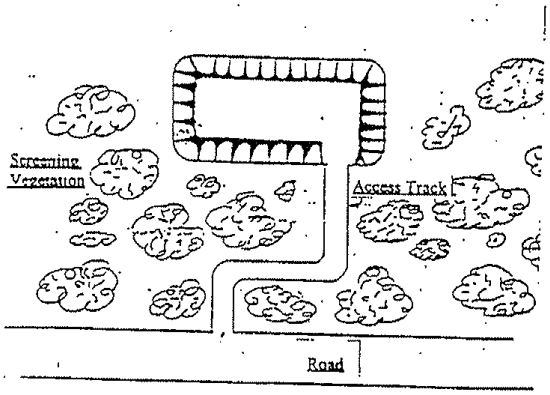
The location, size of deposit, and suitability of the extractive material is fixed by past geological events and useful deposits are often unevenly distributed. When selecting a site, therefore, the must a balance between the visual impact and the economic viability of the operation.

All feasible alternative sites and sources of material should be examined including previously worked sites. The visibility of the sit should be determined from the property boundaries, nearby and distant residences and from nearby and distant vantage points including roads.

It is often possible to reduce or eliminate the visual impact of an excavation by use of the natural topography for screening. Contour maps may be used to locate excavations behind hillsides or in natural depressions, as serious visual impact may occur if the excavation intersects the skyline.

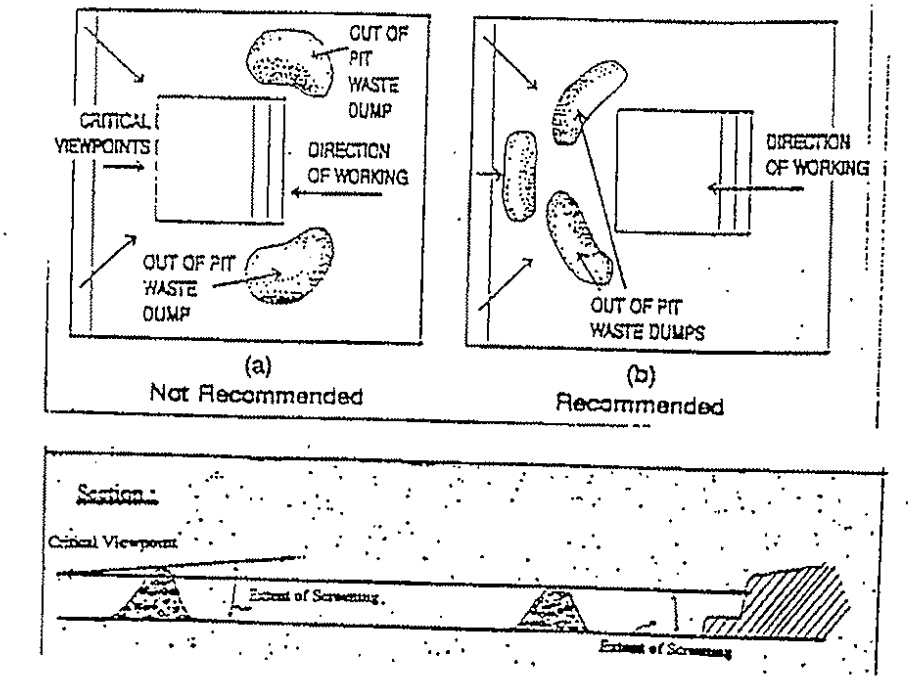
Natural vegetation adjacent to the excavation may be used fro screening the workings. These areas should be maintained as buffer zones with the planting and seeding or further vegetation where necessary to supplement the existing flora (Figure 1).

