SWAN PORTLAND CEMENT LIMITED

PROPOSED QUICKLIME PROJECT AT NOWERGUP

CONSULTATIVE ENVIRONMENTAL REVIEW

Prepared by:

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PROPOSED QUICKLIME PROJECT AT NOWERGUP
CONSULTATIVE ENVIRONMENTAL REVIEW

The Environmental Protection Authority (EPA) invites persons and organizations to make a submission on this proposal.

The Consultative Environmental Review (CER) for the proposed quicklime plant at Nowergup has been prepared on behalf of Swan Portland Cement Limited in accordance with Western Australian Government procedures. The CER will be available for comment for four weeks, beginning on 9 May 1991 and finishing on 6 June 1991.

Comments from government agencies and from the public will assist the EPA in preparing an assessment report, in which it will make a recommendation to Government.

WHY WRITE A SUBMISSION?

A submission is a way to provide information, express your opinion and put forward your suggested course of action including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received will be acknowledged.

DEVELOPING A SUBMISSION

You may agree or disagree, or comment on, the general issues discussed in the CER or with specific proposals. It helps if you give reasons for your conclusions, supported by relevant data.

You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the CER:

- clearly state your point of view
- indicate the source of your information or argument if this is applicable, and
- suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

It will be easier to analyse your submission if you keep in mind the following points:

- Attempt to list points so that the issues raised are clear. A summary of your submission is helpful.
- Refer each point to the appropriate section, chapter or recommendation in the CER.
- If you discuss different sections of the CER, keep them distinct and separate, so there is no confusion as to which section you are considering.
- Attach factual information you wish to provide and give details of the source. Make sure your information is accurate.
- Please indicate whether your submission can be quoted, in part or in full, by the EPA in its assessment report.

Copies of the CER can be obtained from Kinhill Engineers Pty Ltd (47 Burswood Road, Victoria Park), at a cost of $5 plus packaging and postage.

Remember to include:

- name
- address
- date.

The closing date for submission is 6 June 1991.

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
1 Mount Street
Perth WA 6000

Attention: Mr S. Sadlier

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SUMMARY

Swan Portland Cement Limited (Swan) manufactures cement and lime at its Rivervale site. Because of the increasing demand for quicklime in Western Australia, Swan proposes to construct and operate a 230,000 tonne per annum quicklime plant in the Nowergup area, with limestone being supplied from nearby freehold land and mineral leases.

Benefits of the project

The proposed project would have significant benefits. Direct employment would be provided for 120-150 people during the construction phase, twenty to twenty-five people during the operation phase, and nine to eleven people for quarrying operations. Demand for goods and services during construction and operation would result in a significant economic stimulus. A cheaper but better quality product than that currently on the market would be produced, resulting in the potential for cost reductions to local industries and reductions in the demand for imported quicklime alternatives.

Evaluation of alternatives

Alternative sources of limestone were considered; however, all other economic reserves of high grade limestone are already secured, too remote, located where access is denied or difficult, or located in an environmentally sensitive area.

Alternative locations for the quicklime plant were assessed. However, the environmental and social implications of transporting large volumes of limestone on public roads, together with the additional cost to the proponent, made the option of locating the quicklime plant further away from the quarry not feasible.

An assessment was made of alternative routes between the plant site and Wanneroo Road. The preferred option was the use of Gibbs Road; however, because of concerns raised by local residents, this option was not considered appropriate. As a result, the planned extension of Wesco Road would be used. Until the Wesco Road extension has been constructed, quicklime would be transported along Pinjar Road and Flynn Drive.

Tenements

Limestone would be obtained from tenements held by Swan. The Wesco Road leases, located off Wesco Road in Nowergup, comprise the following:

- ML 70/138, known as the Wesco lease
- Lot 7, known as the Gibbs lease (held by Swan as freehold)
- ML 70/141, known as the Wesco North lease
- ML 70/143, known as the Pinjar lease.

The project

Quarrying for limestone is proposed at a rate of 450,000 tonnes per annum. Based on current and proposed quarrying rates and expected future quarrying rates, the Wesco Road leases have a life of approximately 30 years.

Limestone with a calcium carbonate content of over 75 per cent would be extracted. Suitable grade limestone occurs to an average depth of approximately 20 metres (maximum 30 metres) below the existing land surface. Owing to the friable nature of the limestone, no blasting would be required; instead, limestone would be ripped by D9 dozers.

The quicklime plant would be located within a 4 hectare fenced site in the Gibbs lease. The major plant requirements (other than limestone) would be:

- 4 terajoules of natural gas per day
- 5 megawatts of power
- 200-500 kilolitres of water per day.

Atmospheric emissions from the quicklime plant would include carbon dioxide, water vapour, nitrogen and oxygen. No sulphur dioxide emissions would be produced. Solid residue from the quicklime process would be limited to silica reject material, which would be returned to the quarry or sold. The quicklime process would not produce a wastewater stream; all cooling water would be recirculated.

Quicklime would be transported to markets in B-trains or other bulk tankers, which are already in common use in Western Australia.

It is expected that construction of the plant would commence in the third or final quarter of 1991, with commissioning scheduled for the final quarter of 1992.

Existing environment

The lease area consists of coastal Tamala Limestone, which is very porous. A thin layer of sand overlies the limestone. The leases contain a north–south oriented ridge, whereas the plant site is relatively flat.

The Tamala Limestone is underlain by an unconfined aquifer. The water-table lies between 24 metres and 32 metres Australian Height Datum.

Botanical surveys have indicated the presence of *Eucalyptus 'argutifolia'*, a declared rare species which is known to be restricted to a highly specific ecological environment. Four populations are present within the Wesco Road leases.

In addition to *E. 'argutifolia'*, two other *Eucalyptus* species on the Department of Conservation and Land Management Priority Species List were identified: *E. 'petrensis'* and *E. foecunda.*

No archaeological or ethnographic sites of significance are present within the lease area.

Existing background noise levels range between 26 decibels (ambient) and 46 decibels (ambient) at the plant site, and between 25 decibels (ambient) and 46 decibels (ambient) in adjacent areas.

Environmental impacts and management

Construction
The construction of the quicklime plant would create an increase in the volume of traffic in the area. Construction-related traffic from Perth would use either Pinjar Road and Flynn Drive, or Gibbs Road.

Noise from construction activities would not exceed allowable community noise levels.

The vegetation that would be cleared during construction is not unique and does not contain populations of *E. 'argutifolia'*.

Operation
Once the quicklime plant was in operation, limestone would no longer be required at Rivervale for lime manufacture.

The proposed route for the transport of quicklime from the plant is the planned extension of Wesco Road through to Wanneroo Road; this would alleviate the need to use Gibbs Road. Swan has expressed its preparedness to assist with the funding of this extension. Furthermore, until the extension is constructed, Swan is prepared, at considerable additional cost, to use Pinjar Road and Flynn Drive.

Dust from the quicklime plant would be contained through the use of mist water sprays and dust collection units, covering of conveyors and limestone stockpiles, sealing of internal roads, and retention of native vegetation where practicable.

When compared with other land uses in the area, the water requirements of the plant are relatively minor; the volume of water required is equivalent to the water requirement of 4-10 hectares of irrigated horticultural land.

Atmospheric emissions of particulates from the quicklime plant would be well below the limit of 100 milligrams per normal cubic metre recommended by the National Health and Medical Research Council. The emission concentration of nitrogen oxides from the plant would be approximately 100 milligrams per normal cubic metre, well below the maximum allowable emission concentration of 1,300 milligrams per normal cubic metre (24-hour average) recommended by the Advisory Committee on Air Quality. Carbon dioxide emissions would total approximately 260,000 tonnes per annum, representing a potential increase of 1 per cent in the Western Australian emission of carbon dioxide from industrial processes and fossil fuels.

Because of its inert nature, backfilling of silica reject material would not pose a threat to groundwater.

Decommissioning of the plant would involve the removal from site of all structures and materials. The site would then be rehabilitated to meet the requirements of the intended future land use.

Quarrying and rehabilitation
The total area to be quarried in the Wesco Road leases would be 250 hectares.

Because quarrying would be conducted at least 30 metres above the water-table, no impacts on the local or regional water-table are expected.

Dust emissions from quarrying during summer would be minimized through the application of water from mobile tankers where necessary.

Noise contour modelling was undertaken to predict the 'worst case' noise emissions from quarrying and the quicklime plant. Swan would meet all appropriate noise emission requirements set by the EPA.

All *E. 'argutifolia'* populations that occur within the leases would be protected. Quarrying is expected to approach the first population of *E. 'argutifolia'* south of Wesco Road approximately 12 months after project approval. A number of specific measures would be taken to protect this first population, including installation of a barrier fence, establishment of a 10 metre buffer zone and appropriate rehabilitation of adjacent areas. Other populations would not be approached for another 20 to 30 years. This would allow protective measures to be assessed and any possible revisions made, with the approval of the Department of Conservation and Land Management, before other populations were approached by quarrying.

Quarried areas would be rehabilitated following backfilling with silica rejects. Topsoil and overburden from quarried areas would be spread over the backfill and exposed limestone. Topsoil may be supplemented with light brush from surrounding vegetation. Locally collected seeds could also be used to assist with the establishment of a vegetative cover.

Monitoring
A monitoring programme would be implemented to monitor:

- stack emissions (particulate loads and gases)
- ambient air quality (total suspended particulates)
- groundwater
- noise
- rehabilitation
- *E. 'argutifolia'*.

In addition, social impact monitoring would be undertaken, together with measures to respond quickly and effectively to any public complaints.

Specific methodologies for monitoring would be developed in consultation with relevant government authorities.

Section One

INTRODUCTION

1.1 BACKGROUND

Swan Portland Cement Limited (Swan) manufactures cement and lime at its Rivervale site, located within the City of Perth and adjacent to the Burswood Island Resort. Limestone used in the manufacture of cement and lime is currently obtained from privately owned and Crown lease land reserves in the Fremantle–Spearwood and Wanneroo areas.

Since the early 1980s, demand for quicklime in the alumina, gold, mineral sands and other process industries has increased. In order to benefit from this increasing demand, Swan has investigated means by which the calcium carbonate levels of its limestone reserves could be upgraded through the separation of silica. Resolution of the technical difficulties associated with the manufacture of quicklime from land-based limestone resources has provided an opportunity for Swan to re-enter the quicklime market.

Swan proposes to construct and operate a quicklime plant in the Nowergup area, with limestone being supplied from nearby freehold land and mineral leases. The locations of the freehold land, mineral leases and proposed plant site are shown in Figure 1.1.

In accordance with the provisions of the *Environmental Protection Act, 1986*, the Environmental Protection Authority (EPA) was notified of the proposal in August 1990. The EPA determined that the appropriate level of assessment for the project was a Consultative Environmental Review (CER).

1.2 SCOPE OF THE CER

The purpose of this CER is to facilitate the EPA's assessment of the environmental implications of the project and to allow comment by affected parties. The CER has been prepared in accordance with the guidelines issued by the EPA (Appendix A), and its scope is limited to areas that would be directly or indirectly affected by the project.

The CER provides details of the project, identifies the project's potential environmental impacts and outlines the proposed environmental management measures and commitments.

Although the Coogee Springs leases form part of the tenements proposed to be quarried for limestone (which would then be processed at the quicklime plant), a separate development application and environmental assessment would be prepared for these leases for submission to the City of Wanneroo and the EPA at a time closer to when quarrying was scheduled to commence. Limestone from the Coogee Springs leases is expected to be required sometime between 2011 and 2020.

1.3 THE PROPONENT

The proponent is Swan Portland Cement Ltd, an unlisted public company wholly owned by Adelaide Brighton Cement which has considerable experience in the production and distribution of lime and quicklime products.

Swan has been engaged in the manufacture of cement, lime and associated products at its Rivervale site since 1927, and currently produces 250,000-300,000 t/a of these products for the Western Australian market. Swan directly and indirectly employs about 200 people in its operations.

1.4 SCOPE AND TIMING OF THE PROJECT

Subject to meeting all necessary approval requirements, construction of the quicklime plant would commence in the third or final quarter of 1991, with commissioning scheduled for the final quarter of 1992.

The proposed production rate of quicklime would be 230,000 t/a; this may be increased by an additional 230,000 t/a in future years. Limestone would be quarried at a rate of 450,000 t/a. This CER addresses the environmental impacts and management of the project at the quicklime production rate of 230,000 t/a and the quarrying rate of 450,000 t/a; any increases in the rate of quicklime production and/or quarrying would require further environmental assessment by the EPA.

1.5 TENEMENTS

Limestone would be obtained from a number of tenements held by Swan. The locations of these tenements are shown in Figure 1.1, while details of the tenements are provided in Table 1.1.

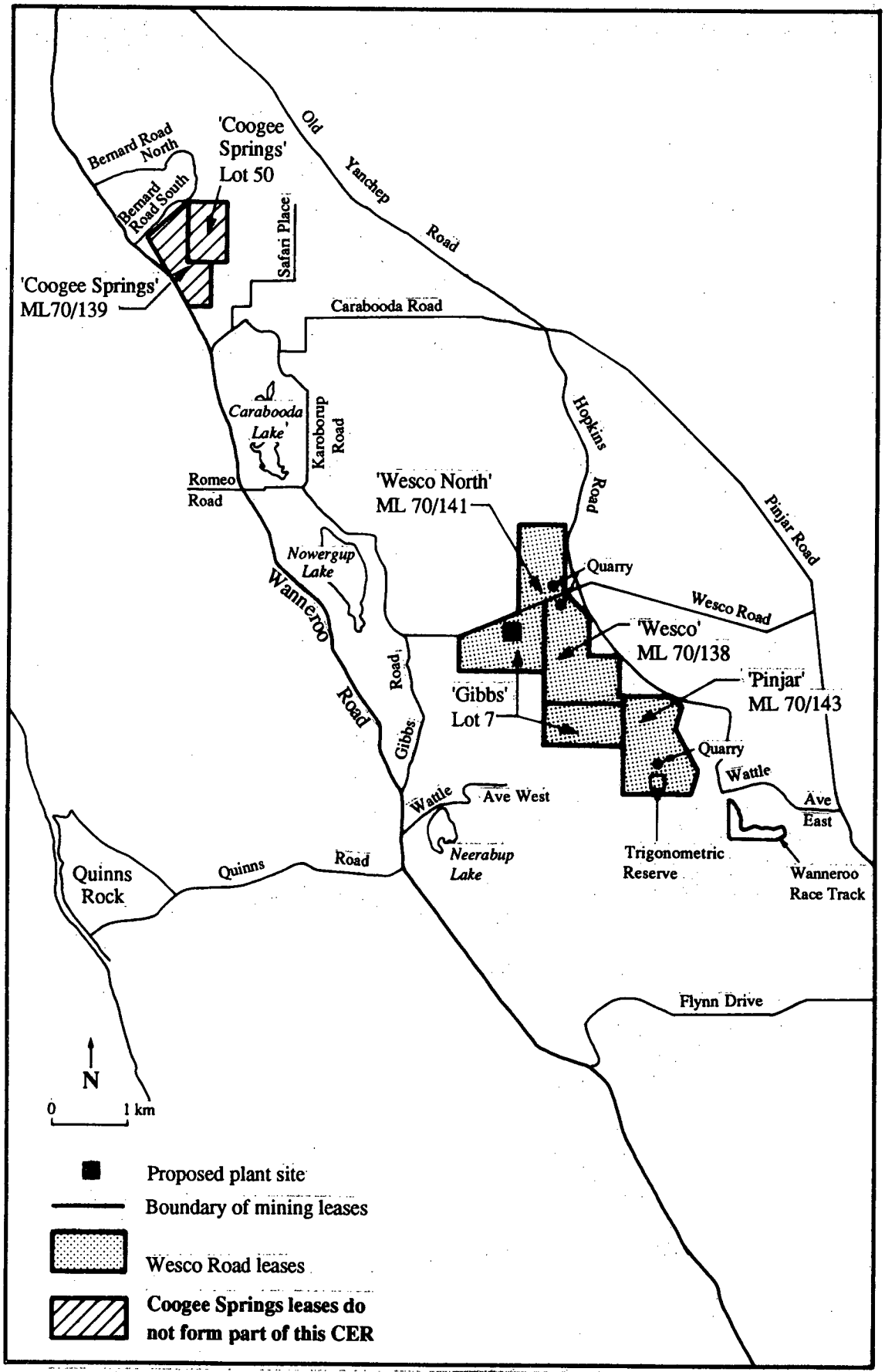


Figure 1.1

LOCATION OF SWAN'S FREEHOLD LAND/MINERAL LEASES AND PROPOSED PLANT SITE

Table 1.1 **Details of tenements held by Swan**

Description	Tenement title	Working title	Owner	Area (ha)
Wesco Road leases				
Mining lease	ML 70/138	Wesco	Crown	129.48
Freehold	Lot 7 *	Gibbs	Swan	121.90
Mining lease	ML 70/141	Wesco North	Crown	61.88
Mining lease	ML 70/143	Pinjar	Crown	118.15
Subtotal				431.41
Coogee Springs leases**				
Mining lease	ML 70/139	Coogee Springs	Crown	71.36
Freehold	Lot 50†	Coogee Springs	E.T. Gibbs	73.25
Subtotal				144.61
Total				**576.02**

* *Old mineral claims 2733 and 70/16339.*

** *The Coogee Springs leases do not form part of this CER.*

† *Lot 50 on diagram 38717 and portion of Crown Grant 3288.*

Tenements ML 70/138, ML 70/141, ML 70/143 and Lot 7 are collectively described as the Wesco Road leases, while ML 70/139 and Lot 50 are collectively referred to as the Coogee Springs leases. The plant would be located within the Gibbs lease, while limestone quarrying would occur in sections of the Wesco North, Wesco, Pinjar, Gibbs and eventually the Coogee Springs leases. All tenements have 21-year leases; all expire on 30 September 2006.

As indicated in Section 1.2, the Coogee Springs leases do not form part of this CER.

Swan holds additional tenements off Yealswamp Road (ML 70/140) and Bailey Road (ML 70/142) further to the north; however, these tenements do not form part of the project being described in this CER. Any proposed development of these tenements would be subject to separate environmental assessment by the EPA.

1.6 LEGISLATIVE FRAMEWORK AND APPROVAL PROCESS

1.6.1 LEGISLATIVE REQUIREMENTS

The relevant legislation and its application to the proposed project are briefly outlined as follows:

- The *Mining Act, 1978* and associated regulations define the terms and conditions relating to the granting of exploration and mining licences, exploration activities, approvals to mine, mining operations and decommissioning/rehabilitation in relation to limestone on Crown land.

- The *Mines Regulations Act, 1946* enables the Department of Mines inspection system to govern the operations at the mine site.

- The *Environmental Protection Act, 1986* requires that the proponent prepare documentation of the proposal for evaluation through the environmental approval process (Section 1.6.2), and provides powers for the prevention, control and abatement of discharges into, and pollution of, the environment.

- The *Town Planning and Development Act, 1928* empowers the City of Wanneroo to control development under the provisions of its Town Planning Scheme.

- The *Local Government Act, 1960* provides authority to the City of Wanneroo with respect to local planning and zoning regulations.

- The *Occupational Health, Safety and Welfare Act, 1984* provides regulations to ensure the health, safety and welfare of the workforce, together with the safety of the general public when on site.

- The *Aboriginal Heritage Act, 1972* provides for the preservation of places and objects customarily used by, or traditional to, Aborigines, and prohibits the concealment, destruction or alteration of Aboriginal sites.

- The *Health Act, 1911* provides for the preservation of public health and authorizes the local authority to carry out the provisions of the Act and associated regulations, by-laws and orders made thereunder.

- The *Conservation and Land Management Act, 1984* provides for the appropriate management of State forests, national parks, nature reserves and other lands, and the conservation and protection of flora and fauna.

- The *Wildlife Conservation Act, 1950* and associated regulations provide for the conservation of flora and fauna, and prevent the taking of protected flora and fauna without an appropriate licence.

- The *Rights in Water and Irrigation Act, 1914* provides for the issuing of licences for bores and other activities that may affect groundwater or surface water resources.

1.6.2 ENVIRONMENTAL APPROVAL PROCESS

The environmental approval process is shown diagrammatically in Figure 1.2.

The CER is intended to provide the public and government with an understanding of the proposal and its environmental implications. Following EPA approval for the release of the CER for public review, written submissions from affected groups and government departments can be made to the EPA during the 4-week review period.