FIG 1 – SCREENING VEGETATION



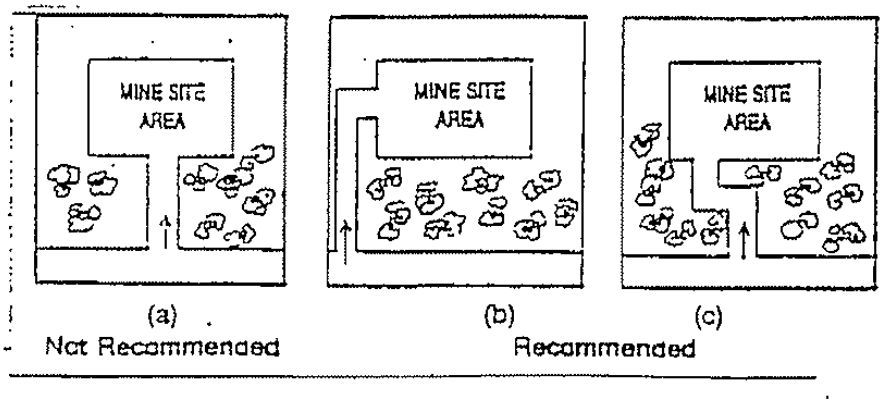
Screening may also be achieved by the construction of contoured soil overburden embankments which should be subsequently vegetated for maximum screening of the site. Consideration should be made for the suitability of overburden material as vegetation medium, eg soil analysis. These embankments must be properly designed particularly with respect to landform so as to blend with the existing contours in the area. These banks should be located close to the critical viewpoint so as to increase the screening effect of the operations (Figure 2). The roads should also be designed to provide for stable drainage and erosion control measures.

FIG 2 – LOCATION OF SCREENING EMBANKMENTS



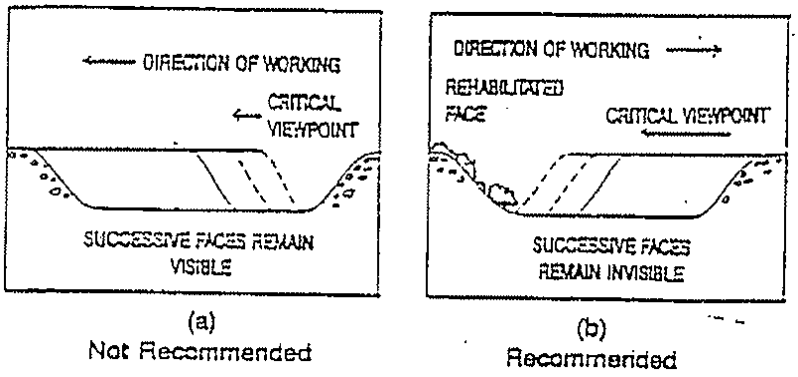
The roads within, and to, the excavation are of prime importance in the development of the operation. The access road to the excavation is also important in relation to the visual impact of the excavation. The road should be located so as to utilise any natural vegetation present to screen the excavation (Figure 1). Further, the access road may be curved to preclude a direct line of sight into the excavation (Figure 3)

FIG 3 – LOCATION OF ACCESS ROADS



The method of operation at the site may be selected to reduce the visual impact. It may be possible to select a starting point that is invisible be retaining a natural screen in place whilst embarking on a tree planting program so that intrusion into the visible will be gradual and the whole area will be screened. Alternatively, the working face may be oriented to present the minimum visual impact from a critical viewpoint (Figure 4).

FIG 4 – DEVELOPMENT – MINIMUM VISUAL IMPACT



The location of waste dumps and fixed plant should be carefully selected so as to reduce their visual impact. These should blend with the natural background by use of complementary colours, vegetation and embankment screening.

The site should also be carefully selected with regard to local watercourses. The disturbance and pollution of watercourses should be minimised by the location of extractive operations and access roads as far as practicable from these watercourses and by the maintenance of vegetative buffer zones around these watercourses.

Site selection is also of importance with respect to noise and dust control. Quarries and pits in which blasting and associated activities are conducted will produce noise and dust problems which may be overcome to some extent by the provision of adequate buffer zones.

4. QUARRY DEVELOPMENT

4.1 Vegetation Clearing and Topsoil Stripping

As far as practicable the clearing of vegetation should be kept to a minimum, only exposing sufficient area as is required for immediate use. Thus only trees and shrubs directly affecting extraction operations should be removed and the surrounding trees left to provide seed for the natural revegetation of the disturbed area. Cleared vegetation should be stockpiled as it can be used as a mulch or cover where suitable following the respreading of topsoil over the area. Alternatively, trees and shrubs can be stockpiled and chopped and the chips respread when returning topsoil to the excavation.

Topsoil is an essential factor in the re-establishment of healthy vegetative growth in any disturbed area and may also be used to create screening banks or mounds. It is essential, therefore, that the topsoil on access tracks and the excavation area is stripped, and stockpiled separately from overburden material.