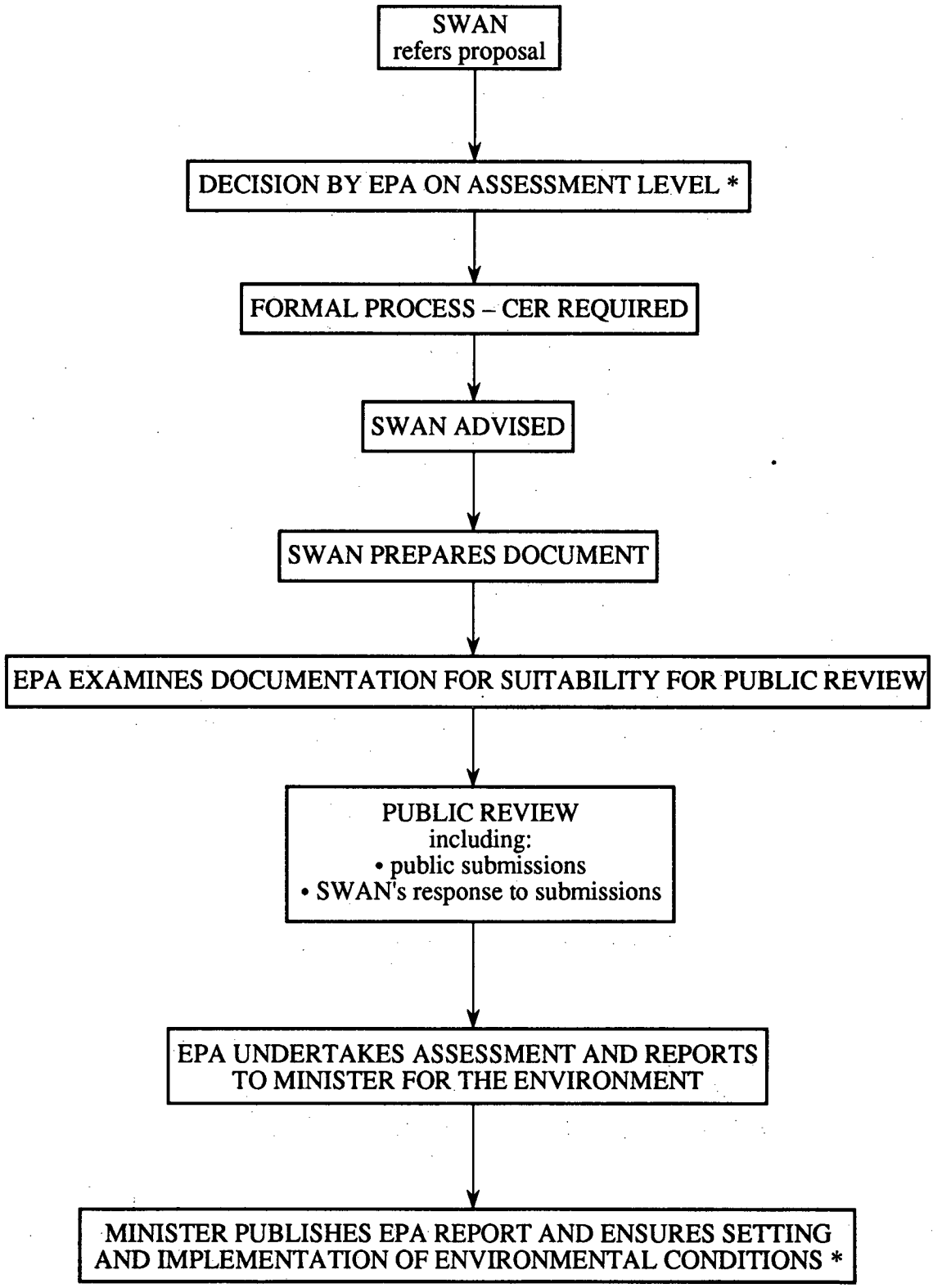
The proponent is then given an opportunity to respond to the points raised in these submissions. The proponent's responses will then be incorporated into the EPA assessment of the proposal. The EPA will recommend to the Minister for the Environment that the project is:

- environmentally acceptable
- acceptable subject to certain conditions, or
- environmentally unacceptable.

1.7 STRUCTURE OF THE CER

The CER presents the following information:

- the need for quicklime and the benefits of the project (Section 2)
- possible alternatives concerning resources, siting and operations (Section 3)
- details of the project including quarrying and quicklime processing (Section 4)
- the physical, biological and human environments in the lease area (Section 5)
- the potential environmental impacts of the project and their management (Section 6)
- the proposed monitoring programme (Section 7)
- the public consultation programme undertaken (Section 8)
- a summarized list of environmental commitments (Section 9)
- conclusion on the environmental acceptability of the project (Section 10).



* Appeal point

Figure 1.2
ENVIRONMENTAL APPROVAL PROCESS

Section Two

PROJECT JUSTIFICATION

2.1 NEED FOR QUICKLIME

The market for quicklime and associated products in Western Australia approximates 750,000 t/a, with continued strong growth in most areas of application. Quicklime is used for the neutralization, coagulation, causticization, dehydration, hydrolysis and absorption processes.

Quicklime has a wide range of uses including, but not limited to, the following:

Metallurgical

- Alumina industry: Quicklime is used extensively in the alumina industry to reconstitute caustic soda, the primary agent used in the processing of bauxite to produce alumina. Quicklime is also used as a filter aid and impurity precipitator, and for treatment of solid waste. The alumina industry constitutes about 60% of the current quicklime market.

- Gold processing: Since the introduction of the carbon-in-pulp process in the gold industry, quicklime has become an essential means to control the pH of the crushed ore slurry, to enable the leaching of gold using sodium cyanide. The gold industry uses about 25% of the quicklime currently sold in Western Australia.

- Mineral sands processing: Quicklime is used for pH control, sulphate water treatment and removal of contaminants. The mineral sands industry is considered a major growth area for quicklime consumption, with many of the end-uses for the mineral sands also incorporating lime as an additive (e.g. pigments, paints).

- Iron and steel industry: Quicklime is used to remove sulphur and phosphorus from molten metal.

Building

- Construction: Quicklime is used for the production of slaked lime (hydrated form), which is used extensively in the construction industry as a component of mortar. Quicklime is also used to make sand lime bricks.

- Glass and ceramics: Glass, as well as other refractory products such as ceramics, are manufactured using lime.

Agricultural

- Fertilizers: Quicklime is used in the manufacture of fertilizers, primarily to assist in the free-flowing characteristics of mixed fertilizers, to reduce bag rotting and as a nutrient.

- Soil amendment: Lime is added directly to pastures for soil stabilization and for neutralizing soil acidity.

Environmental

- Water treatment: Quicklime is used to soften water and also to improve coagulation, a process which removes suspended solids from water.

- Wastewater treatment: Government and industry use quicklime to adjust pH, remove phosphorus and precipitate heavy metals during the treatment of domestic and industrial wastewater.

- Air pollution: Lime products are applied by some local industries to scrub noxious emissions (containing sulphur dioxide, fluorides or hydrochloric acid) from waste gas streams.

The long-term demand for quicklime is expected to increase in the alumina, gold and mineral sands processing industries, and environmental sectors, as well as from new industrial developments in Western Australia. The increase in the local production capacity of quicklime as a result of this project should prevent any possible shortfall in the supply of quicklime.

2.2 BENEFITS OF THE PROJECT

2.2.1 THE STATE AND LOCAL COMMUNITY

The economic and environmental benefits of the project are indicated as follows:

Economic

- Generation of direct employment for 120-150 people for 12 months during the construction phase, 20-25 people during the operation phase, and 9-11 people for quarrying operations.

- Creation of an increased demand for local goods and services which would provide an economic stimulus through investment in local businesses, resulting in additional indirect employment.

- Industrial investment of $40 million, the major part of which would be spent in Western Australia, thereby providing an economic stimulus to the civil and engineering sectors of the State.

- Establishment of a competitive source and increased availability of a better quality quicklime, which would reduce the demand for imported alternatives due to their relative unit costs.

- Provision of a possible catalyst for additional secondary industries to become established in the northern corridor.

- Cost reductions to local industries that utilize quicklime in their processes through:

  - reduced transport costs;

  - improved productivity (due to increased throughputs as a direct result of using finer, denser and faster reacting quicklime);

  - competitive pricing;

  - technical services support.

- Increased value added to supplies of Western Australian limestone and natural gas through the manufacture of quicklime.

Environmental

- Utilization of land-based limestone resources, resulting in less environmental impact than utilization of resources in other more environmentally sensitive areas.

- Compliance with the objectives of the State Energy Conservation Strategy (Government of Western Australia 1990) through:

  - a greater than 40% reduction in energy usage compared with conventional processing technologies;

  - reduced aggregate carbon dioxide emissions through improved fuel efficiencies;

  - reduced transport energy usage (and cost) as a result of processing the limestone near the quarry rather than at Rivervale.

- Reduction in transport flow and congestion in the inner city area through the development of industry in the northern regions of Perth.

- Provision of additional quicklime on the market, thereby improving its general availability for use in the environmental management field.

2.2.2 THE PROPONENT

The benefits of the project to the proponent include:

- a more diverse product base, ensuring a more broad-based, financially stable and profitable operation;
- additional base feedstock for other secondary building products, including hydrated slaked lime;
- an opportunity to utilize Swan's reserves of lower grade limestone deposits;
- improving Swan's share of the current and future market demand for quicklime.

Section Three

EVALUATION OF ALTERNATIVES

3.1 QUICKLIME

There are a limited number of viable alternatives to quicklime-based products that are suitable for the uses presented in Section 2.1. Caustic soda, alternative carbonates and other base alkali groups can be used; however, these are imported at significantly higher cost than the quicklime currently available.

3.2 SITE LOCATIONS

3.2.1 RESOURCES

A comprehensive survey of the limestone and limesand resources between Lancelin and Bunbury has recently been conducted by the Geological Survey of Western Australia, a division of the Department of Mines (Gozzard 1987).

The survey concluded that most of the area between Lancelin and Bunbury contains medium grade limestone suitable only for construction purposes. Only three areas (State Forest No. 65 and environs, the Spearwood–Tamworth Hill area and the Tims Thicket area) have proven high quality limestone resources. Limestone near Kooallup Lagoon and between Myalup and Binningup also appear to have high grades; however, further geological assessment would be required in order to define the extent of these resources. High quality land-based limesands are restricted to an area between Ledge Point and just north of Lancelin.

The possibility of using alternative limestone resources to those available in the Wesco Road leases has been assessed. Alternative resources would not be developed at this stage for a number of reasons, including:

- proximity to existing or future urban development
- access to resource either denied or difficult due to government policies
- resource already being utilized, or mining tenements held by others
- distance from metropolitan area or markets
- location within existing National Parks
- insufficient high grade limestone present
- extent and grade of limestone deposits not yet evaluated
- cost of deposit or royalties considered excessive

- presence of magnesium carbonate impurities which are difficult to remove
- mining on vegetated dunes likely to be environmentally unacceptable
- environmental impact of mining sea-sands from Cockburn Sound.

3.2.2 QUICKLIME PLANT

The establishment of the quicklime plant in a location remote from the limestone resources would require transportation of large volumes of material to the plant. This would result in:

- high transport costs
- increases in the number of heavy vehicles on public roads
- increased risks to other public road users
- increased need for road repairs and maintenance.

Furthermore, if the quicklime plant were located away from the limestone resources, a rezoning would be necessary under the requirements of the City of Wanneroo (whereas the processing of limestone adjacent to its source is a permitted land use).

It would be practical and economic to process limestone adjacent to its source and to use road transport for quicklime distribution. It would mean that approximately 50% less traffic movements on public roads would be required than if limestone were also transported.

Establishment of the quicklime plant at Swan's Rivervale site would incur economic and environmental costs, because of the need to transport limestone through the metropolitan area. In addition, the establishment of additional industrial development in the inner city area is likely to be publicly unacceptable.

For these reasons, it is proposed to locate the quicklime plant adjacent to the main source of limestone.

An assessment of possible locations for the quicklime plant within the Wesco Road leases took the following factors into account:

- the need to avoid sterilization of high grade limestone
- easy access to Wesco Road
- sufficient land area to accommodate possible future expansion
- proximity to areas being quarried (in order to minimize haul distance)
- access to necessary infrastructure services.

Apart from the proposed site, there are no locations within the Wesco Road leases that satisfy these requirements, principally because of the risk of limestone sterilization and the distances required to haul limestone.

3.3 MINE PLANNING STRATEGIES

The proposed mining strategy is outlined in Section 4.1.4. Alternatives to this strategy include:

- removal of all economic, high grade limestone within the leases, regardless of environmental sensitivities or known rare species;

- opening up the entire area to be quarried rather than progressive quarrying and rehabilitation as the limestone is extracted.

These alternative mine planning strategies are both considered to be environmentally unacceptable.

The area to be quarried is determined by overburden to limestone ratios and by the grade of limestone. The minimum grade proposed to be quarried is 75% calcium carbonate, normally suitable only for road base material.

3.4 SCALE OF OPERATION

Increases in the proposed scale of operation would be limited by the capacity of the quicklime processing plant and by market demands. Any such increase would require further environmental assessment by the EPA.

Reductions in the proposed scale of operation would be dependent on market conditions; however, given recent market trends, a downturn in demand is unlikely. Operation of the plant below its capacity would prevent Swan from capitalizing on the increasing demand for quicklime and could also affect the viability of the project.

3.5 PROCESS TECHNOLOGY

The production of quicklime (calcium oxide) is achieved by the calcining (heating) of limesand, limestone or other materials that are rich in calcium carbonate.

A number of different types of calcining units are available, including:

- fluid bed calciners, where the feedstock is suspended in a bed during the calcining process by means of an upward flow of air;

- recirculating fluid bed calciners, where the air velocity in the fluid bed is increased and 20-30% of the material in the fluid bed is recirculated as feedstock to allow for improved control of calcining temperature and time;

- flash calciners, where the feedstock is carried upwards by high velocity air, with rapid calcination occurring;

- rotary kilns, where the feedstock is progressed by rotation of the kiln.

The flash calcining system is preferred for the following advantages:

- lower energy consumption through better fuel efficiency
- lower Greenhouse gas emissions
- lower capital costs
- higher quality product.

3.6 TRANSPORT OPTIONS

3.6.1 LIMESTONE

Road transport is assessed as being the only practical method of moving limestone to the plant because of its inherent flexibility, which is important should changes to quarrying schedules and operations be required. The use of a conveyor system is not considered viable on the grounds of economics and practicability. The distance from the nearest existing rail system and the capital cost of establishing a rail system serve to exclude the possibility of using rail to transport limestone.

3.6.2 QUICKLIME

The use of rail transport for quicklime distribution is not considered viable for the same reasons as those indicated in Section 3.6.1.

Owing to the geographically widespread demand for quicklime throughout the State, bulk tankers (most likely B-trains) are considered the most feasible means of quicklime distribution. Road transport would ensure minimal handling of the product and would be the most suitable means of servicing the fragmented and changing distribution of end-user destinations.

The Main Roads Department (MRD) has specified roads that B-trains are permitted to use within the metropolitan area and the south-west region of Western Australia. Quicklime would be distributed along these transport routes; should alternative routes be required, approval from the MRD would be sought.

A number of transport route options are available between the plant site and Wanneroo Road (Figure 3.1), including the use of:

- Gibbs Road
- Pinjar Road and Flynn Drive
- a planned extension of Wesco Road westward from Gibbs Road to Wanneroo Road.

The planned extension of Wesco Road is the proposed route, even though the preferred option is the use of Gibbs Road. The residents of Gibbs Road have expressed concern over the potential for increased traffic flow on this road. In the short term, and until the extension is constructed, Swan is prepared to use Pinjar Road and Flynn Drive.

3.7 NO-GO OPTION

If the project did not proceed, the economic and environmental benefits to the State, local community and the proponent (as presented in Section 2.2) would not be realized. Furthermore, the opportunity for alternative and higher quality supplies of quicklime for the uses indicated in Section 2.1 would be lost.

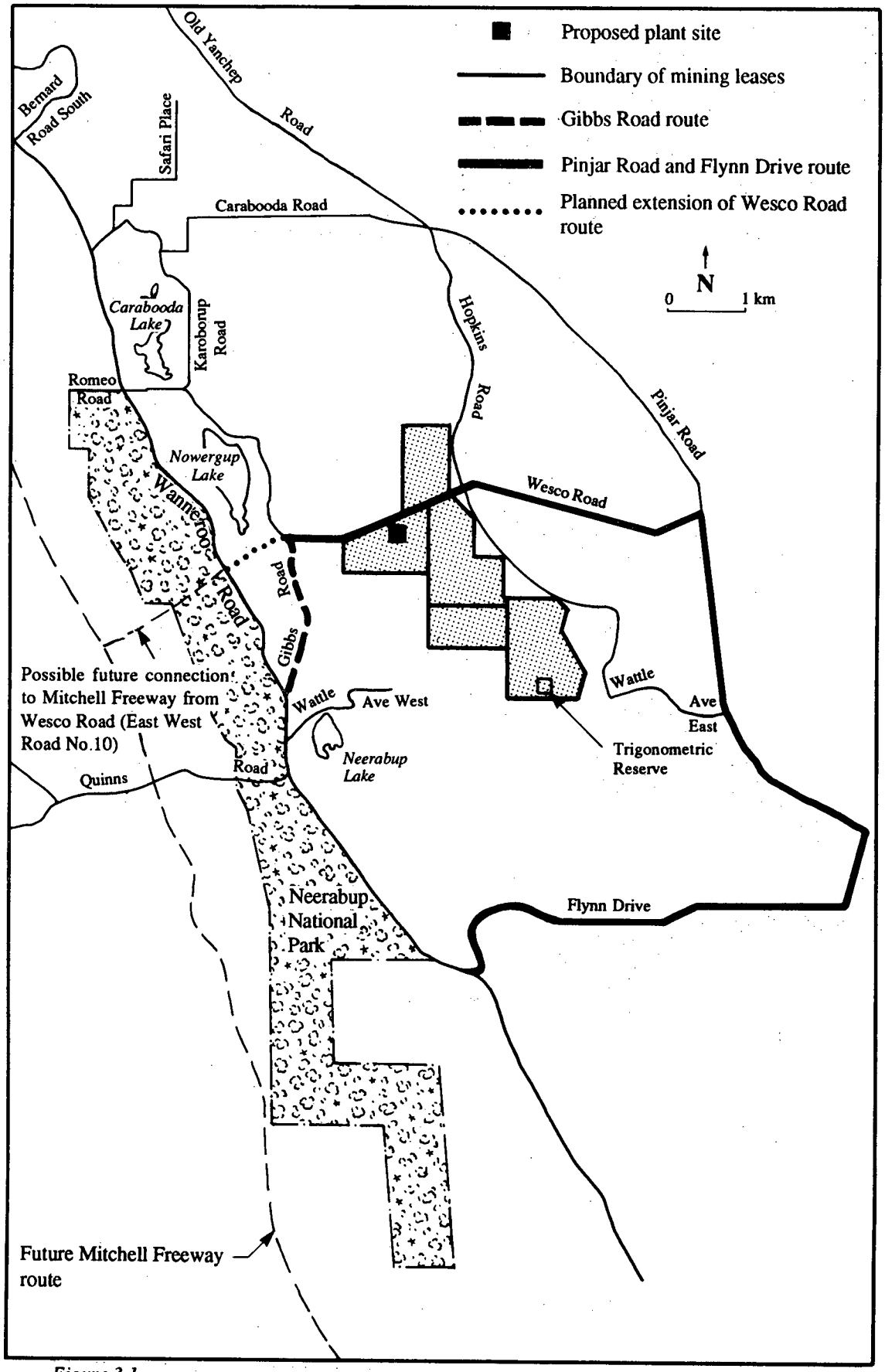


Figure 3.1
ALTERNATIVE TRANSPORT ROUTES

Section Four

PROJECT DESCRIPTION

4.1 QUARRY PLANNING

4.1.1 RESOURCES

The estimated economic limestone resources in each of the Wesco Road leases are as follows:

• Wesco North	2.8 Mt
• Wesco	15.5 Mt
• Gibbs	8.4 Mt
• Pinjar	14.1 Mt
Total	40.8 Mt

4.1.2 QUARRYING RATES

Limestone supplied to the quicklime plant would be quarried at a rate of 450,000 t/a.

The capacity of the quicklime plant may be doubled in the future, resulting in a doubling of the quarrying rate to 900,000 t/a. Further expansion beyond 900,000 t/a is also being contemplated. As with possible future expansion of the quicklime plant, any increases in the quarrying rate beyond 450,000 t/a would require environmental assessment by the EPA.

The existing quarrying operations in the Wesco lease and the transport of limestone from this lease to the Rivervale site for the manufacture of cement and lime would continue until the proposed quicklime plant became operational. Approximately 150,000 t/a of limestone is currently obtained from the Wesco lease.

Based on current and proposed quarrying rates and the expected future quarrying rates, it is estimated that the life of the quarries in the Wesco Road leases is approximately 30 years.

4.1.3 QUARRYING SCHEDULE

Indicative commencement and completion dates of quarrying in each lease are provided in Table 4.1.

Table 4.1 **Indicative schedule of quarrying**

Lease	Year of commencement	Year of completion
Wesco	Currently being worked	2006
Gibbs	2006	2011
Pinjar	2011	2020
Wesco North	2020	2022

A number of factors could affect this schedule, including the mix of limestone grades required, market conditions for quicklime, and performance of the quicklime plant. As a result, adherence to the indicative schedule cannot be guaranteed.

As indicated in Table 4.1, the Wesco lease (which is already being quarried to provide limestone to the Rivervale operation) would continue to be worked to supply limestone to the quicklime plant. Quarrying would then generally extend southward through the Gibbs and Pinjar leases, and eventually to the Wesco North lease. At some stages, quarrying may involve operating in more than one area at any one time.

4.1.4 QUARRY STRATEGY

The area proposed to be quarried within the Wesco Road leases is shown in Figure 4.1.

Definition of the quarry area has been based on the location and depth of suitable grades of limestone. Limestone that has a calcium carbonate content of over 75% would be quarried. Suitable grade limestone would be quarried to a depth of, on average, about 20 m (with a maximum depth of 30 m) below the existing land surface.

The area to be quarried would total about 250 ha, and would be progressively cleared, worked and rehabilitated. Where practicable, the area excavated would be kept to a minimum.

The batter angle of the quarry sides would be 1:6 (about 9°).

The existing and final contours of three cross-sections representative of the quarry area are shown in Figure 4.2. The locations of each cross-section in relation to the proposed quarry area within the Wesco Road leases are indicated in Figure 4.1.

DCE

The quarry strategy has taken into account the presence of a gazetted rare eucalypt—*Eucalyptus 'argutifolia'* (Section 5.2.1). A 10 m buffer around this species has been incorporated into quarry planning in order to protect the populations. Further details of the quarry strategy pertaining to *E. 'argutifolia'* are provided in Section 6.3.8.

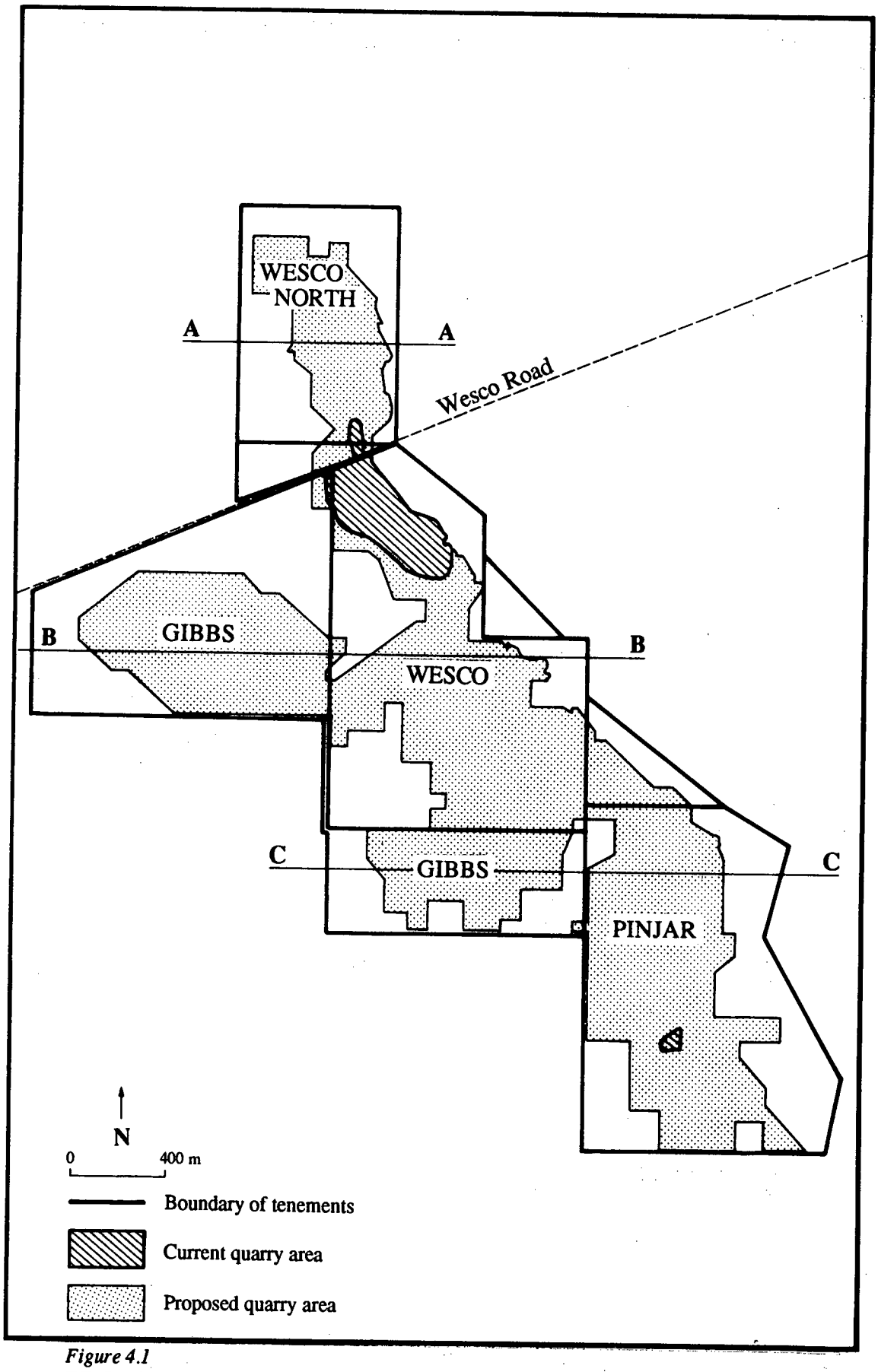
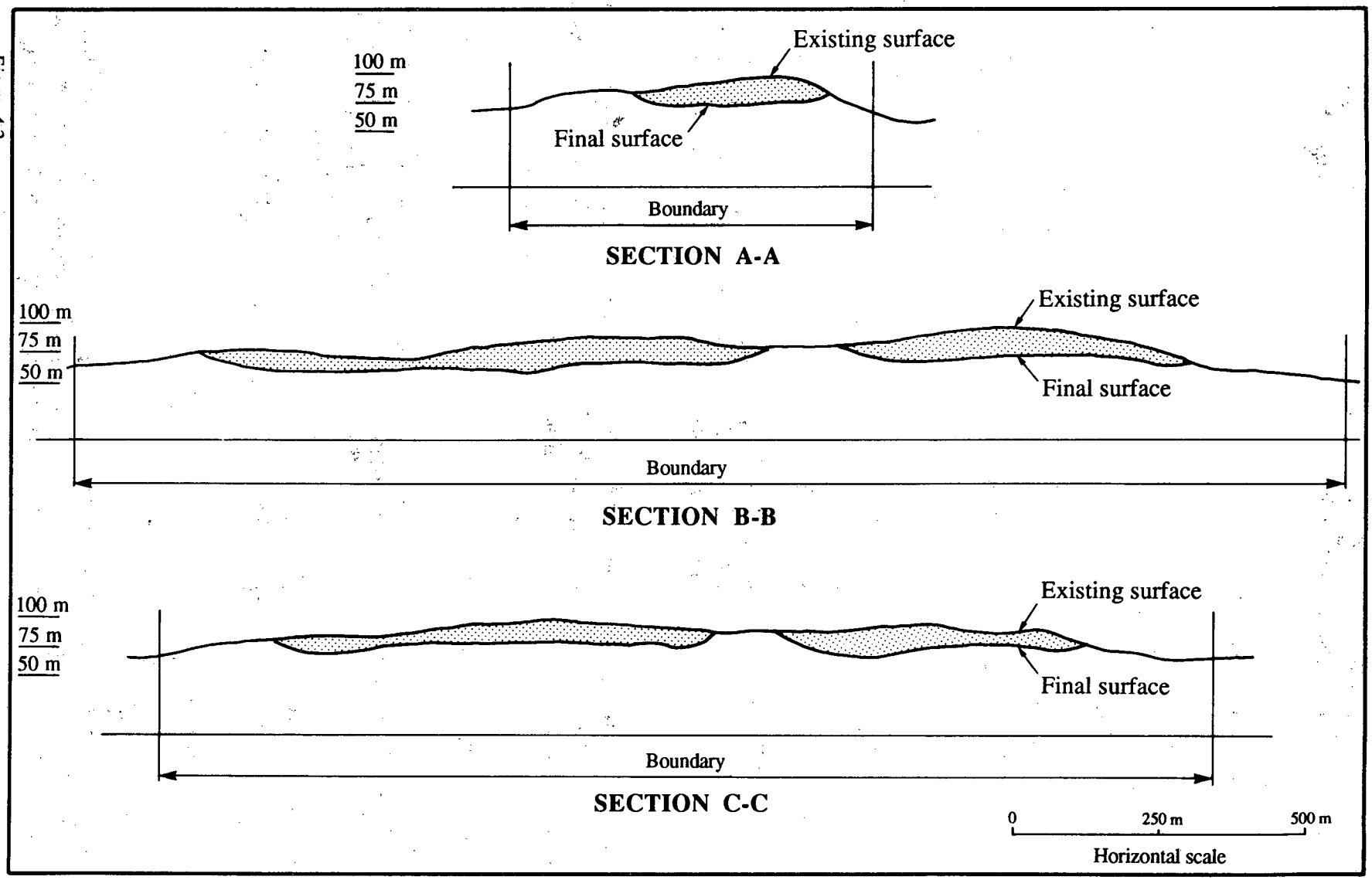


Figure 4.1

PROPOSED QUARRY AREA WITHIN THE WESCO ROAD LEASES

Figure 4.2

FINAL CONTOURS FOR THE QUARRIED WESCO ROAD LEASES



The areas of the Wesco Road leases not planned to be quarried (Figure 4.1) would be retained to serve as a buffer to quarrying operations. These areas contain:

- no limestone
- uneconomic deposits of limestone, or
- gazetted rare plants.

4.2 QUARRY OPERATIONS

Owing to the soft nature of the limestone, no blasting would be required.

Although Swan may undertake quarrying operations itself in the future, quarrying would initially be carried out by contractors under the direction of Swan. The machinery used would therefore depend on the appointed contractor. Quarrying would most likely require:

- two D9 dozers
- two front-end loaders
- four to six off-road haul trucks.

Quarry operations would involve the progressive removal and storage of surface vegetation and associated topsoil and overburden from the area to be quarried. Rehabilitation would be progressively undertaken during quarrying operations to the satisfaction of the EPA.

Dozers would be used to work limestone from the quarry face and establish limestone stockpiles of various grades on the quarry floor. Front-end loaders would then load limestone into trucks for transport to the quicklime plant.

4.3 QUARRY FACILITIES

The quarry contractor may require a maintenance/refuelling depot, together with a small transportable site office and ablution facilities. Should fuel storage be required, storage facilities would comply with the requirements of the EPA and the Department of Mines.

Power would be supplied from the quicklime plant. Domestic water requirements would be met by replenishment of a portable water storage tank (approximately 500 L capacity) from the plant water supply.

4.4 LIMESTONE TRANSPORT

Front-end loaders would load limestone from quarry floor stockpiles into 35 t haul trucks for delivery to the quicklime plant. Limestone would be transported from the Wesco, Gibbs and Pinjar leases on haul roads within the leases; this would not involve the

crossing of public roads. It would be necessary to cross Wesco Road in order to transport limestone from the Wesco North lease to the quicklime plant.

It is expected that quarrying and the transport of limestone would be undertaken during a single shift (7 a.m. to 6 p.m.), 5 or 6 days per week. Should quarrying rates be increased in the future, additional shifts may be required.

4.5 THE PLANT

The plant would be designed for a capacity of 230,000 t/a of quicklime, although this could be increased to 460,000 t/a through the duplication of key production facilities. Any proposals to increase the plant's capacity beyond 230,000 t/a would require further environmental assessment by the EPA.

The plant and associated facilities would be established on a 4 ha site, which could also accommodate future expansion requirements. A conceptual layout of the plant site is presented in Figure 4.3.

The plant site would contain the following:

- dump pad
- limestone crushing and screening station
- transfer station
- crushed limestone storage and reclaim building
- milling, drying and classifying building
- precipitator
- preheating and beneficiation plant
- surge bin
- silica reject silo
- calciner and cooling tower
- load-out silos and weighbridge
- compressor house
- switchroom and transformers
- office and control room
- workshop
- road network and car park.

The office/workshop area would have the following facilities:

- general office
- laboratory
- control room (for remote operation of the production plant)
- office and workshop ablutions
- amenities room (capacity for ten persons)
- ambulance room
- workshop (incorporating fitting/boilermaking, electrical and instrument areas).

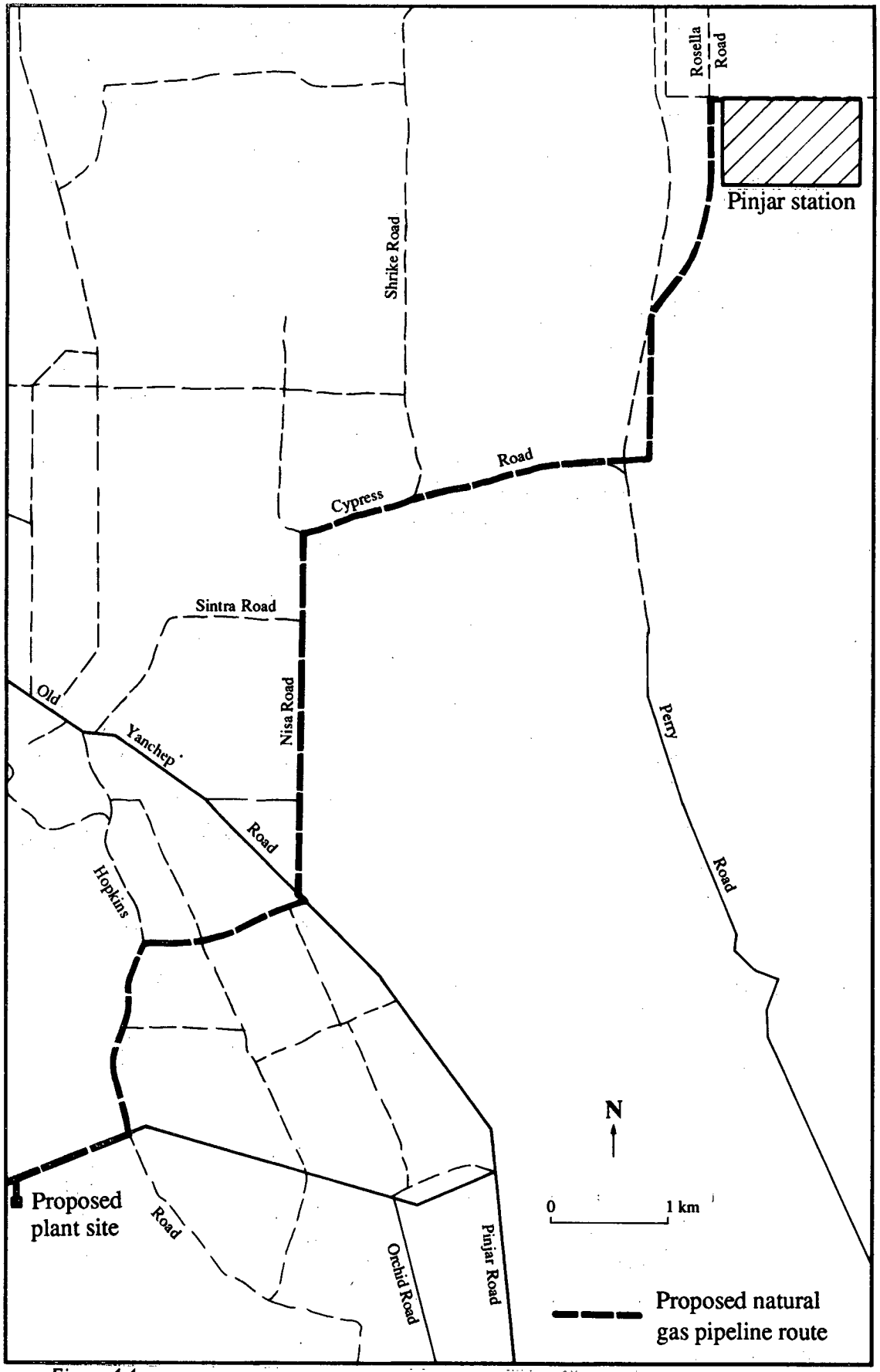
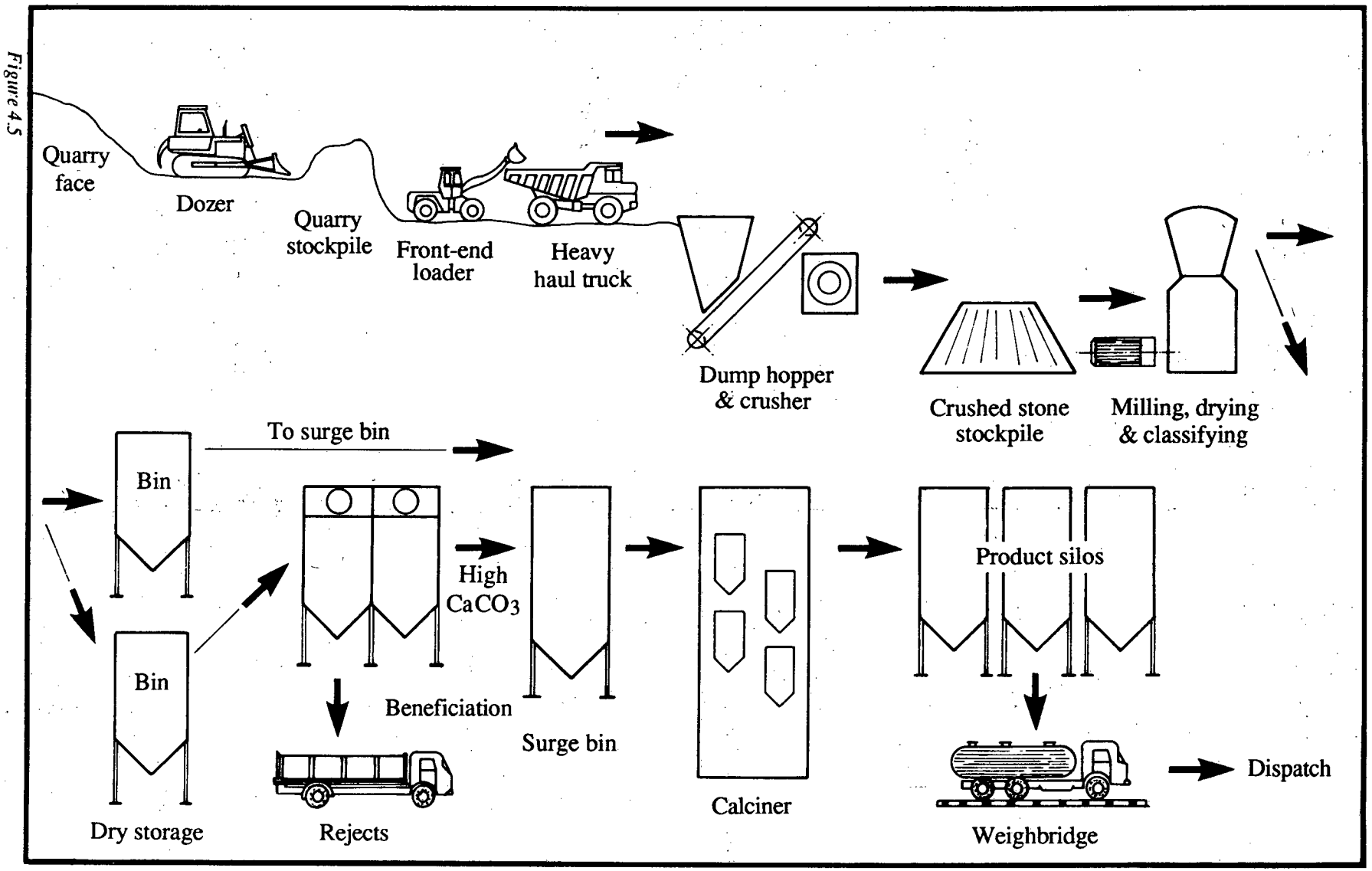


Figure 4.4

PROPOSED ROUTE OF THE NATURAL GAS PIPELINE BETWEEN THE PINJAR STATION AND THE PLANT SITE

Figure 4.5

SIMPLIFIED FLOW DIAGRAM OF THE QUICKLIME PROCESS



The plant site would be secured by a 2 m high wire fence topped with three strands of barbed wire to prevent unauthorized public entry. An internal fence would also be installed to isolate the main production area.