The overburden is the material below the topsoil which must be removed to obtain the primary resource (stone, gravel etc). It is also invaluable for the rehabilitation of the site, such as backfilling and building banks and barriers to provide visual screens, therefore should also be stripped and stockpiled.

Topsoil and overburden should be removed progressively and this removal should but be any more extensive that is required to maintain production. Thus, where possible, pre-stripping form any stage prior to completion of the previous stage of excavation should be minimised. It is advantageous to avoid intermediate storage and respread topsoil stockpiles are not placed so should not be placed against trees or shrubs so as to prevent disturbance of this vegetation when topsoil and overburden and returned to the site.

Stockpiles may be subject to erosion by wind or water and some temporary protection may be required before they are respread where these factors are significant. This protection may include water sprays, vegetative seeding, mulches, plastic mesh or netting and the provision of adequate drainage.

4.2 Method of Extraction

Extraction operations should be programmed to ensure the minimum disturbance of the working area consistent with operational requirements of plant manoeuvrability and efficient operation of the site. This is achieved by the systematic extraction and rehabilitation of the site through the used of planned bays and the use of benches or terraces on steeper land.

4.2.1 Planned Bay Method

This method of extraction, an example of which is shown in Figure 5, is particularly suited to gravel pit operations on relatively level ground. The site to be worked is divided into sections or bays. The first section or bay is then stripped of vegetation, topsoil and overburden which is stockpiled for later use in rehabilitation. Extractive material is then removed and the worked out section is

completely rehabilitated. The next section is then stripped and the process is repeated. The use of planned sections or bays for the extraction of material this reduces the area disturbed at any one time sot that the visual impact and also the potential for erosion of the site are minimised.

4.2.2 Benching

In areas of steeper land the use of benches or terraces may be required, in addition to the planned bays. The quarry should therefore be developed in a series of benches commencing at the top of the hillside and progressing downwards. The topmost bench invariable has the greatest visual impact on the landscape. It is therefore desirable to commence operations at the highest point so that rehabilitation of the scar can be carried out early in the life of the operations. The benches should be of a sufficient number to allow drilling and blasting (if required), loading, and clean up of material to be carried out without one operation interfering with the other.

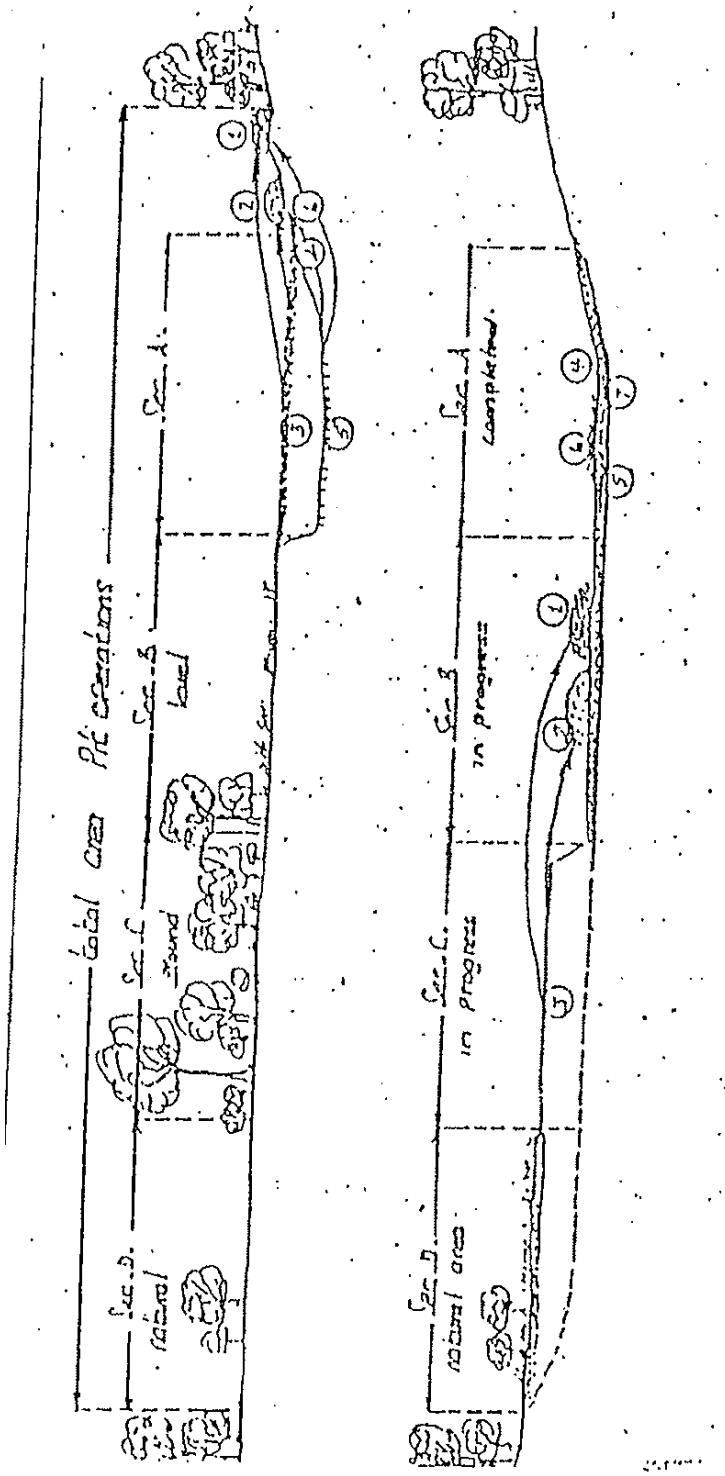
The minimum height of the quarry face may be determined by the thickness of the bed of material being worked, by places of weakness in the bed or by environmental considerations. Low faces are desirable from a safety aspect and for a reduced environmental impact. The maximum height which a quarry face may reach is determined in consultation with the Mines Inspector of the NSW Department of Mineral Resources.