4.6 PLANT CONSTRUCTION

Construction would take 12 months, and require a workforce of 120-150 personnel. Under normal circumstances, standard construction hours (between 6 a.m. and 6 p.m.) would be worked. Should construction activities that could affect the nearest neighbours be necessary outside these standard hours, the residents would be forewarned.

All construction materials and practices would be in accordance with relevant Australian or international standards.

4.7 PLANT OPERATION

With the exception of maintenance shut-downs, the plant would be designed to operate on a 24-hour continuous production basis.

Plant operation and maintenance would be based on established and proven practices adopted by Australian and overseas quicklime operations using similar facilities.

Specialized training in the efficient and safe operation of the plant would be provided to all operating staff. The efficiency of the plant's operation would be maximized by the use of the most recent process technology, effective control systems and regular preventative maintenance, together with various safeguards such as fire protection, monitoring, back-up systems and provisions for emergency shut-downs.

4.8 PLANT REQUIREMENTS

4.8.1 LIMESTONE

Limestone for processing would be extracted at a rate of 450,000 t/a from the areas and in the manner outlined in Sections 4.1 and 4.2.

4.8.2 NATURAL GAS

The quicklime process would require natural gas to generate heat during the drying and calcination of limestone. Natural gas would be required at a rate of 4 TJ/d.

Natural gas would be supplied by the State Energy Commission of Western Australia (SECWA) from its Pinjar gas turbine station located 4 km to the north-east of the plant site. The proposed route of the pipeline from the Pinjar station to the plant site is shown in Figure 4.4. The environmental implications of this route would be addressed separately and as soon as practicable by SECWA in accordance with the requirements of the EPA.

The natural gas supplied by SECWA is expected to have the following typical analysis (molecular percentage):

• Methane	95.2%
• Carbon dioxide	1.7%
• Ethane	1.6%
• Nitrogen	0.8%
• Propane	0.4%
• Butanes, pentanes, hexanes	0.3%

4.8.3 POWER

Power requirements are expected to be 5 MW. Power would be supplied by an extension of the 22 kV SECWA regional grid which passes to the north of the plant site. Power would be reticulated throughout the plant by underground lines.

4.8.4 WATER

The Water Authority of Western Australia (Water Authority) has indicated that sufficient groundwater is available in the area to meet the water requirements of the quicklime plant.

The plant water requirement would be approximately 200-500 kL/d. Plant water would be directed to a recirculation pond and used for cooling purposes. The domestic water requirement is estimated at 1.5 kL/d. Water would be required at the workshop, amenity facilities, laboratory, office and production areas.

4.8.5 COMPRESSED AIR

Compressed air would be generated on site from compressors. Compressed air at 700 kPa would be used for drying, milling, beneficiation, calcining and dispatch operations.

4.8.6 CONSUMABLES

Consumables would be delivered by road, and would include lubricants, general office supplies, spare parts and a range of other items.

4.9 PROCESS DESCRIPTION

A simplified flow diagram of the quicklime process is shown in Figure 4.5.

Limestone would be tipped from dump trucks into a receival hopper, which would self-discharge onto a reclaiming apron feeder. The limestone would then be fed to the crushing plant. Crushed limestone would be directed to a covered storage building, from where it would be fed to a grinding mill feed bin via a semi-enclosed belt conveyor system.

1	DUMP PAD
2	CRUSHING AND SCREENING FACILITY
3	TRANSFER STATION
4	COVERED STORAGE BUILDING
5	MILL BUILDING
6	PRECIPITATOR
7	700 TONNE FEED BIN
8	CALCINER
9	REJECTS SILO
10	LOAD-OUT-SILOS
11	COMPRESSOR HOUSE
12	SWITCHROOM AND TRANSFORMERS
13	CRUSHING M.C.C.
14	OFFICE AND CONTROL ROOM
15	WORKSHOP
16	CAR PARK
17	WEIGHBRIDGE

Figure 4.3
CONCEPTUAL PLANT LAYOUT

The combined drying–milling system would reduce the moisture content of the limestone feed material and further reduce its size. Waste heat from the calciner would be used in the drying–milling circuit. Following this circuit, the limestone would be classified. Some of the milled limestone of a particular size range would be directed to a preheater before being fed to the beneficiation plant. The rest of the milled limestone would be directed to a dry storage bin.

The beneficiation process is designed to remove the majority of the silica from the limestone, to produce material with an increased calcium carbonate content. Reject material from the beneficiation process would be conveyed to a 350 t capacity silica reject silo. Silica rejects would be returned to the quarry by truck, or sold.

The beneficiated limestone would be combined with the unbeneficiated limestone fines and fed to a surge bin prior to calcination.

The calcination process produces quicklime and liberates carbon dioxide in accordance with the following reaction:

$$CaCO_3 + \text{heat} \Rightarrow CaO + CO_2\,(\text{gas})$$

Calcination is achieved at a temperature of around 1,100°C and the feedstock (limestone) is held at this temperature for sufficient time to allow the chemical reaction to completely finish. Heat for the calcining process is provided inside the calciner furnace such that combustion takes place directly in contact with the feedstock to ensure maximum heat efficiency.

Natural gas would be fed into the calciner to enable combustion and calcination of the feedstock. Exhaust gases would be cooled and passed through a dust collection system before being vented to the atmosphere through an exhaust stack. Collected dust would be returned to the calciner feed bin.

Quicklime leaving the calciner would be conveyed to a series of dispatch silos.

4.10 WASTE PRODUCTS AND DISPOSAL

4.10.1 ATMOSPHERIC EMISSIONS

All atmospheric emissions from the calciner, milling plant and beneficiation plant would be combined in an electrostatic precipitator and then vented through the dust collector exhaust stack. The flow-rate volume of the stack is expected to be about 112,050 Nm^3/h.

The estimated composition of the atmospheric emissions and their relative weight, volume, emission rate and concentration are presented in Table 4.2.

Table 4.2 **Composition of atmospheric emissions**

Atmospheric emission	Weight (%)	Volume (%)	Emission rate (Nm^3/h)	Concentration (mg/L)
Carbon dioxide	20.1	12.7	14,240	249.7
Water vapour	16.2	22.4	25,120	180.2
Nitrogen	55.0	56.8	63,610	709.6
Oxygen	8.7	8.1	9,080	115.7

The use of natural gas in the calcining process would ensure that sulphur dioxide emissions from that source were negligible.

4.10.2 SOLID RESIDUE

Silica rejects would result from the beneficiation of limestone; they would typically be composed of:

- silica 87%
- calcium carbonate 8%
- other 5%

The silica rejects would be produced at a rate of 75,000-80,000 t/a, representing approximately 15% of input tonnes to the plant. The particle size of the silica rejects would be between 75 µm and 840 µm. Should potential markets be identified, silica rejects would be made available for sale; otherwise, the rejects would be returned by truck to the quarried area.

All material retained in the dust collection systems would be returned to the appropriate stages of the quicklime process; no disposal off site would be required. Dust collected at the crusher station would be fed onto the crusher station discharge conveyor, while dust from the milling circuit would be fed to the dry storage bin. Dust from the preheater, beneficiation plant and calciner would be directed back to the calciner. All conveyors in the plant area would be sealed to prevent dust generation.

4.10.3 WASTEWATER

The quicklime process does not produce a wastewater stream. Cooling waters from the crushing, milling, beneficiation and calcining facilities would be directed to an impermeable pond for recirculation.

Wastewater from ablution/sanitary sources would be directed to a biological waste treatment system.

Runoff from impervious surfaces would be directed to a central soak, via a network of shallow 'V' drains adjacent to roadways.

4.11 PRODUCT TRANSPORT

Quicklime would be transported in B-trains and other bulk tankers, all of which are already in common use throughout Western Australia. The B-trains would have a double assembly of two trailers, with a combined length (including the prime-mover) of 19.4 m. The total payload capacity would be 39.5 t, while the gross weight of a loaded B-train would be 59 t.

The frequency of load-outs from the plant would depend on market demands; however, based on a 6-day week, it is expected that approximately sixty vehicle movements per day would be required. Quicklime would be transported direct to consumers, including approximately 18,000 t/a to Swan's Rivervale operation.

The main roads that would be used for product transport within the metropolitan area include sections of Wanneroo Road, Gnangara Road, Beechboro Road, Tonkin Highway, Roe Highway, Great Northern Highway, Leach Highway and Stock Road–Rockingham Road.

The main roads to be used outside the metropolitan area include sections of the Brand Highway, Great Eastern Highway, Albany Highway and the South Western Highway.

Details of transport routes between the plant site and Wanneroo Road are provided in Section 6.2.1.

4.12 WORKFORCE REQUIREMENTS

The construction phase would require a workforce of 120-150 personnel.

It is expected that a workforce of between nine and eleven personnel would be required for quarrying operations: possibly one supervisor, two dozer operators, two front-end loader operators and four to six truck drivers.

The operation of the quicklime plant would require a workforce of approximately twenty to twenty-five personnel, who would be engaged in processing, transportation, maintenance, administrative and miscellaneous duties.

The construction and operation workforces would be recruited from the Perth metropolitan area.

4.13 PROJECT SCHEDULE

Construction is scheduled to commence in the third or final quarter of 1991, with commissioning scheduled for the final quarter of 1992. Quarrying to supply limestone to the quicklime plant is expected to commence by the third quarter of 1992.

Section Five

EXISTING ENVIRONMENT

5.1 PHYSICAL ENVIRONMENT

5.1.1 CLIMATE

The relative proximity of Nowergup to the Perth meteorological station and the similar distance from the coast of each location suggest that climatic conditions at Nowergup and Perth would be comparable.

Perth and Nowergup are characterized by a Mediterranean climate, with hot dry summers and mild wet winters. Average annual rainfall is about 870 mm, 80% of which occurs between May and September (inclusive). The mean annual evaporation is about 1,800 mm.

Wind roses for Perth are provided in Figure 5.1. Prevailing wind patterns in winter are variable with occasional strong westerly gales; whereas in summer, morning easterlies are generally followed by strong south-westerly sea breezes.

5.1.2 TOPOGRAPHY

The topography of the Wesco Road leases is characterized by a north–south oriented ridge, which rises to 90 m Australian Height Datum (AHD). Westwards from the ridge, the topography slopes to below 60 m AHD. Eastwards from the ridge, a distinct scarp is evident, where the topography drops to an elevation below 50 m AHD.

The proposed plant site is relatively flat, and slopes gently toward the north-west. The average elevation of the site is 65 m AHD. The plant site is bounded to the south-west, south and east by limestone ridges.

5.1.3 SOILS

The lease area consists of coastal Tamala Limestone, which was formed by cementation of aeolian sediments. Tamala Limestone is a granular porous stone composed mainly of particles of quartz, a trace of feldspar, and shell fragments with discrete silica sand grains, cemented in calcium carbonate. The sediments originally accumulated on the sea bed, but with changes in the sea level they became unconsolidated dunes which were eventually stabilized by vegetation. Dissolution and redeposition of the calcium carbonate have subsequently cemented the constituent grains together, giving the limestone its present characteristics. Caprock of relatively hard secondary limestone has formed on the

surface after prolonged exposure, effectively masking the character of the underlying stone.

There is little large-scale dissection of the limestone, but weathering has produced a severely cavitated surface, with solution pipes often extending to 5 m below ground level. These solution pipes are now infilled with silica sand and vegetable matter. Unconsolidated silica sand (Cottesloe soil association) constitutes overburden on the limestone, with deep pockets of overburden infilling depressions along the ridge and on the lower levels of these former dunes. A thin layer of grey-yellow sand overlies much of the limestone within the lease area.

The Wesco Road leases contain large quantities of commercial grade limestone (i.e. average calcium carbonate content >81.6%). As indicated in Section 3.2.1, proven resources of high grade limestone occur in only three places between Lancelin and Bunbury; almost all of these resources are not available or generally not suitable for use for a range of reasons. Therefore, the high grade limestone present in the Wesco Road leases is a valuable resource within relative proximity to Perth, making the quicklime project feasible at this location.

5.1.4 HYDROGEOLOGY

The Tamala Limestone is underlain by an unconfined aquifer, the depth of which is partly a function of the local topography (i.e. the water-table rises below hills and falls under valleys). The water-table itself has a natural gradient and lies between 24 m and 32 m AHD. The unconfined aquifer overlies the Yarragadee Formation which occurs at a depth of 300 m.

The general direction of groundwater flow, as indicated in the Perth Urban Water Balance Study (Water Authority 1987), is from east to west. Lake Pinjar, located to the east, acts as a compensation basin for high water levels and effectively fixes the maximum groundwater levels at its surface elevation, approximately 55 m AHD.

The water-table fluctuates in response to a dynamic equilibrium established between the various hydrological processes comprising recharge, discharge and storage. In general, the greatest recharge occurs during winter when the rate of recharge exceeds the rate of discharge, causing an increase to groundwater storage (i.e. rise in the water-table). Conversely, there is little recharge during the summer months and the ongoing groundwater discharges result in a lowering of the water-table. In the vicinity of the lease area, the depth to the water-table somewhat attenuates these phenomena, and the variations in water-table level are likely to be less than the regional average (probably around 1 m).

Recharge rates over the limestone outcrop are high, probably in excess of 30% of the average annual rainfall. The rainfall not recharged to groundwater is lost to evapotranspirative processes. Surface runoff is negligible. Evapotranspirative losses include interception of rainfall on leaves and subsequent evaporation, and temporary water storage as soil moisture and subsequent evapotranspiration.

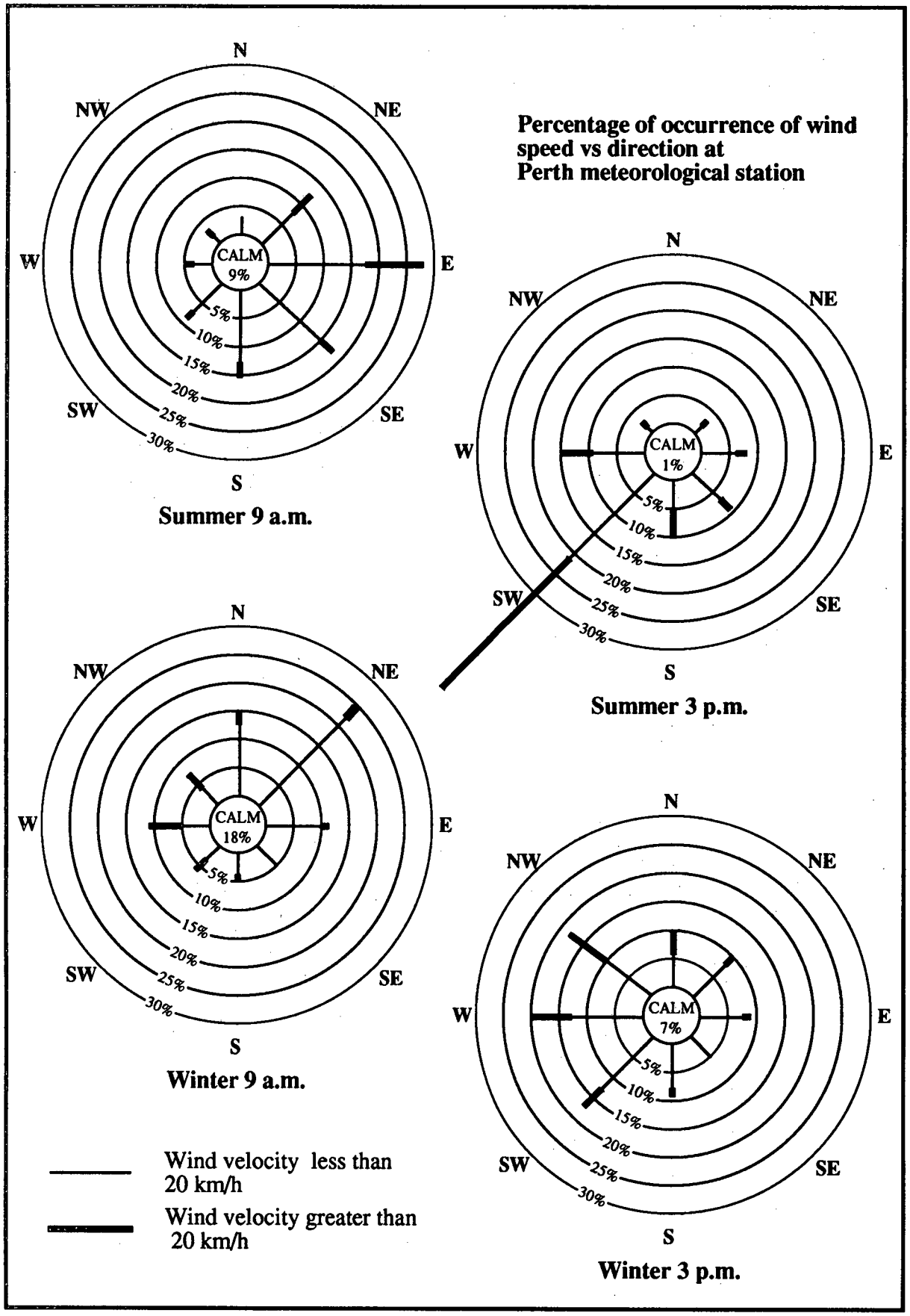


Figure 5.1
WIND ROSES FOR PERTH
Source: Bureau of Meteorology

Interception losses account for the largest proportion of water loss from small rainfall events where there is dense vegetation cover and few open soil areas. After sufficient rain falls to saturate the vegetation, additional rainfall contributes to soil recharge. The calcareous soils and outcropping limestone are highly permeable and readily accept infiltration.

Direct infiltration and infiltration of locally ponded rainfall are the major recharge processes. The infiltrating water moves preferentially along root channels and fractures, which may be enlarged by solution, and also by interstitial flow. The greatest rate of recharge is likely to occur along these solution pipes, particularly where they are connected to a surface depression which collects surface water. Although the rate of recharge infiltration by interstitial flow is less, it is still relatively high because of the high permeability of the bulk limestone.

There are two chains of wetlands in the area: the Wanneroo wetland chain (to the west), including Loch McNess and Nowergup Lake, and the Spearwood/Bassendean Dune wetlands (to the east), including Lake Pinjar. The Wanneroo wetlands are elongated, steep-sided lakes with surface recharge, and they may have associated local perched water-tables. The interdunal wetlands are surface expressions of the groundwater levels.

5.1.5 WATER AVAILABILITY TO VEGETATION

The major limitation to vegetation growth and survival within the Wesco Road leases is likely to be water availability over summer, although other factors including nutrition and exposure to wind are also significant. Both the overlying sand and the limestone have very low water-holding capacity, with little plant-available water. Current operations in the Wesco lease have indicated an average water content in quarried limestone of 4-5% in summer and 6% in winter.

As summer rainfall at the site is low (<100 mm over the three summer months), vegetation must rely on:

- root penetration of some 40 m to the permanent water-table or to the capillary fringe above the water-table. Even in fine-grained sediments, the height of this capillary fringe rise is less than 3 m (Ward 1975); and/or

- utilization of the relatively small amount of water retained in the soil/limestone from periodic wetting fronts moving through the limestone from rainfall events.

Because of the dense nature of the vegetation within the lease area, it is likely that each plant has a very limited lateral root spread, and therefore a limited capacity to draw water from a wide area. Each plant could therefore explore and draw water from a relatively narrow but potentially long vertical cylinder of soil, which may extend to the water-table. Deep-rooted species could expand the root exploration volume at depth compared to shallow-rooted species. Existing vegetation immediately adjacent to the face of a number of disused quarries in the area appears healthy and largely unaffected by past quarrying operations.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 VEGETATION AND FLORA

Botanical surveys

Two botanical surveys have been conducted within the Wesco Road leases: the first in May 1990 (Froend 1990) and the second in July-August 1990 (Froend and van der Moezel 1990). The results of the May and July-August surveys are presented in Appendix B and Appendix C, respectively.

The objective of the first survey was to identify and locate any rare species present in the northern section of the Wesco lease. Eighteen sites were sampled; each site was oriented on a 50 m x 100 m grid, and the presence and relative abundance of species in a 20 m radius were recorded. A total of eighty species were recorded.

The July-August 1990 survey covered all of the Wesco Road leases. The objectives of this survey were to determine which species were present and to identify and locate any rare or otherwise significant flora. A total of 108 sites were sampled. Sampling was performed at each intercept of a 200 m grid; at each site, plants within a 50 m radius were identified. A total of 110 species were recorded.

Vegetation

The vegetation of the Wesco Road leases consists of dense shrubland (1-2 m in height), with scattered small populations of emergent eucalypts (2-10 m in height). The predominant larger plants include various species of *Acacia, Allocasuarina, Calothamnus, Dryandra, Grevillea, Hakea, Hibbertia, Leucopogon, Melaleuca and Xanthorrhoea.* The deeper sands over limestone along the eastern boundary of the leases and the south-western section of the Wesco North lease contain banksia open woodlands and marri *(Eucalyptus calophylla)* woodlands.

Gazetted rare species

One gazetted rare species—*Eucalyptus 'argutifolia'*—was recorded (Grayling and Brooker, in press). *E. 'argutifolia'* is currently listed as a declared rare species under the name *Eucalyptus* sp. *'yanchep'*.

Presently DRF

Significance of E. 'argutifolia'

E. 'argutifolia' is a small mallee, endemic to Western Australia and known only to occur in ten populations between Wanneroo and Wilbinga Peak (12 km north of Yanchep National Park). Outliers occur in the Hill River area near Jurien and another near Seabird (although the identification of the latter population has not yet been confirmed). The Wilbinga Peak population is estimated to comprise two to three plants, with another population of similar size present at Wabling Hill, 600 m to the south-west of Wilbinga Peak. Four populations occur near Parrot Ridge; the two on the eastern side of Parrot Ridge consist of about forty plants collectively, the population on the north-western side of Parrot Ridge comprises about twenty-five plants, while on the south-west side there are about ten plants.

E. 'argutifolia' is generally found on the steeply sloping sides of limestone ridges and breakaways in shallow pockets of soil over jagged, eroded limestone. These ridges rise abruptly from the surrounding plains, and the shrub vegetation found on their slopes is distinct from the banksia–jarrah woodlands of the plains. Within the Wesco Road leases, most populations are located on the eastern sides of limestone ridges and towards the eastern extremities of the commercially viable quarrying areas. The species is therefore restricted to a highly specific ecological environment.

The locations of the *E. 'argutifolia'* populations within the leases have been mapped, and the Department of Conservation and Land Management (CALM) has been given this information. Four populations are present: Population A consists of about four plants, Population B comprises forty plants, Population C has about thirty plants in scattered subpopulations, and Population D comprises about thirty-five plants. The presence of *E.'argutifolia'* within the Pinjar lease (Population D) represents the southernmost known distribution of the plant.

As a result of the discovery of *E. 'argutifolia'* within the Wesco Road leases, a further survey was conducted to identify any other populations of *E. 'argutifolia'* in the area around the leases. This survey restricted its search area to the species' known natural habitat: limestone ridges or hills. In addition, vegetation types and species associations were used as indicators of likely *E. 'argutifolia'* habitats.

No other populations of *E. 'argutifolia'* were found; however, it was concluded that further survey work may locate other populations towards the northern part of the species' range. The presence of *E. 'argutifolia'* populations south of the Wesco Road leases is considered unlikely, because the areas of limestone ridges, particularly to the west of Wanneroo Road, have been cleared for urban development.

Morphological differences are apparent within and between the populations of *E. 'argutifolia'*. Fertility also appears to vary between the populations, with some (including plants within the population immediately south of Wesco Road) producing fruit without viable seed, and some possibly incapable of fruiting (P. Grayling, Department of Botany, University of Western Australia, pers. comm., August 1990).

The mallee habit of eucalypts results from lignotuber (swollen stem base) formation, from which multiple stems may arise. As the lignotuber grows and the plant 'spreads', some areas may die off, giving rise to separate but genetically identical plants; these are distinct from plants originating from seedlings—the normal method of reproduction in eucalypts—which are likely to differ genetically. Within the populations of *E. 'argutifolia'*, it is currently unclear how many separate plants exist, and how many arise from multi-stemmed lignotubers of single plants. Apart from physical excavation, this question could only be resolved by identifying the genetic content of each stem and each population.

The level of genetic diversity present in the populations of *E. 'argutifolia'* is of importance in determining the current developmental stage of the species and may be important for long-term species' survival. Because of the apparent differences in morphology within and between different populations, each plant and each population

may represent a unique gene pool for the species. If so, the genetic diversity represented by each plant or population of plants may be of importance in the continued development of the species, or in future survival. Furthermore, as some plants appear to be sterile (not uncommon in small, inbred populations), a gene pool external to those individuals or populations unable to successfully self-pollinate may be vital to the species' survival, because survival of sterile plants will be limited to the current generation.

Priority species

In addition to the gazetted rare species *(E. 'argutifolia')*, several species on CALM's Priority Species List (previously known as the Reserve Species List) were identified within the Wesco Road leases. These include:

Eucalyptus 'petrensis': Priority 3—Species that are known from several localities, some of which are on lands not under immediate threat. These species are under consideration for declaration as rare flora but are in need of further survey.

- *Eucalyptus foecunda:* Priority 5—Species that are considered to have been adequately surveyed and not endangered or in need of special protection, but could be if present circumstances changed. Priority 5 includes taxa that are vulnerable to disease or disturbance, or that have restricted geographical ranges. These species are usually represented on reserves.

Another species *(Conostylis pauciflora)* found within the leases has been identified by the Western Australian Herbarium as the common northern form, and not the 'Hacienda' form on CALM's Priority 5 list. A further species tentatively identified as the listed species *Jacksonia sericea* in Appendix B has since been identified by the Herbarium as *J. stricta.*

As with the *E. 'argutifolia'* populations, the locations of priority listed species within the leases have been mapped and made known to CALM.

5.2.2 FAUNA

The Division of Natural Science of the Western Australian Museum provided a computer listing of species of mammals and herpetofauna recorded within the area between Parrot Ridge in the north, Wanneroo township in the south, Lake Pinjar in the east and the intersection of Bernard Road South and Wanneroo Road in the west. The species recorded within the search area, including ten mammal species and forty-two herpetofauna species, are listed in Appendix D.

The species listing does not necessarily represent a comprehensive list of all fauna present within the Wesco Road leases; however, it does represent what has been recorded in the general region of the leases.

Only two species (*Macropus fuliginosus* and *Menetia greyii*) were recorded in close proximity to the lease area.

Of the species in Appendix D, only one is rare or declared likely to become extinct. Museum records show that the southern brown bandicoot (*Isoodon obesulus*) has been recorded twice (once in 1967 and again in 1977) approximately 6 km south of the southern extremity of the leases. A faunal study of the northern Swan Coastal Plain recorded the two specimens in dense *Melaleuca* and *Kunzea ericifolia* shrubland over low heath and sedgeland—a habitat not found in the lease area (Western Australian Museum 1978). Therefore, it is considered unlikely that the southern brown bandicoot occurs in the lease area.

The 1978 study also identified 223 species of birds which have occurred, or are known to occur, in that region. Some of these birds would occur within the leases, while others would possibly be seasonal visitors.

5.3 HUMAN ENVIRONMENT

5.3.1 ZONING

Under the Metropolitan Region Scheme, a portion of the Wesco North lease is zoned State Forest; the remainder of the Wesco Road leases, comprising Crown and private land (Lot 7), is zoned rural. Land to the west and south of the leases is zoned rural; land to the north-east is zoned State Forest.

Under the provisions of the Wanneroo Town Planning Scheme No. 1, the Wesco Road leases are zoned rural, with a minimum 20 ha subdivision development control standard.

5.3.2 LAND USE

The Wesco Road leases are presently unoccupied and largely undeveloped, except for a limestone quarry being worked by Swan in the Wesco lease. Quarrying in this lease was carried out intermittently during the late 1960s and 1970s. Up until 1977, quarrying was also undertaken in the Pinjar lease, to comply with the requirements of the special Crown leases then in force. The southern portion of the Pinjar lease contains a 3,600 m^2 Trigonometric Reserve (Reserve No. 11930) used for surveying purposes. This reserve has been excised from the lease.

Adjoining the south-west and north-west sides of the Wesco Road leases are large rural properties (50-100 ha). Along Gibbs Road, property sizes decrease to 10-20 ha, with a diverse range of land uses including market gardening, quail farming and hobby farming. There is one dwelling on Wesco Road, located 1.3 km from the proposed plant site. This dwelling is associated with a market garden on a 50 ha lot. State Forest No. 65 lies to the east and north-east of the Wesco Road leases. To the south-east is the Wanneroo Park Racing Circuit. Figure 5.2 shows residences and land uses in the populated area immediately west of the Wesco Road leases.

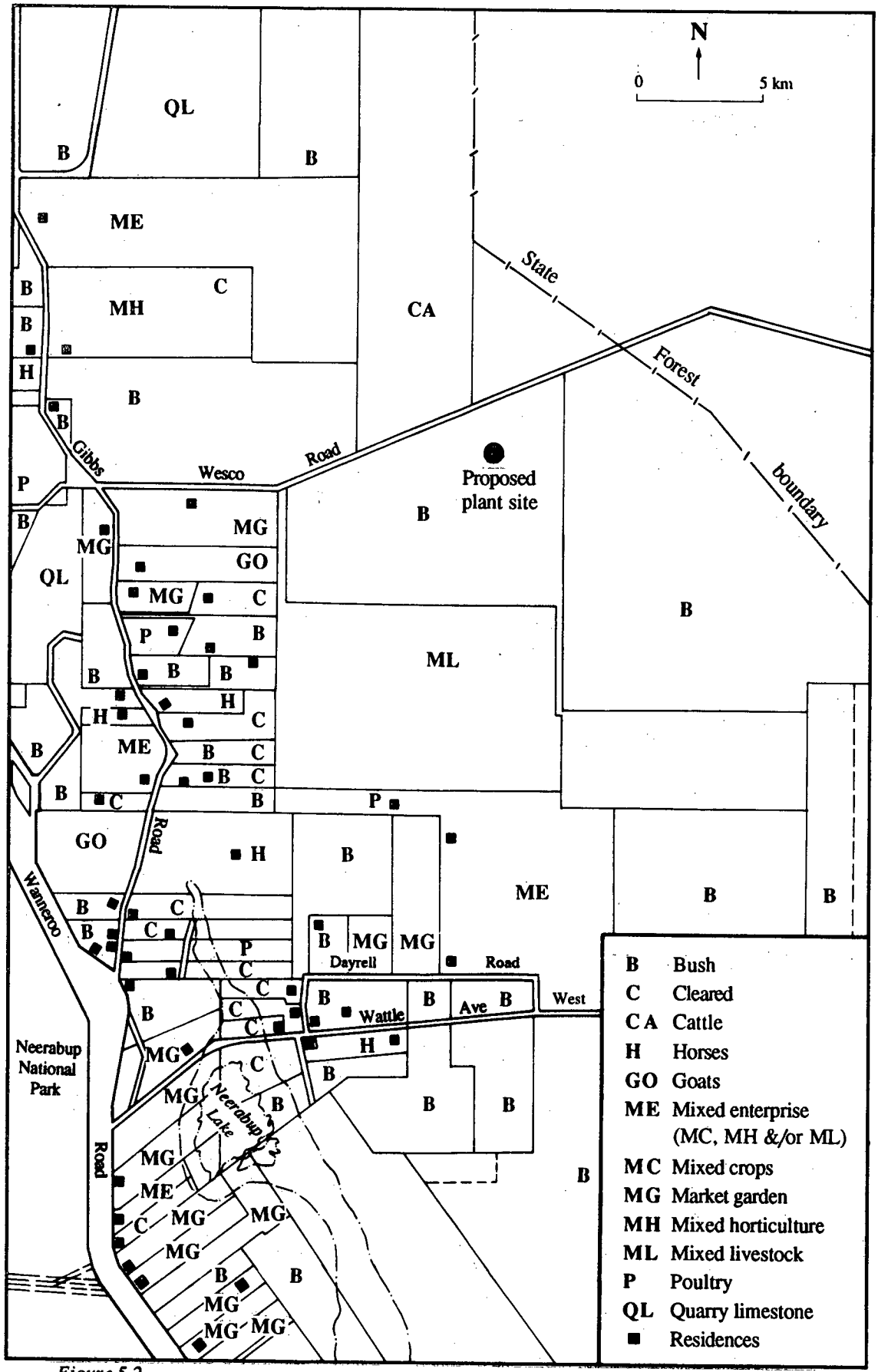


Figure 5.2

RESIDENCES AND LAND USES SURROUNDING THE WESCO ROAD LEASES

5.3.3 ABORIGINAL HERITAGE

As recommended by the Department of Aboriginal Sites of the Western Australian Museum, an archaeological and ethnographic survey for Aboriginal sites within the Wesco Road leases was conducted (McDonald, Hales and Associates 1990).

The Department of Aboriginal Sites has no record of the presence of Aboriginal sites of significance or archaeological artefacts within the lease area. However, an archaeological site (Murrays Cave S00159) was recorded as being located near the southern boundary of the Pinjar lease. A detailed examination has since ascertained that this site is in fact located further west near Orchestra Shell Cave, which is 2.5 km to the west-south-west of the Pinjar lease.

The ethnographic survey identified four Nyungars who had knowledge of, and associations with, the lease area, and who were entitled to speak for the area. All four were interviewed, while two participated in site inspections. The interviews and site inspections with the Nyungars did not identify any sites of religious/spiritual or other ethnographic significance within the lease area.

It was concluded that no archaeological or ethnographic sites of significance, as defined by Section 5 of the *Aboriginal Heritage Act, 1972*, occur within the Wesco Road leases.

5.3.4 INFRASTRUCTURE SERVICES

Roads

Access to the proposed plant site from Perth is currently via either Pinjar Road and Flynn Drive, or Gibbs Road. The City of Wanneroo has plans to extend Wesco Road between Gibbs Road and Wanneroo Road (Section 6.2.1).

Water and sewerage

The plant site is neither serviced with metropolitan scheme water nor connected to deep sewerage. Groundwater resources are available, while the nearest deep sewerage is located near Quinns Rock township, 6 km to the south-west.

Power

An existing 22 kV SECWA power grid extends along Wesco Road.

Natural gas

The plant site is not connected to the SECWA natural gas grid; however, natural gas is available to be piped from the Pinjar gas turbine station.

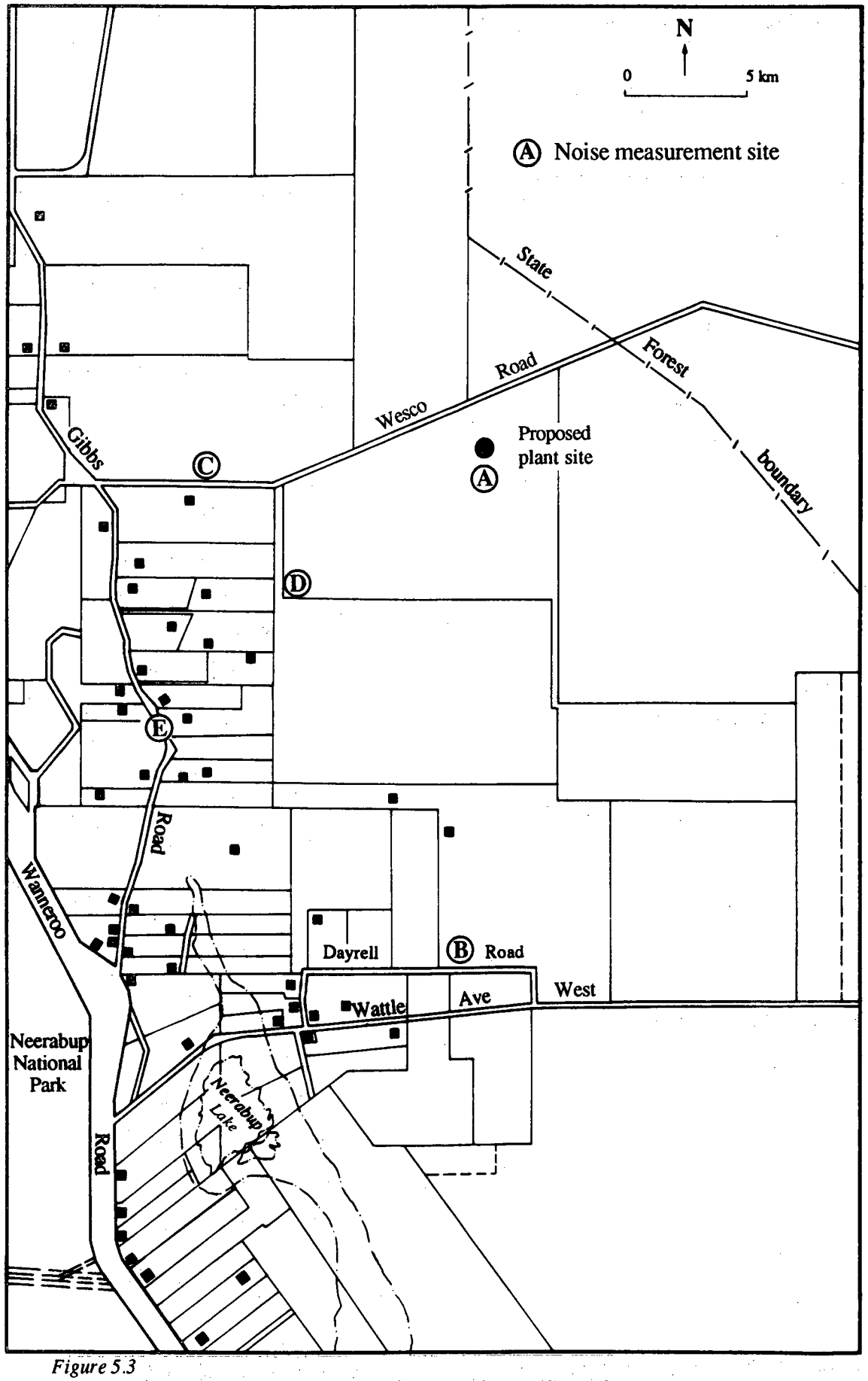


Figure 5.3

BACKGROUND NOISE MEASUREMENT SITES

5.3.5 SOCIO-ECONOMIC BACKGROUND

Demographic profile

The Wesco Road leases are located within one of Perth's fastest growing local government areas. Table 5.1 indicates that the total population in the City of Wanneroo increased by an annual average of 7.4% between 1986 and 1989.

Table 5.1 **Total population: City of Wanneroo**

Year	1986	1987	1988	1989
Population	133,924	142,191	151,930	163,722

Source: Australian Bureau of Statistics 1990.

The City of Wanneroo has a relatively youthful population compared with the State average.

Economic profile

The Wanneroo region has always had a mixed basis of economic activity. Historically, the area has relied on market gardening as an employment and income generator; however, in more recent years, the economy has diversified. In the southern section of the municipality, residential development and light industry have expanded significantly in the last 15 years.

The North Ward of Wanneroo, which contains the Wesco Road leases, supports a diverse range of predominantly agricultural land uses.

5.3.6 NOISE

A survey of the background noise levels at the proposed plant site and at various locations in surrounding areas has been undertaken (Sound and Vibration Technology Pty Ltd 1991). Background noise measurements were recorded on 20 December 1990 between 3.30 p.m. and 7 p.m. and again on 31 December 1990 between 4 a.m. and 6.15 a.m. The locations where noise measurements were taken are shown in Figure 5.3.

Table 5.2 presents the results of the noise measurements, together with comments on the sources of noise.

The background noise levels recorded at the plant site were approximately 46 dB(A) during the day (3.30 p.m.) and approximately 26 dB(A) early in the morning (4 a.m.). Background noise levels at locations on Wesco Road, Gibbs Road and Dayrell Road were between approximately 33 dB(A) and 46 dB(A) during the day (4.30-7 p.m.) and between approximately 25 dB(A) and 33 dB(A) early in the morning (4.40-6.15 a.m.). Noise sources were mostly attributed to existing quarrying operations, distant traffic, farming activities and bird calls.

Table 5.2 **Background noise measurements**

Location (refer Figure 5.3)	Time	Wind speed (m/sec)	L5*	L10*	L50*	L90*	L95*	L_{eq}**	Comments
			dB(A)						
20/12/90 (p.m.)									
A	3.30	0-1	51.0	49.8	45.5	40.2	34.4	46.5	Bulldozer and front-end loader operating in adjacent quarry.
B	4.30	0.3-0.5	41.8	39.4	32.7	30.9	30.5	37.8	Bird calls. Traffic noise. Dozer engine noise.
C	5.00	Calm	37.3	36.4	31.9	29.6	29.2	33.3	Bulldozer operating. Bird calls.
D	6.15	0-0.8	47.8	44.5	39.2	38.0	37.6	42.3	Bore running. Many domestic bird calls. People talking and tractor starting and driving.
E	7.00	0-0.5	49.4	47.5	45.3	43.4	42.7	46.0	Bore and sprinkler noise. Tractor noise. Bird calls.
31/12/90 (a.m.)									
A	4.00	0-0.6	29.2	28.3	25.7	24.1	24.0	26.1	Machinery noise (pump?). Traffic and bird calls.
B	4.40	0-0.3	31.7	30.8	28.1	26.8	26.6	28.8	Many bird calls.
C	5.15	Calm	34.8	33.4	26.5	23.2	22.9	29.4	Many bird calls.
D	5.50	Calm	30.1	29.2	22.5	21.9	21.8	25.4	Traffic noise. Bird calls.
E	6.15	Calm	39.4	35.0	31.7	30.5	30.4	33.4	Many bird calls. Traffic and low level pump noise.