The width of quarry benches must provide sufficient space to permit safe working. In some vase the benches will be of sufficient width for the loading of machine and the transport equipment to be used in safety to allow the extracted material to be stockpiled.

All benches should be self draining with the drainage arranged in such a low pattern so as to minimise erosion. Upon completion of extraction operations on each bench, or suitable section thereof, rehabilitation should e carried out. This rehabilitation is enhanced by drilling of drill holes one metre below the final bench height during extraction operations. The fracturing of the rock material, which occurs as a result of this drilling, provides conditions amenable to plant growth.

Where appropriate the benches may be treated (blasting, ripping etc) to create benches of irregular length, height and width such that when rehabilitation is complete, the will blend more effectively with the surrounding area. The sharp and regular outlines characteristic of quarries increase their prominence in the landscape, and should thus be avoided. Where rehabilitation of benched areas require topsoil for plant growth, special measures may be required, such as backslope benching or excavated holes filled with soil.

Figure 5 Planned Bay Method



PIT TREATMENT

Operations to be phased progressively in sections A-D.
Each section to be developed in sequence 1-7.

1. Remove vegetation and stockpile.
2. Remove topsoil and stockpile.
3. Remove gravel.
4. Return topsoil to floor of pit and spread evenly.
5. Rip floor of pit along contour to mix topsoil and allow water penetration.
6. Spread vegetation evenly over floor of pit.
7. Seed with appropriate grass/clover or native tree seed/fertiliser mixture.

4.3 Water Management

One of the major causes of pollution arising from quarry sites is the sediment derived from the water erosion of the disturbed sites. Water erosion can cause sheet, rill and gully erosion and the siltation of water storage, access roads, agricultural drainage systems and natural flow lines and creek systems. Water may come from rainfall falling onto the site, existing, streams running through it and any water used in the extraction process. Erosion can be controlled by one or more of the following methods:-

i) restricting the amount of water before entering the site or divert them away from the quarry site. Consultation with the Department of Water Resources is required;

ii) limiting the area of the site which is disturbed;

iii) managing the water leaving the site. Discharge shall pass through a vegetative filter before entering any water course.