* *Noise level that is exceeded 5% (10%, 50%, 90%, 95%) of the time.*
** L_{eq} *= equivalent continuous sound level.*

6 ENVIRONMENTAL IMPACTS AND MANAGEMENT

6.1 CONSTRUCTION OF THE QUICKLIME PLANT

6.1.1 SOCIAL IMPACTS

Due to the scale and location of the proposed project, social impacts would be restricted to the local neighbourhood. During construction, these impacts are likely to be related to employment, transport systems, noise and dust.

Employment

The 12-month construction phase would provide employment for 120-150 people. Because these future employees are expected to come from the Perth metropolitan area, the construction phase would not place significant additional demands on existing local community infrastructure.

Transport systems

There would be two main sources of increased traffic during the construction phase: workforce (commuting) vehicles and construction-related delivery vehicles. Construction workforce commuting could result in a maximum of 300 vehicle movements per day. Construction-related deliveries (utilizing a combination of heavy and light trucks) could result in approximately thirty additional vehicle movements per day.

The majority of construction-related vehicles are expected to come from Perth and could use either Pinjar Road and Flynn Drive, or Gibbs Road. The use of Pinjar Road and Flynn Drive by the workforce and for other construction purposes would be preferred as it would avoid problems associated with the use of Gibbs Road; however, most of the construction-related traffic would use the Gibbs Road route because of its shorter distance and the reduced travelling time. Although Gibbs Road was not originally designed for heavy vehicles, the road geometry has been modified to cater for both heavy vehicles and school buses. The use of Gibbs Road would cease when Wesco Road was extended to meet Wanneroo Road (Section 6.2.1.)

Swan would actively encourage its employees and contractors to drive safely in the area of the plant and quarry in order to minimize the risk of traffic accidents.

Noise

Noise emissions during construction activities, which would take place only during daylight hours, would be intermittent. In Western Australia, allowable community noise levels are set out in the Noise Abatement (Neighbourhood Annoyance) Regulations, 1979, as amended by the *Environmental Protection Act, 1986*. During construction of the plant, noise levels would comply with these regulations and with the requirements of the *Occupational Health, Safety and Welfare Act, 1984* in relation to the safety and welfare of the workforce.

All construction machinery would be fitted with appropriate noise suppression devices. Construction noise levels would comply with the requirements of the Department of Occupational Health, Safety and Welfare. In addition, noise levels would comply with the allowable community noise levels as set out in the Noise Abatement (Neighbourhood Annoyance) Regulations, 1979.

Dust

Dust generation would be limited to areas of site preparation involving earthworks. **Dust suppression measures, including application of water from tankers, would minimize dust generation during site preparation and construction activities.**

6.1.2 BIOTA

Construction would be restricted to the 4 ha (200 m x 200 m) plant site, the only exceptions being the formation of the main access road and the haul road between the quarry areas and the plant site dump pad.

Where practicable, native vegetation would be retained during site clearing operations within the plant site. The vegetated non-quarry areas beyond the plant site would also be retained; however, 3 m wide fire-breaks would be established around the plant site fenceline.

Site preparation and construction of the quicklime plant and associated facilities would affect about half of the native vegetation inside the plant site. Additional vegetation would be affected during the construction of the main access road and the haul road. **Where practicable, vegetation and topsoil cleared during the construction phase would be used in the rehabilitation of disturbed areas within the plant site and the quarry.**

The vegetation that would be cleared for the construction of the plant is not unique and does not have significant conservation value.

6.2 OPERATION OF THE QUICKLIME PLANT

6.2.1 SOCIAL IMPACTS

During the operation phase, impacts upon the human environment are likely to be related to transport systems, noise, dust and the visual landscape. Impacts of the project workforce on local community infrastructure would be minimal. The permanent workforce would consist of twenty to twenty-five personnel, all of whom are expected to commute from the Perth metropolitan area.

Transport systems

Under current operations, limestone from the Wesco lease is transported along Wesco Road and Gibbs Road en route to Swan's Rivervale site, where it is needed for cement and lime manufacture. **Once the quicklime plant became operational, limestone for lime manufacture would no longer be required at Rivervale; therefore, no further use of Gibbs Road to transport limestone to Rivervale for this purpose would be necessary.**

During the operation phase, the main sources of traffic would be workforce commuting vehicles, product transport, and incidental goods delivery. In comparison with the construction phase, workforce commuting trips would be reduced, with an estimated sixty to seventy vehicle movements per day. Incidental goods delivery (utilizing light trucks) would also be minimal, with an estimated maximum six to eight vehicle movements per day. A total of sixty vehicle movements per day (thirty departures, thirty arrivals) would be required for the transport of quicklime to the various markets.

Quicklime would be transported to users in B-trains or other bulk tankers, which have a proven safety record for the transportation of quicklime. The nature of the contents of these vehicles should not pose any significant environmental threat in the event of an accident. In addition, because B-trains are enclosed vehicles, the risk of dust blowing from them during transport is eliminated.

As indicated in Section 3.6.2, the preferred transport option is the use of Gibbs Road; however, as a result of local residents' concerns over the potential for increased traffic flow on Gibbs Road, this route would not be used (Section 8). These concerns were initially raised at a meeting at the City of Wanneroo in May 1989. One of the resolutions of that meeting was the need to proceed with the planned extension of Wesco Road westward to meet Wanneroo Road. Details of this extension are outlined in a preliminary design study of East West Road No. 10 commissioned by the City of Wanneroo (Sinclair Knight & Partners 1989). The route of the planned extension is shown in Figure 3.1. The City of Wanneroo has also indicated a need to discuss possible funding assistance for this extension with operators and potential operators of quarries in the area. Swan has expressed its preparedness to assist with funding; however, to date, no further progress has been made by the City of Wanneroo in relation to a commitment to establish the extension.

Swan proposes to transport quicklime along the planned extension of Wesco Road to Wanneroo Road, thus avoiding Gibbs Road. However, until the Wesco Road extension is constructed, Swan is prepared, in the short term, to use Pinjar Road and Flynn Drive. This interim route would involve an additional 17 km round trip and would significantly add to the operating costs of the project. The route passes through State Forest and rural areas and runs adjacent to the Wanneroo Golf Course and a light industrial area; no residential areas are involved. Both Pinjar Road and Flynn Drive are capable of accommodating the additional number of vehicle movements without significant effects on existing traffic flows and safety levels.

Although the use of Gibbs Road is preferred, quicklime would be transported from the plant via the planned extension of Wesco Road. In the short term, and until the extension has been constructed, Swan is prepared to use Pinjar Road and Flynn Drive for the transportation of quicklime.

Transport of limestone within the lease area would be along private roads. **Prior to the development of the North Wesco lease, negotiations would be held with the City of Wanneroo concerning possible temporary diversion of Wesco Road and other measures to avoid conflict with public road users.**

Noise

An assessment of noise level predictions from the quicklime plant and quarrying operations was undertaken (Sound and Vibration Technology Pty Ltd 1991); however, the assessment did not separate plant-source noise from quarry-source noise. For this reason, the impact of noise from the quicklime plant is incorporated with the impact of noise from the quarry operations. The results of the noise modelling predictions are presented in Section 6.3.6.

Dust

Dust emissions from plant operations would be negligible. **Measures to be implemented at the quicklime plant to prevent dust generation would include the installation of mist water sprays and dust collection units, covering of conveyors and limestone stockpiles, sealing of internal roads, and retention of vegetation (where practicable) within the plant site.**

The plant site would be landscaped with native trees and shrubs to help reduce dust generation and provide a visual screen from Wesco Road.

Visual landscape

The operation of the quicklime plant would affect the visual landscape in two ways: the plant itself and production lighting required for night operation.

The plant site is separated from residences on Gibbs Road by a significant north–south oriented ridge. The average elevation of the plant site is 65 m AHD. The most

prominent component of the plant would be the calciner; this would be 65 m high (127 m AHD), which is the equivalent height of a 17-storey building. Given the ridge height of 92 m AHD and a slope westwards of approximately 10% from the ridge to a height of 25 m AHD at Gibbs Road, it is expected that only the very top portion of the calciner would be visible to local residents.

Landscaping would include the establishment of native trees and shrubs around the plant site and between the plant and Wesco Road. The objectives of landscaping would be to provide a visual screen and to ensure an attractive working environment for Swan's employees. Landscaping would also help prevent dust generation.

Lighting would be provided at approximately 15 m above the ground, as well as fitted on the sides of the calciner. **All external lighting would be screened and would be directed inwards to minimize interference with residents.** Fluorescent tubes would be used throughout. In addition, aviation authorities may require some form of hazard lighting on the calciner because of its height. A soft glow would emanate from the plant.

6.2.2 GROUNDWATER

Public and private water supplies for the Wanneroo area are drawn from the substantial groundwater resources in the region. The groundwater resources of the superficial formations near the plant site are heavily committed for environmental and water supply purposes. The Wanneroo Groundwater Area allocation for private purposes (15×10^6 m^3/a north of Flynn Drive [Dames & Moore 1986]) has been almost entirely assigned to horticultural users. However, groundwater supplies for the quicklime plant would not be obtained from the shallow superficial formations, but from the deeper Yarragadee Formation which is located at a depth of about 300 m.

Land used for horticulture requires, on average, 15,000 kL/ha/a of water for irrigation. Based on a growing period of 43 weeks, the average daily irrigation rate is 50 kL/ha (Department of Agriculture, pers. comm., 1991). The volume of water required by the quicklime plant is 200-500 kL/d, which is equivalent to the water requirement of 4-10 ha of irrigated horticultural land. Therefore, when compared with other land uses in the area, the water requirements of the plant are relatively minor.

Any production bores established in or near the plant site would be located within the Wanneroo Groundwater Area and, as such, would require a licence from the Water Authority. Such a licence would include conditions to ensure that abstraction at the rates specified would have no cumulative effect on the local and regional groundwater system and would not damage local wetlands.

Swan would undertake an examination of practical means of reducing the demand for water through recycling and improvements in process technology.

6.2.3 ATMOSPHERIC EMISSIONS

The quicklime process produces waste gas, in which the primary substance of concern is particulate matter. As with all combustion processes, nitric oxide and nitrogen dioxide are produced, although using natural gas as the fuel would reduce the volume of these by-products. Other products of combustion are water vapour, which may under cool conditions cause a visible plume of steam as it condenses, and carbon dioxide.

Movement of the plume

The temperature of the stack gas is expected to average 122°C, approximately 100°C greater than the average air temperature at the site. As the density of this hot gas would be approximately two-thirds that of the ambient air, the plume would normally rise through the atmosphere until, by radiation and dispersion, it had cooled sufficiently to occur the same density as the surrounding air. This would normally occur at approximately 400-500 m above ground level. However, this behaviour and the subsequent movement, dispersion and ground level contact of the plume are subject to very great variability. Approximations of the concentration distribution can be calculated by use of models for the dispersion processes. This is not considered warranted in the present instance, because of the low concentration of nitrogen oxides in the output waste gas.

Particulates

An electrostatic precipitator would be installed to ensure the levels of suspended particulates from the quicklime plant were below the limit of 100 mg/Nm^3 recommended by the National Health and Medical Research Council (1979). The particulates are expected to be predominantly limestone, slaked lime and quicklime, with a small proportion of silica. The height of the waste gas stack, from which particulates would originate, would extend 5 m above the calciner.

Nitrogen oxides

The emission concentration of nitrogen oxides, expressed as NO_2, is expected to be 100 mg/Nm^3, which would be well below the maximum allowable emission concentration of 1,300 mg/Nm^3 (24-hour average) recommended by the Advisory Committee on Air Quality. The low concentration, compared with that from coal-burning furnaces, is a consequence of the almost total absence of combined nitrogen compounds in the natural gas.

Carbon dioxide

Approximately 70% of the carbon dioxide in the stack emissions would originate from the calcination process, and the remainder from the combustion of natural gas.

Carbon dioxide emissions would total approximately 260,000 t/a. The proportion originating from the combustion of natural gas would increase the Western Australian emissions of carbon dioxide from fossil fuels by 0.32%; if the carbon dioxide resulting

from the calcination of limestone were also included, the Western Australian emissions of carbon dioxide from industrial processes and fossil fuels would increase by 1%.

However, the majority of the lime would, either in the short or medium term, react with atmospheric carbon dioxide to form bicarbonate:

$$CaO + 2CO_2 + H_20 \Rightarrow Ca(HCO_3)_2$$

In the medium term, this would result in a net reduction of atmospheric carbon dioxide levels by approximately 100,000 t/a.

6.2.4 SOLID RESIDUE DISPOSAL

Silica rejects would be produced during the beneficiation of limestone and would mainly be composed of silica and calcium carbonate in the proportions indicated in Section 4.10.2.

Should markets be found, silica rejects would be sold and used off site. Potential markets exist in the manufacturing, construction and landscaping/nursery industries. Should markets not be found, the rejects would be returned to the quarries. On-site disposal of the rejects would involve backhauling to the quarry from where the material originated; they would provide fill during rehabilitation. Owing to the minimal amount of available topsoil and overburden, the silica reject material would be valuable in providing a porous medium for plant growth over the base of the quarried areas during rehabilitation.

The silica rejects would be totally inert and would not contain any material that could possibly contaminate groundwater resources. Dust generation would be unlikely, owing to the particle sizes of the rejects and because topsoil and overburden material would be placed over the top of them.

Material retained in the dust collection systems would be returned to the quicklime process, thus alleviating the need for disposal off site.

Solid domestic wastes, such as office material, would be removed from site by contractors for recycling or disposal in an approved landfill site, such as Tamala Park. **All solid refuse and construction material wastes would be removed from site and disposed of in accordance with the requirements of the City of Wanneroo.**

6.2.5 LIQUID WASTES

The quicklime process does not generate wastewater; all cooling water would be delivered to an impermeable recirculation pond. The pond would be designed to prevent seepage of cooling waters. Water losses would only occur through venting of water vapour and through natural evaporation from the recirculation pond.

The biological waste treatment system for domestic effluent would be constructed and operated in accordance with the appropriate regulations of the *Health Act, 1911*, and to the satisfaction of the EPA.

There would be no bulk on-site storage of fuels, oils, lubricants, cleaning chemicals and other miscellaneous chemicals. These materials would be stored in bunded, impermeable areas, with drainage to an oil trap, to ensure containment of any spill and prevent infiltration to the groundwater.

All oil trap sludges, spent chemical/fuel/oil containers and waste lubricants would be removed from site and recycled where practicable. Where recycling was not possible, solid wastes and sludge would be disposed of in accordance with the requirements of the City of Wanneroo and the Health Department of Western Australia (Health Department).

Oil traps and impermeable bunding would be used to contain spills of fuels, oils, lubricants and chemicals. Oil trap sludges, spent containers and waste lubricants would be recycled or disposed of in accordance with the requirements of the City of Wanneroo and the Health Department.

Stormwater runoff would be directed to a central soak basin. Due to the high porosity of Tamala Limestone, stormwater would infiltrate to the water-table. The small catchment area and the absence of pollutant sources would ensure that contamination of groundwater was negligible.

6.2.6 BIOTA

The operation of the quicklime plant would have a negligible to minimal impact on flora and fauna.

The prevention of dust generation from the plant site (Section 6.2.1) would ensure that nearby flora was not affected by dust.

The impact of increased noise levels on fauna is difficult to predict; however, studies have demonstrated that fauna become adapted to changes in noise levels and are often unaffected after a period of familiarization (Ninox Wildlife Consulting 1990).

6.2.7 SAFETY AND EMERGENCY SERVICES

The health of all personnel at the quicklime plant would be safeguarded in accordance with the requirements of the Department of Occupational Health, Safety and Welfare. Personnel involved in the operation of the plant would be made aware of all safety procedures and, where necessary, issued with protective clothing and safety equipment.

The quicklime plant would be comprehensively instrumented and computer-controlled, enabling the shutting down of any section of the process which varied from its normal operating condition. All information pertinent to the safe and efficient operation of the plant would be transmitted direct to the central control room where it would be constantly under surveillance by specially trained operators.

The City of Wanneroo and State authorities would be consulted in relation to their requirements for plant fire-fighting services and equipment. Fire-fighting and warning devices (fire-extinguishers, fire-blankets, fire-detection systems, sprinkler systems, etc.) would be strategically located around the plant. The Bush Fires Board would be consulted on fire safety, particularly in relation to fire prevention and detection and in the formulation of plans to safely combat fires. Fire-breaks would be maintained on each side of the external plant fencing.

Emergency-stop pushbuttons would be fitted adjacent to the intake and discharge points of all belt conveyors, bucket elevators and screw conveyors and at all working platforms. All conveyors would have rope-operated conveyor trip switches along their entire length. Warning hooters would also be installed to forewarn of start-ups.

The plant would incorporate a wide range of safeguards such as fire protection, instrument monitoring, back-up systems and provisions for emergency shut-downs. Where appropriate, personnel involved in the operation of the quicklime plant would be issued with protective clothing and safety equipment. The City of Wanneroo and the Bush Fires Board would be consulted for advice on the prevention and suppression of fires.

6.2.8 DECOMMISSIONING

Specific details of decommissioning are yet to be formulated; such details would be developed nearer to the end of the plant life. Eventual decommissioning could involve the plant being used for other purposes, in which case another environmental study might be required; alternatively, it could be shut down and dismantled.

In the event of shut-down and dismantling, consultations would need to be held with the City of Wanneroo and the Department of Planning and Urban Development (DPUD) to determine intended future land use of the site. Decommissioning would probably involve the dismantling and removal from site of all buildings, structures, foundations, equipment, pipelines and powerlines associated with the plant. The site would then be rehabilitated to meet the requirements of the intended future land use.

The plant site would be left in an unpolluted, stable, free-draining, vegetated condition, free from potential hazards and to the satisfaction of the EPA.

6.3 QUARRYING AND REHABILITATION

6.3.1 CLEARING

Clearing would be limited to the area to be quarried, as defined in Figure 4.1. The temporary loss of vegetation in the quarry area is unavoidable; rehabilitation would result in the eventual establishment of a vegetative cover.

The area of vegetation to be affected by quarrying in the Wesco Road leases after 30 years would be 250 ha, representing a gross annual average of 8.3 ha. During the first 3-4 years of quarrying, this rate of clearing would be approximately 4-5 ha/a.

6.3.2 CONSERVATION AND RECREATIONAL VALUES

Other than the high conservation value of the *E. 'argutifolia'* populations (Section 5.2.1), the remainder of the lease area has no known significant conservation value. As the *E. 'argutifolia'* populations would be protected from the effects of quarrying, their conservation value would be preserved.

No authorized recreational pursuits are currently undertaken within the lease area. As a consequence, quarrying would not affect the existing recreational value of the leases.

6.3.3 GROUNDWATER

As a result of clearing for quarry operations, interception losses would be reduced and localized ponding of rain water could occur in some areas prior to infiltration. The activities of the earthmoving machinery may induce fracturing of the near-surface limestone, thereby increasing its permeability. These factors would result in increased groundwater recharge. However, because of the relatively small area of enhanced recharge involved and the highly porous soils near the water-table, long-term impacts are unlikely to be significant.

Most of the commercially viable limestone reserves within the leases occur in the first 20 m below ground level, to a maximum depth of 30 m. Existing quarrying operations in the Wesco lease, and exploratory drilling to define the limestone reserves (to 30 m), have yet to encounter the water-table. Because quarrying would be carried out at least 30 m above the water-table, and because the water-table underlying the lease area is an expression of the regional water-table, neither the local nor regional water-table levels would be significantly affected.

The impacts on the quality of groundwater from the use of machinery is expected to be negligible, because of the small number of machines involved and the measures undertaken to prevent fuel and lubricant spillages. These measures would include regular maintenance of machinery and removal of used lubricants off site. In addition, fuel and lubricants would be stored within bunded, impermeable areas, to contain possible spillages and prevent infiltration to the groundwater.

6.3.4 PLANT WATER AVAILABILITY

As the permanent water-table underlying the leases is unlikely to be affected by quarrying, the phreatophytic vegetation is also unlikely to be affected, if protected from physical damage.

Vegetation reliant on moisture stored above the water-table for survival during summer would only be affected by quarrying if the volume of soil retained were insufficient to enable adequate water storage for summer use. Based on estimates by AGC Woodward-Clyde Pty Limited, the effect of quarrying on the water content of the limestone is only likely to extend some 3-4 m from the quarry face (AGC Woodward-Clyde 1991).

Therefore, vegetation that does not have roots within this area would not be affected by quarrying. Hence, the buffer zone provided between the vegetation and the quarry face should include the area of expected root exploration plus an additional 4 m to ensure that vegetation was physically protected from the quarrying operations.

This assessment is supported by observations at the existing quarry faces in the Pinjar lease, where vegetation on the edge of the face has apparently been unharmed by past quarrying activities. Its intact condition indicates adequate water (and nutrient) availability in extreme circumstances, even where no buffer has been retained.

6.3.5 DUST

When considered necessary, water from mobile tankers would be applied to the quarry and haul roads to reduce dust levels. The 4-5% moisture content in the limestone would help reduce the potential for dust generation during quarrying operations. In addition, the distance separating the quarry area from the nearest residence would assist in reducing the potential impact of dust. The prevailing south-westerlies during summer would prevent dust from reaching residences located to the west and south of the quarry; however, morning easterlies during the summer months would have the potential to carry some dust toward these residences.

6.3.6 NOISE

Noise contours were developed by modelling the predicted sound power of mobile and stationary plant and equipment likely to result from operations at the quicklime plant and the quarry (Sound and Vibration Technology Pty Ltd 1991).

The estimated sound power levels for each item of significant mobile and stationary plant and equipment are presented in Appendix E.

Modelling took into account the following assumptions:

- Mobile equipment would have an average noise level of 90 dB(A) at a distance of 1 m.
- All vehicles would operate at 100% capacity and in close proximity to each other (in order to derive estimated peak noise levels from quarrying operations).
- The number of vehicles operating in the quarry would include one front-end loader, two dump trucks and one D9 dozer, with one dump truck at the dump pad (in order to derive estimated typical noise levels from quarrying).
- The quicklime plant would operate at 100% capacity.
- The topography of the lease area would be flat.
- Noise emissions would be equal in all directions.

The estimated error for noise contour modelling is +0-6 dB (i.e. actual noise is unlikely to be greater than estimated, but could be less by up to 6 dB).

The 'worst case' locations for quarry operations within the Wesco Road lease area, in terms of their potential noise impact on local residents, are shown in Figure 6.1. These locations (numbered 1-3) are situated along the western border of the leases. Owing to its proximity to a residential area, Location 1 is considered to have the greatest noise potential; Locations 2 and 3 have less noise potential.

The noise contour modelling considered nine separate scenarios. Scenarios 1-6 incorporated the worst case meteorological condition of a thermal inversion with an ambient temperature of 20°C and 50% humidity at each of the Locations 1, 2 and 3. Of these, Scenarios 1-3 assumed all machinery and equipment were in operation at the plant and quarry, while Scenarios 4-6 assumed two trucks, one dozer and one front-end loader operating at the quarry, with two trucks operating at the plant dump pad. Scenario 7 incorporated a light easterly wind blowing at 5 m/s (18 km/h), with all quarrying equipment operating at Location 1. Scenario 8 incorporated a light south-westerly wind blowing at 5 m/s (18 km/h), with all quarrying equipment operating at Location 1. Scenario 9 assumed that the mobile equipment noise emissions were reduced to 85 dB(A) at a distance of 1 m, with all quarrying equipment operating at Location 1.

The results of the modelling for each of these scenarios are presented in Table 6.1 and shown diagrammatically in Figure 6.2.

Table 6.1 **Noise contour results for the various scenarios**

Scenario number	Location (Figure 6.1)	Figure reference (Figure 6.2)	Equipment operating	Highest noise at closest residence dB(A)	Comments
1	1	(a)	All equipment operating at quarry	45-50	Temperature inversion
2	2	(b)		40-44	Temperature inversion
3	3	(c)		40-42	Temperature inversion
4	1	(d)	2 trucks, 1 dozer	45-48	Temperature inversion
5	2	(e)	1 front-end loader at	40-45	Temperature inversion
6	3	(f)	quarry, 2 trucks at plant	40-42	Temperature inversion
7	1	(g)	All equipment operating at quarry	50-55	Light easterly at 5 m/s
8	1	(h)	All equipment operating at quarry	38-40	Light south-westerly at 5 m/s
9	1	(i)	All equipment operating at quarry	38-42	Mobile equipment noise reduced to 85 dB(A)

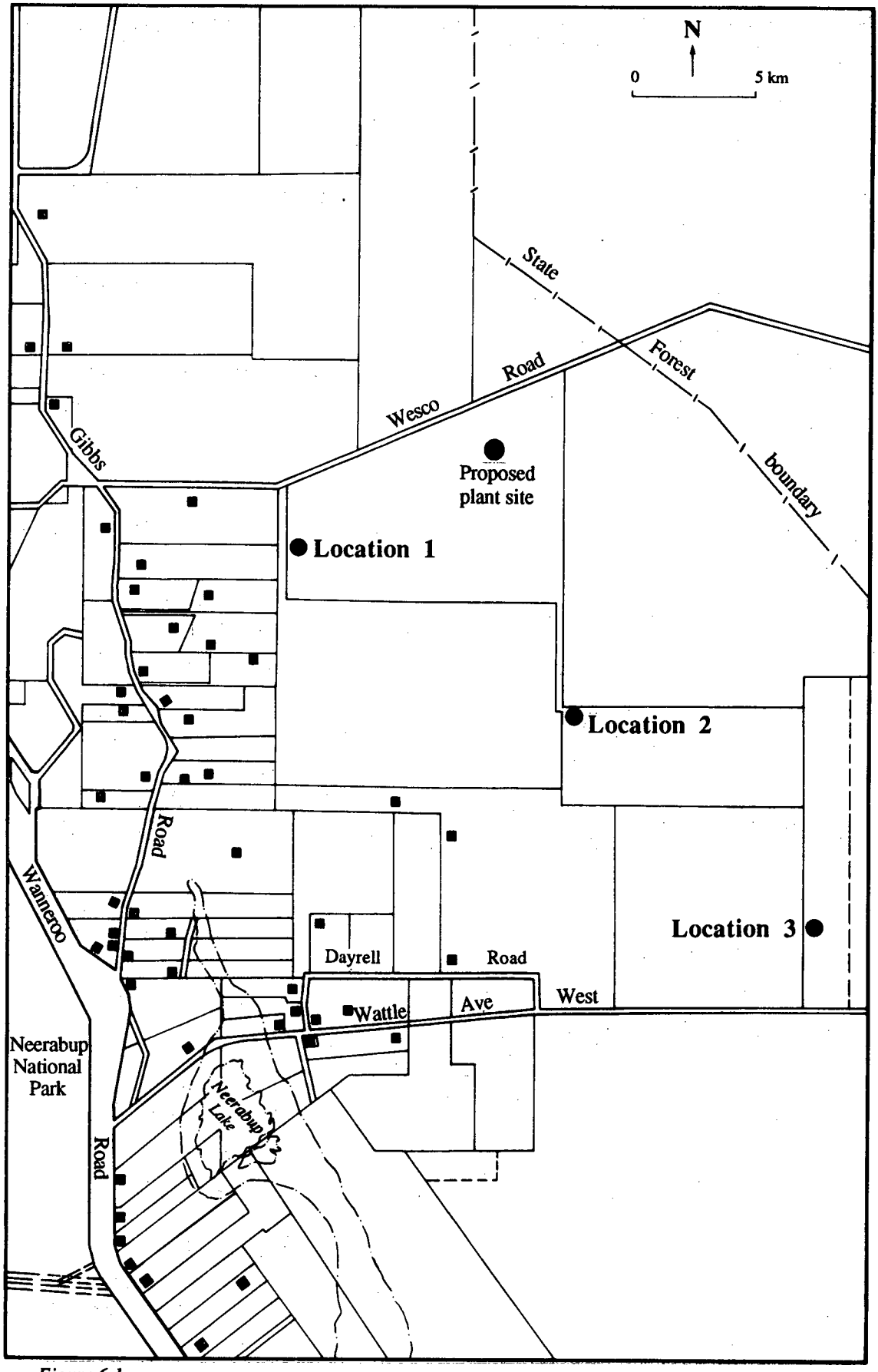


Figure 6.1

WORST CASE LOCATIONS FOR QUARRY OPERATIONS WITHIN THE WESCO ROAD LEASE AREA IN TERMS OF NOISE POTENTIAL

As indicated in Section 5.3.6, daytime background noise levels near residences on Wesco Road, Gibbs Road and Dayrell Road varied between 33 and 46 dB(A), while early morning noise levels in the same areas varied between 25 and 33 dB(A).

All scenarios considered in the modelling are worst possible cases. Factors that would contribute towards reducing these predicted noise levels or reducing the impact of noise on residents include the following:

- **Quarrying would not be undertaken any closer than 200 m from the westernmost boundary of the Gibbs lease; therefore, actual noise levels would be less than the worst case predictions.**

- **Quarrying would not be undertaken outside daylight hours, except in exceptional circumstances, at which time the nearest residents would be notified.**

- Quarrying would be conducted within a pit below the ground level of existing ridges, which would reduce the effects of noise.

- **All mobile equipment, such as dozers and trucks, would be fitted with silencers to reduce tonal and impulsive noise emissions.**

- **All potential noise-generating equipment associated with the quicklime plant would incorporate effective sound-proofing measures, such as mufflers and a range of enclosures, to minimize noise emissions.**

- Noise emissions from both mobile equipment and plant operations would, to some extent, be masked by other noise sources, such as traffic on Wanneroo Road and Gibbs Road and adjacent farming activities.

- Noise emissions from both the quarry and plant operations would be reduced by the ridge separating the lease area from Gibbs Road (which the modelling did not take into account).

- As indicated in Figure 5.1, the prevailing wind conditions in the area are westerly during winter and south-westerly, with strong early morning easterlies, during summer, which would serve to mask noise from the plant and quarry operations.

Swan would meet all appropriate noise emission requirements set by the EPA.

Where appropriate, employees would be issued with protective hearing equipment to ensure worker safety and health. Noise levels at the plant and during quarrying operations would not exceed the requirements of the *Occupational Health, Safety and Welfare Act, 1984* for protection of the workforce.

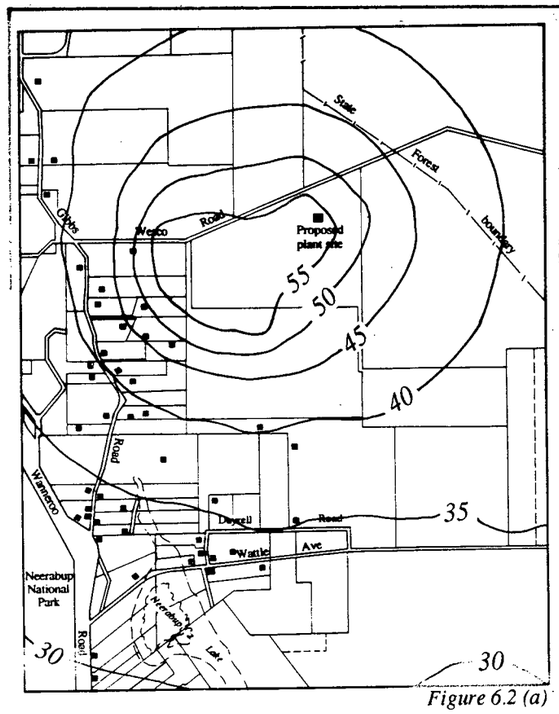


Figure 6.2 (a)

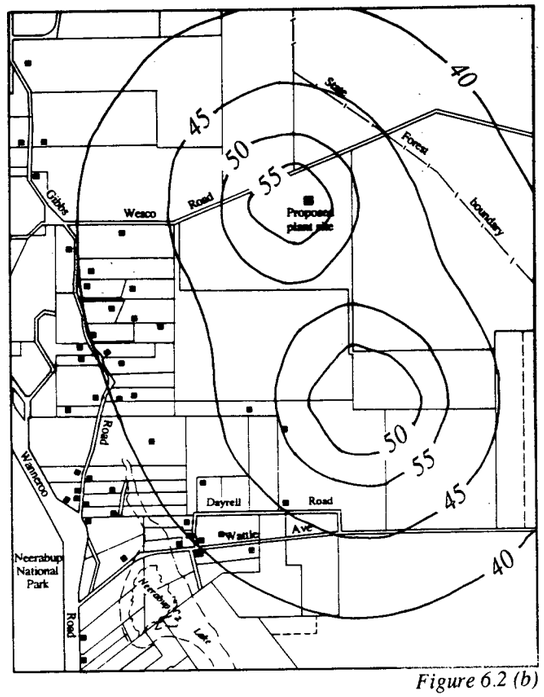


Figure 6.2 (b)

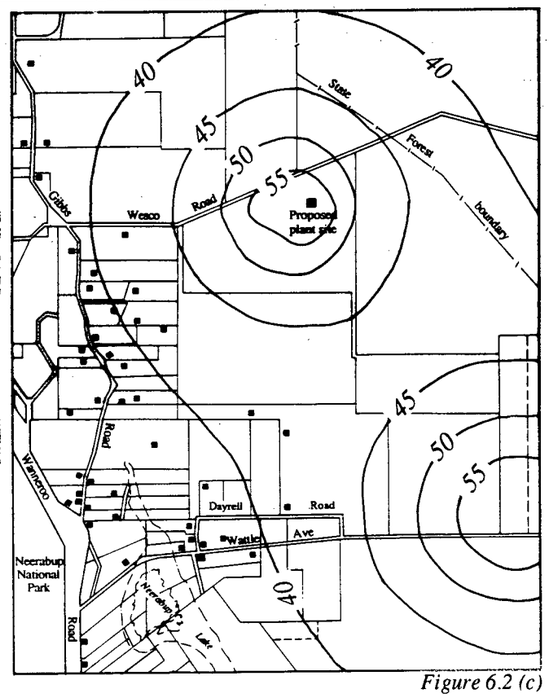


Figure 6.2 (c)

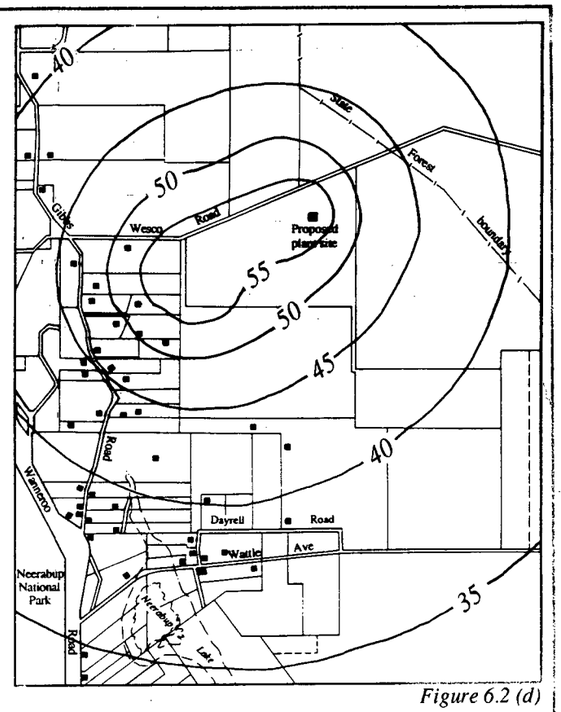


Figure 6.2 (d)

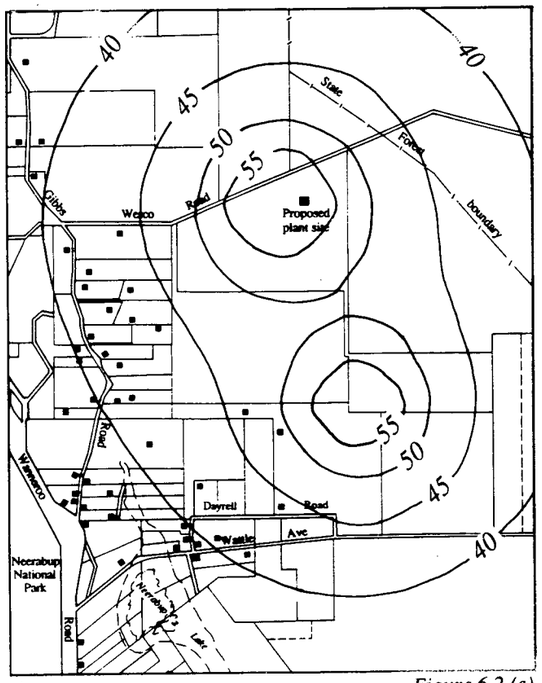


Figure 6.2 (e)

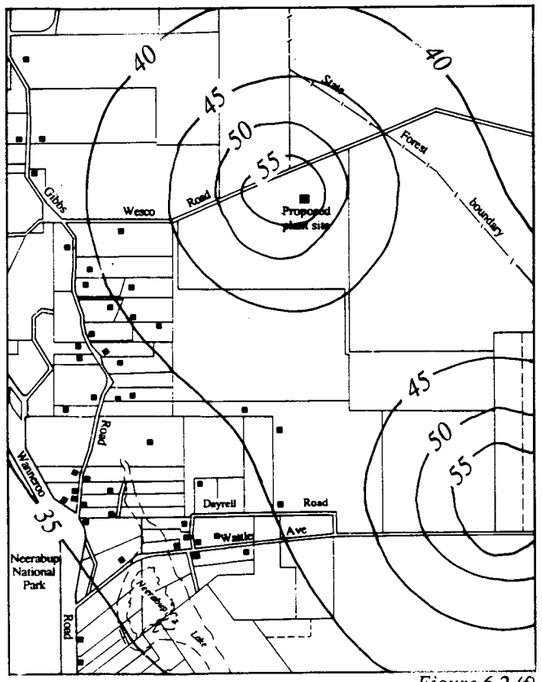


Figure 6.2 (f)

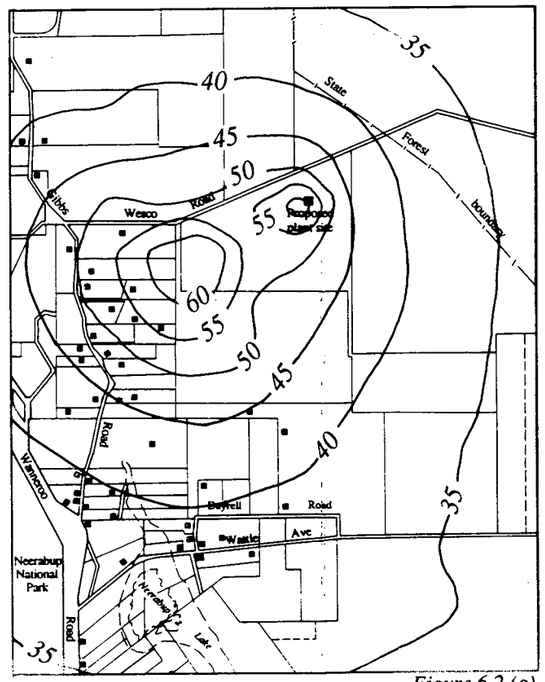


Figure 6.2 (g)

N

0 5 km

Figure 6.2

RESULTS OF NOISE MODELLING

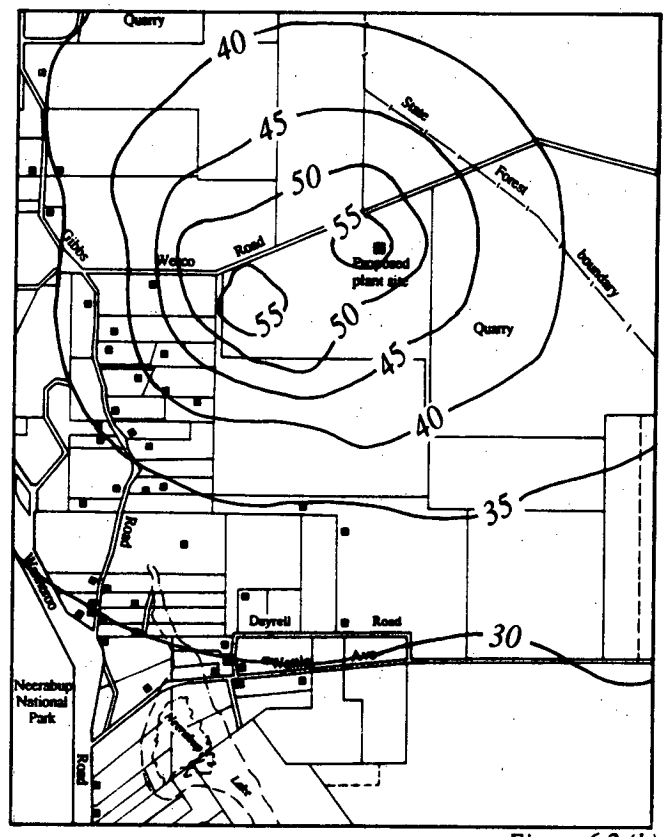


Figure 6.2 (h)

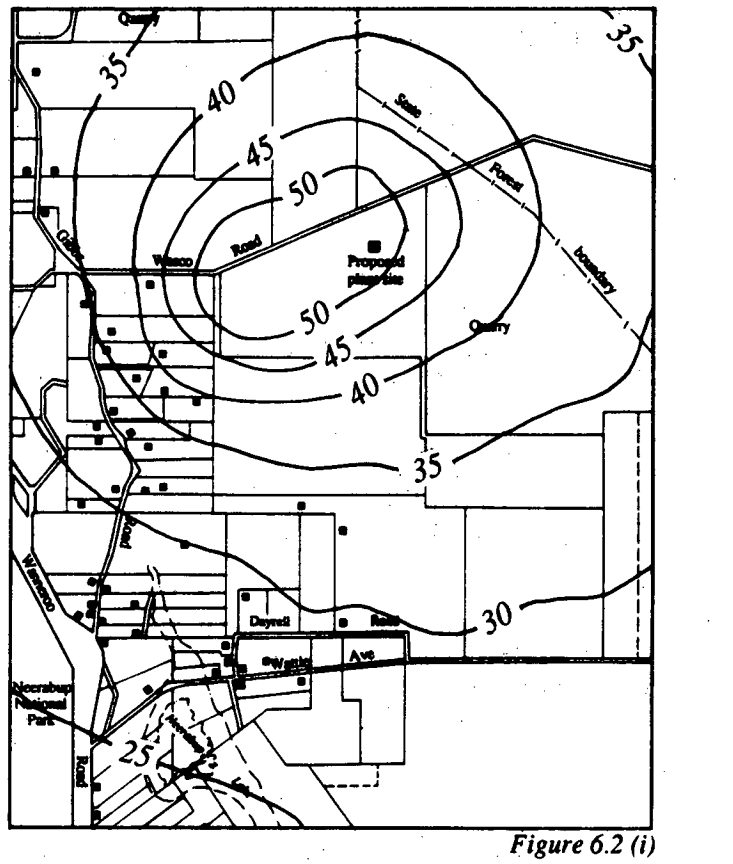


Figure 6.2 (i)

Figure 6.2 (Continued)

RESULTS OF NOISE MODELLING

6.3.7 FUTURE LAND USE

The Wesco Road leases are contained within an area currently zoned rural under the Wanneroo Town Planning Scheme. The DPUD's Metropolitan Region Scheme allows the extraction of basic raw materials within the lease area.