4.3.1 Water

i) Water Entering the Site

The volume of run-off water entering the site may be reduced by the use of diversionary or holding structures such as drains, banks or dams. Run-off should be diverted into stable flow lines outside the area of the pit where possible. Every effort should be made to site quarries away fro natural water courses and flow lines. Where this is not possible it may be necessary to dam these water courses or divert them away from quarry sites.

ii) Limiting Area of the Site Disturbed

It is often not possible to prevent all water entering the site, such as from rainfall and ground water, thus it is essential that the area disturbed is minimised. This will be achieved if the method of operation, as outlined above, is utilised. Further, access roads should be maintained in a stable condition such that water does not concentrate and flow along then by the use of cross drains and table drains. It is also essential that traffic is restricted to defined tracks and roads which are located so as not to contribute to degradation by channelling excess run-off onto pit areas or adjacent land.

iii) Management of Water Leaving the Site

The water that does enter the site and flow over disturbed area must be controlled to prevent the transport of sediment into nearby watercourses or adjacent land. Unless the excavation is to be later used for water storage purposes it should be adequately drained and run-off channels provided so that the quarry and the processing and storage areas are maintained in as dry a condition as possible and erosion is controlled. This is best achieved by channelling this water into silt dams or traps of adequate size which act as settling dams allowing suspended solids to settle. The clean water can then be pumped, siphoned pr permitted to seep from the area. These dams should be regularly cleared of sediment and sludge which should be disposed of in such a manner as to not pollute any water courses or drains.

Further, grease and oil traps should be build in drains near workshops and places where vehicles or machines are likely to cause spillage. These traps should be regularly cleaned out and the waste oils collected and removed from the site in a satisfactory manner.

4.3.2 Dust

The production of dust from quarries and gravel pits may create a safety hazard from employees or be a nuisance to nearby residents. The dust may result from all aspects of the operations including blasting, loading and transport, processing, stockpiles and the general work area including access roads. In many of these cases the dust nuisance will not be immediately apparent and will be more severe during periods of strong winds. The wind direction and possible wind abatement should be considered and if necessary operations should cease if dust production is too high.

The production of dust in quarries and gravel pits may be controlled by various techniques, depending upon the dust source.

Blasting

Dust may be controlled by wet drilling, mist drilling or by drilling with an exhaust system to clear and collect dust.

When blasting is conducted it should be ensured that the dust produced is blown away from neighbouring houses.

Loading and Transport

During drier summer months, if sufficient heavy trucks have passed over the road surface to create fines, there may be generation of dust. Therefore if the quarry is located in an area where dust is likely to be a problem all roads and access tracks within the premises should be sealed where practicable or otherwise oiled or watered when necessary.

Vehicle movements should be restricted to defined roads and tracks and the speed of vehicles should be restricted.

When leaving the quarry site vehicles carrying extracted material should have an effective cover over the load or have the load wetted down.

Processing

Dust produced by the operation of crushing and screening plant should be controlled by the use of fixed water sprays or dust extraction equipment installed at all fixed crushers and at all points where crushed material changes direction due to a belt transfer. Dust extraction equipment should also be incorporated with all vibrating screens.

Alternatively, the crushing and screening plant should be totally enclosed and fully serviced by dust extraction equipment. This should include the covering of all conveyor runs.

Dust production may also be controlled by the use of certain plant practices which may include the separation of non-dusty from dusty operations, the enclosure of dusty machines and the reduction of the amount of fall of materials at transfer points and into bins.

Stockpiles

Dust arising from stockpiles of topsoil, overburden, extracted and processed material should be controlled by one or more of the following methods:-

covering with plastic sheeting; roofing; planting with, and maintenance of, suitable vegetation; the use of water sprays or the spraying with chemicals to produce an impermeable membrane.

The location of stockpiles in an area protected from prevailing winds and away from nearby residents may also reduce the dust nuisance.

General Work Area

The operator should ensure that good housekeeping practices are employed in the work area. This should include the prevention of the accumulation of dust in or around any plant or building, the clean up of any spillage and the paving, oiling or watering of the general plant environs.

The quantity of dust emanating from a quarry site may also be reduced by minimising the area of the site which is disturbed. Further, the effect of prevailing winds and any consequent dust production may be reduced by the effective use of screening vegetation and the local topography.

A measure of the effectiveness of these dust control procedures is that dust should not be able to be seen leaving the general work area or the areas on which the crushing and screening pant is located, when these viewed from any point on the boundary of the premises.

4.4 Noise Control

Noise is defined as objectionable or unwanted sound. There are three major categories of noise sources which arise from quarrying operations, fixed plant, mobile plant used within the premises and external transport movements. The equipment and activities in these categories include compressors, drills, blasting, loaders, crushers, screens, conveyors and trucks.

A simple method of avoiding the noise problems associated with quarrying operations is to restrict the hours of operation at the site excluding, where possible, operations during weekends and before 7.00am and after 6.00pm on weekdays.

The level of noise reaching the general public from a quarry during working hours will depend upon the noise generated from the sources outlined above, the distance between the noise sources and the receiver and the degree of attenuation along the noise path. There are, therefore, two fundamental noise control techniques available to the quarry operator:-

1. the reduction of the noise generated at the sources; and
2. increasing the attenuation or absorption between the source and the receiver by the careful location of equipment.

4.4.1 Noise Reduction at the Source

This may be achieved by the replacement of existing equipment with more modern machinery or by altering the design or improving the maintenance of existing equipment. All drilling equipment, for example, should be effectively silenced and these silencers should be fully maintained so as to remain effective. Alternatively, the fixed equipment may be placed in an acoustically designed building or enclosure to reduce the noise emanating from the site.

4.4.2 Noise Control by Equipment Location

Site selection (Section 3) is obviously a most effective method of minimising potential noise problems from a quarry site.

A second method involves the use of barriers whether already existing, such as past excavations and the natural topography, or specially constructed for this purpose, such as topsoil or overburden stockpiles.

Noise from mobile plant is generally more difficult to control than noise from fixed plant. The former may be minimised by the location of internal haul routes close to the internal face of an excavation on site, away from nearby houses for example.

In order to achieve the greatest reduction in noise levels from noise barriers, the noise source and the barrier should be as close to each other as possible in a similar manner as for visual screens (Figure 2).

The planting of trees on earth mounds or barriers is an effective method of visually screening the quarry site as noted earlier. But barriers comprising trees are relatively ineffective in the reduction of noise levels as a wide belt of trees with a dense understorey is required to cause a significant reduction. The importance of trees as a visual screen however should not be underestimated and a combination of earth banks and tree screens may achieve desirable results from both acoustic and visual aspects.

4.4.3 Blasting

One of the major sources of noise from a quarrying operation is that generated from the blasting of rock material. Blasting operations may produce ground vibrations and low frequency air blast and it is the latter which is the greatest potential noise source from blasting.

The escape of explosive energy from quarry blasting, as air blast, not only results in excessive noise, but also represents inefficiency of the blasting technique.

The extent of air blast is determined by several factors including the type and quantity of explosive, the degree of confinement, the method of initiation, the local geology and topography and atmospheric conditions. A modification of blasting technique including reduced charge size and improved detonation, which should be carried out in accordance with the requirements of the Department of Mineral Resources, are thus effective methods of reducing air blast.

Air blast may also be reduced by avoiding blasting when the prevailing atmospheric conditions are unfavourable, such as adverse wind direction and low cloud for example, and at inappropriate times, such as early morning or late evening.

Generally, air blasting produced from secondary blasting is greater that that produced from the primary or initial blasting operations. The use of impactors as a replacement for secondary blasting will thus markedly reduce the levels of air blast emanating from the quarry site.

4.5 Rehabilitation

4.5.1 Rehabilitation Concurrent with Extraction Operations

It is not possible to plan the rehabilitation of a quarry site unless the ultimate land use has been determined. In specific situations a land use different from the original may be required, such as forestry, waste disposal, recreation or conservation. In a majority of cases, however, a return to the original land use of native forest or pasture will be desirable and it is upon this assumption that the following rehabilitation guidelines are based.

For the rehabilitation of a quarry site to be successful from both an environmental and economic point of view rehabilitation procedures must be conducted concurrent with extraction operations and should be commenced as soon as possible. Initial excavations may be difficult to conceal although the use of existing screening vegetation (Section 3) may provide a visual screen until a sufficient area has been worked to enable rehabilitation to commence.

Sufficient personnel and resources must be allocated during the operation to enable progressive rehabilitation without impeding production. Funds for final rehabilitation should be budgeted for during the operation, as there may be insufficient income at the end of the operation to cover final costs.

Economically, it is more beneficial to conduct the earthmoving operations required for the rehabilitation of disturbed sites while the heavy equipment is available and working on the site rather than to bring back this equipment following cessation of operations. Similarly, the extent of any measures for erosion control which may be required will be considerably reduced if these are carried out progressively rather than allowing run-off to cause extensive and expensive (to alleviate) damage.

Rehabilitation procedures may be implemented immediately following the selection of the site and involve the minimal clearing of vegetation, stripping and stockpiling of topsoil, the use of erosion control techniques and a systematic method of site development.

The systematic method of operations outlined in Section 4 should result in the formation of stable areas such as benches or bays which may be rehabilitated concurrent with extraction operations in another area of the site. In the case of the planned bay method this stable area would be a worked out bay. Ina benched quarry this area should be each successive bench so that as soon as practicable after extraction of material from the bench rehabilitation should be instigated. This is of particular importance in hard rock quarries as the upper faces are likely to be more visible and thus early screening is essential.

i) Earthworks

The first step in the rehabilitation process involves the re-shaping of the worked area. If the final land use of the site is to be the same as the site prior to extraction operations, this re-shaping should aim to approximately the original contours of the area. In the case of a benched quarry this may be achieved by the removal of the edges of each bench and the rounding off of the lip and toe of the pit face by blasting. To further approximate the surround countryside and reduce the visual impact of the site, the benches may be made irregular in length and height also by blasting. In those sites where the extraction of material has produced sheer face, these should be removed by the levelling and battering of the faces.

ii) Topsoil Spreading

Topsoil should then be spread uniformly over the stable surfaces to as great a depth as possible to encourage revegetation of the site. This will occur due to the often high nutrient status of topsoil, the improved soil structure and the water-holding capacity.

iii) Ripping

The recontoured areas covered with topsoil should then be deep-ripped where possible to a depth of 500mm to provide suitable substrata for root development by improved aeration and water-holding capacity and to create a firm bond between the ripped substrata and the topsoil or overburden. The rip lines should be parallel to the contour to reduce water run-off and increase water infiltration into the site.

iv) Revegetation

Prior to revegetation of the site any soil conservation structures such as contour banks and diversion banks that may be required should be constructed to control the run-off of water.

If the final land use is to be the same as the site prior to extraction operations the plant species selection for revegetation should be the same native species which previously occurred in the general area. The aim of these rehabilitation procedures, therefore, should be produce a self-maintaining plant community of broadly similar species composition and appearance to the surround landscape.

In disturbed sites plant growth may be limited by many factors. One of the most important of these is the nutrition of plant species and so, dependent upon the nutrient status of the site, the application of fertiliser may be required.

Revegetation on steep slopes may be assisted by the use of mulch which protects the structure of the surface soil by reducing run-off, conserving soil moisture and reducing the surface temperature. Mulching materials include straw, grass-hay and any brush or scrub removed in the initial clearing of the site. There are several other techniques to assist revegetation in steep areas and these include the use of bitumen emulsion, hydro-mulching and chemical stabilisers.

The revegetation of the site concurrent with extraction operations should not be limited to those areas at which extraction has been completed. It may be necessary, for example, to temporarily revegetate overburden and topsoil stockpiles as outlined in Section 4. In those areas where browsing by native or domestic animals may be a problem revegetated areas should be fence to exclude these animals.

In all cases provision be made for –

1) watering (eg drip irrigation or if to be manually watered, access ways to be provided);
2) maintenance (viz. replacement due to loss; and
3) general nurture until vegetation is well established.

In all cases it is recommended that native species are to be planted within these revegetation schemes with a preference for local species.

V) Maintenance

The revegetation of the site should be followed by a carefully planned maintenance program to ensure its success. Such measures may include watering, further fertilising, fence repair and continued pest control. When revegetation is carried out progressively personnel on-site may be used to conduct maintenance of revegetated areas.

4.5.2 Rehabilitation Following Cessation of Extraction Operations

The rehabilitation requirements of a quarry site following the completion of operations at the site should be considerable reduced if the progressive rehabilitation of the site has been conducted. The details of these rehabilitation procedures are provided in Section 4.5.1 and may be summarised as follows:-

a) Earthworks;
b) Spreading of topsoil;
c) Ripping;
d) Revegetation;
e) Maintenance.

Prior to the commencement of earthworks at the site following the completion of extraction operations all fixed and mobile equipment, all temporary and permanent structures and all waste materials should be removed from the immediate rehabilitation site area. The latter materials should be disposed of at a licensed refuse disposal site.

Those disturbed areas of the site which have not been rehabilitated concurrent with extraction operations should then be rehabilitated using procedures outlined above. Rehabilitation should include treatment of the internal roads and tracks.

The quarry site should therefore be left in a stable, free draining and revegetated state which blends in with the contours and vegetation of the surrounding area.