Future planned land uses in the vicinity of the Wesco Road leases are partly determined by the DPUD's North-West Corridor Structure Plan and its November 1990 Urban Expansion Policy Statement (DPUD 1990a). Both of these documents support the recently released METROPLAN (DPUD 1990b), which replaces the Corridor Plan (Metropolitan Region Planning Authority 1970). The Draft North-West Corridor Structure Plan was released for public comment in mid-February 1991. The area surrounding the Wesco Road leases is proposed as a basic raw materials extraction zone. In addition, a major six-lane highway with a north–south alignment is planned (in the long term) along the ridge of the Wesco Road leases. However, it is unlikely that there would be any pressure from urbanization in the next 20-30 years.

6.3.8 *E. 'argutifolia'*

Measures to protect populations of *E. 'argutifolia'* have been developed by AGC Woodward-Clyde (AGC Woodward-Clyde 1991), whose conclusions are outlined as follows (refer to Section 5.2.1 for population descriptions).

Quarrying would approach the *E. 'argutifolia'* stand immediately south of Wesco Road (Population C) approximately 12 months after approval for the project was granted. The stand further south (Population D) and those north of Wesco Road (Populations A and B) are located in areas that would not be quarried for another 20-30 years. Therefore, any effects of quarrying on the first stand of *E. 'argutifolia'* could be monitored, with ample time in which to modify management plans, if necessary, before quarrying approached the other populations.

The areas occupied by *E. 'argutifolia'* populations are underlain by limestone of a commercially viable grade, and are therefore suitable for quarrying by Swan. However, in recognition of the conservation value of this species, Swan would retain all populations present within the lease area, and would implement measures to protect them from damage.

Areas of the leases containing populations of *E. 'argutifolia'* would not be quarried and would be protected from damage to the satisfaction of the EPA.

The *E. 'argutifolia'* Population C presents some difficulty for the progression of quarrying operations further south. The distance between the westernmost extremity of the commercial grade limestone and Population C is only 200 m at the existing ground surface. By retaining a batter angle of 1:6 from both sides of the quarry, a maximum quarry depth of approximately 5 m would be achieved in the centre of this transect. This would be considerably less than the depth of commercial grade limestone (15-20 m), and about 10-15 m above the depth of the quarry floor immediately north of the transect.

Because the viability of the project depends upon extraction of the maximum volume of commercial grade limestone possible, access to the reserves south of this *E. 'argutifolia'* stand would be required. In order to avoid the construction of roads over areas not to be quarried and to ensure a separation of at least 50 m between batter slopes (to allow for quarry traffic), the following is proposed:

- Quarrying to the west of *E. 'argutifolia'* Population C would be carried out to a vertical quarry face up to the westernmost extent of commercial grade material. Owing to the physical nature of the limestone, there would be little risk of the face collapsing. After quarrying was completed, silica rejects from the quicklime plant would be returned to the quarry floor, to establish a 1:6 slope from the existing ground surface at the top of the vertical face, sloping eastwards. Silica reject backfill would be returned to the site within 12 months of quarrying.

- Quarrying would be conducted up to 10 m to the west of Population C, at a batter slope of 1:3. No silica rejects would be returned to this face. Quarrying would not be conducted to the east of the population.

The net result of the proposed management plan for *E. 'argutifolia'* Population C is shown in Figure 6.3. The *E. 'argutifolia'* population would be retained on an area of protected headland and would be undisturbed to the east. Some 55,000 m^3 of commercial grade limestone would be contained in the protected area. To the immediate north and south of the population, quarrying would not be undertaken any closer than 10 m from the population, while to the north-east and south-east quarrying would be carried out at a greater distance, determined by the extent of commercial grade limestone.

Quarrying within the vicinity of the other populations of *E. 'argutifolia'* is not proposed within 20 years of project approval. None of these populations is located in areas of concern with respect to quarry access or transport. It is proposed that each population be retained within a 10 m buffer, with batter slope and other details to be determined to the satisfaction of CALM at least 12 months prior to quarrying within 100 m of any population.

Specific management proposals to protect *E. 'argutifolia'* are as follows:

- **Swan would ensure that no physical damage to any population of *E. 'argutifolia'* would occur as a result of its quarrying or associated operations, and would endeavour to prevent damage from other causes. A quarry management plan addressing the management of *E. 'argutifolia'* and other flora, water, and rehabilitation techniques would be prepared in consultation with CALM to the satisfaction of the Department of Mines and the EPA.**

- **Quarrying would not be undertaken within 10 m of any stem, plant or population of *E. 'argutifolia'*. No batter slope steeper than 1:3 would be established within 80 m of any stem, plant or population, apart from the access road.**

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- **All areas within 80 m of the *E. 'argutifolia'* populations, apart from the access road, would be fully rehabilitated in order to re-establish indigenous species on the batter slopes. Rehabilitation would commence within 12 months of the cessation of quarrying in the area, and would be conducted as described in Section 6.3.10.**

- **A 1.5 m barrier fence would be constructed around each *E. 'argutifolia'* population, to restrict vehicular movement in the area. The fence for *E. 'argutifolia'* Population C would be erected within 3 months of project approval and before quarrying approached within 200 m of the population. For the other populations, fencing would be erected at least 1 year before quarrying approached within 200 m of any population.**

Swan would fund electrophoretic studies to establish the genetic relationship of individual plants within and between populations of *E. 'argutifolia'*. This work would assist in the formulation of future management plans for the species.

The proposed measures would be applicable to all populations of *E. 'argutifolia'* within the leases subject to the current quarrying proposal. However, **as the subsequent populations of *E. 'argutifolia'* would not be approached by quarrying for a considerable time after the first, it would be possible to assess the results of long-term monitoring of the first population** (proposed by Swan; refer Section 7). **Should it then be considered necessary, management measures could be revised in consultation with CALM.** It is possible that additional long-term studies could be carried out on seedling propagation to further determine the level of fertility and genetic diversity which exists within the species. This work could serve as an adjunct to the proposed electrophoretic studies, and could establish the feasibility of 'supplementing' existing *E. 'argutifolia'* populations in an attempt to increase their capacity to produce viable seed and to establish in other localities.

6.3.9 OTHER LISTED FLORA SPECIES

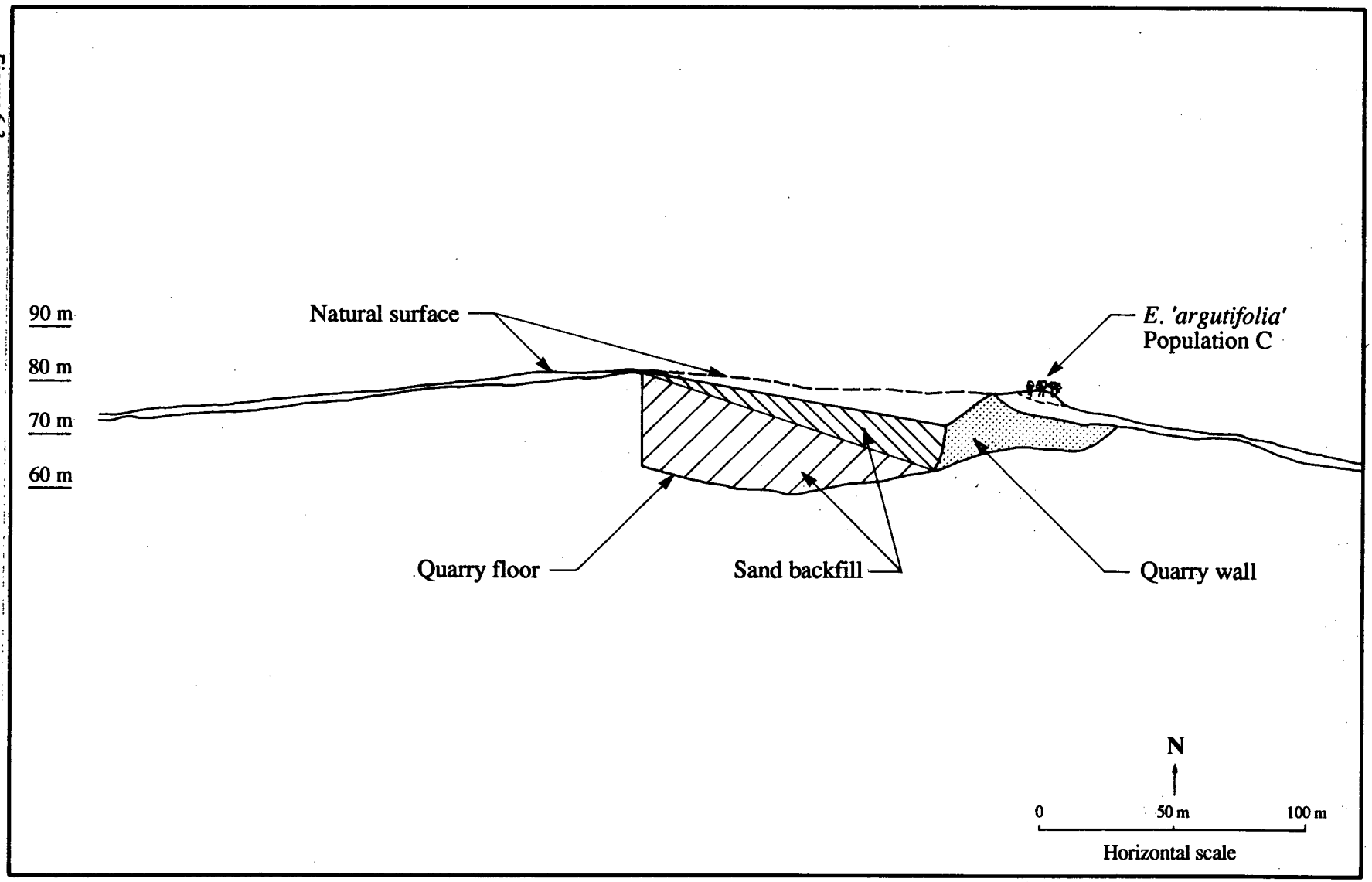
The proposed quarrying operations would necessitate the clearing of approximately 80% of the area occupied by *Eucalyptus 'petrensis'* within the leases. The *E. 'petrensis'* populations retained would be those coincident with *E. 'argutifolia'* populations, and those growing in areas of non-commercial grade limestone. Similarly, populations of *E. foecunda* would be retained where they are coincident with *E. 'argutifolia'* (estimated to be 30% of the total area occupied by *E. foecunda*). Removal of the other *E. 'petrensis'* and *E. foecunda* populations would be required to enable the project to proceed.

6.3.10 REHABILITATION

The primary objectives of rehabilitation would be to stabilize the surface of disturbed areas and to re-establish self-sustaining native vegetation. Rehabilitation of land affected by quarrying would be progressive and integrated with quarrying activities.

Figure 6.3

CROSS-SECTION SHOWING QUARRY FROM SOUTH



Topsoil/overburden management

It is recognized that viable topsoil material is the most valuable resource for the rehabilitation of quarried areas, or of land disturbed by associated activities. As previously indicated, most of the lease area has only a shallow layer of sandy topsoil. Typically, the upper 150 mm of topsoil is particularly important because it holds viable seeds, propagative parts of plants, organic matter and micro-organisms.

Topsoil and overburden would be obtained from areas to be quarried, and used for the rehabilitation of disturbed areas. All topsoil/overburden would be progressively removed from areas to be quarried, and stockpiled. Stockpiles would be located to one side of quarry areas to ensure they were not disturbed. Stockpiles would be limited to a height of 2-3 m to ensure that, wherever possible, the soil structure (if any) was maintained and that the biologically valuable seed, organic matter, micro-flora and soil invertebrate fauna were preserved.

Wherever possible, topsoil and overburden would be applied directly to quarried areas requiring rehabilitation, as the value of stockpiled topsoil declines with time because of in situ germination and biological decomposition. If topsoil storage is likely to exceed 12 months, the seed store may be replenished by sowing native legumes on the stockpiles to enrich the rhizobium content of the topsoil, which would assist with seedling establishment after subsequent spreading.

Quarry rehabilitation

Before backfilling with silica rejects, the quarry would be made up of solid or partially disturbed coarse limestone, which, because of its physical nature, is not susceptible to wind or water erosion. Ripping prior to deposition of the silica rejects is not considered necessary, as the limestone is likely to already contain fractures. The particle size and porosity of the silica reject material would make wind and/or water erosion unlikely; however, if erosion were identified, contouring and/or stabilization with coarse limestone overburden would be undertaken.

Within 12 months of the completion of quarrying, final contouring of the area backfilled with silica reject material would be completed to the satisfaction of the EPA.

During quarrying operations, batter slopes of 1:6 would be established, except in the area around *E. 'argutifolia'* Population C (Section 6.3.8). Rehabilitation would be undertaken with these quarried batter slopes—no recontouring is planned.

Rehabilitation would commence as soon as practicable after the completion of backfilling operations. Topsoil and overburden would be applied over the floor and slopes of the quarry by a dozer. Because of the small amount of available topsoil, the depth of topsoil spread over the backfilled silica is not expected to be more than 30-40 mm. Topsoil may be supplemented by the placement of light brush from surrounding vegetation (excluding the areas of protected *E. 'argutifolia'* populations), to assist as a binder and an additional source of organic matter and seed. Scattered over the surface of the replaced topsoil, brush would provide a protective mulch as well as a habitat for colonizing fauna. Alternatively, locally collected seeds from native plants known to be adapted to limestone

areas could be used to aid the establishment of a vegetative cover, as would natural seed dispersal from adjacent areas.

Pending further discussions with CALM, consideration would also be given to the establishment of *E. 'argutifolia'* (from seedling) within the rehabilitated areas adjacent to the existing populations. Establishment of additional plants may have some beneficial effect on the long-term maintenance of the species by introducing additional genetic material or increasing the number of individual plants, but the desirability of interfering with natural populations of the species is debatable from a conservation viewpoint. Swan would consider advice from CALM in relation to the establishment of additional plants of *E. 'argutifolia'* in the quarried area, and would produce a management plan before proceeding with such action.

Rehabilitation of the quarry area would be progressively undertaken to the satisfaction of the EPA. Rehabilitation would essentially involve the backfilling of silica reject material and the spreading of topsoil over the quarry floor and slopes. Topsoil may be supplemented by the placement of light brush from surrounding vegetation. Consideration would be given to the establishment from seedling of *E. 'argutifolia'* in the areas adjacent to existing populations, but this would not be undertaken without the agreement of CALM.

7 MONITORING

A conceptual monitoring programme has been developed to monitor:

- air quality (stack and ambient air quality)
- groundwater
- noise
- rehabilitation
- *E. 'argutifolia'*.

Further details of the conceptual monitoring programme are presented in Table 7.1.

Specific methodologies for monitoring would be developed in consultation with relevant government authorities. The monitoring requirements of the EPA and the Water Authority would be detailed in relevant licence conditions issued to Swan. The Works Manager would assume responsibility for the implementation of the monitoring programme.

Should considerable urban development occur in the future within close proximity to the plant site, monitoring may be expanded to reflect changes in surrounding land use.

Monitoring of atmospheric emissions would be undertaken by extracting samples isokinetically from the waste gas stack. Should it be necessary, opacity would also be measured. Specific training in sampling techniques would be provided to Swan personnel involved in this monitoring.

Total suspended particulates would be monitored using two high volume samplers: one located upstream and one located downstream of the plant. The high volume samplers would be established and operated in accordance with Australian Standard 2724.3-1984. Wind speed and direction data would be obtained from the Bureau of Meteorology to facilitate interpretation of air quality and noise monitoring results. The results of monitoring for particulates would be reported annually to the EPA.

Details of groundwater monitoring (if required) would be prepared in consultation with the Water Authority. Requirements for monitoring would be indicated in the licence conditions issued by the EPA and the Water Authority.

Noise surveys would be carried out at established sites at possibly six monthly intervals or following significant changes to plant equipment or processes. The noise surveys would be undertaken by contractors or suitably trained Swan personnel, and in

accordance with Australian Standard 1055-1984. Noise levels recorded would be compared with established background levels in the same area.

Rehabilitation of the quarried areas would be monitored to assess its effectiveness and to make appropriate recommendations on possible improvements to the rehabilitation techniques adopted.

The health of the buffer areas retained around each *E. 'argutifolia'* stand would be monitored. This would involve a detailed botanical survey of the buffers at least 1 year prior to quarrying within 100 m of an *E. 'argutifolia'* population. Surveys would be carried out within 100 m of each population, and repeated each January, April and September thereafter until 4 years after quarrying operations have been completed. The identity, location, size and general vigour of all species within the buffers, using written and photographic records, would be reported. Reports would be submitted to CALM after each survey.

In addition, social impact monitoring would be undertaken to record any complaints to the proponent or City of Wanneroo, instances of working outside normal hours, and the effectiveness of management of these issues. Furthermore, measures would be implemented by which any issues of concern raised by local residents during the construction and operation phases could be addressed. These would include the following:

- A contact 'community liaison' person for the plant would be nominated.
- Local residents would be advised of this person's name, his/her availability and how to contact him/her.
- Local residents would be offered opportunities to view the plant during construction and when commissioned.
- Practices would be adopted to deal with local complaints as quickly as possible.

This strategy aims to establish and maintain a long-term relationship with the plant's nearest neighbours.

Table 7.1 **Conceptual monitoring programme for the quicklime project**

Parameter	Equipment	Location	Frequency	Data	Frequency of reporting	Reporting to
Plant operation						
Air quality						
• Stack testing	Lear Siegler GS80	Cooling tower	Monthly	Particulate load and gases	Six monthly or annually (subject to EPA requirements)	EPA (subject to licence conditions)
• Ambient air quality	High volume samplers	Upstream and downstream of plant	Cyclic (24 hours on 6 day cycle)	Total suspended particulates	Annually (subject to EPA requirements)	EPA (subject to licence conditions)
Groundwater	Water samples	Water Authority bore wells	Subject to Water Authority licence conditions	Subject to Water Authority licence conditions	Subject to Water Authority licence conditions	Water Authority (subject to licence conditions)
Noise	Sound level meter	Adjacent to residences and lease area	Six monthly	Sound power levels	Annually (subject to EPA requirements)	EPA (subject to licence conditions
Quarrying and rehabilitation						
Rehabilitation	Visual assessment	Quarried area that has been rehabilitated	Annually	Rate of cover establishment, stability of quarry slopes, success of rehabilitation methods	Annually (subject to EPA requirements)	EPA/CALM (subject to licence conditions)
E. 'argutifolia'	Visual and photographic assessment	*E. 'argutifolia'* buffers	January, April and September each year for 4 years	General health of all plants and signs of stress	After each survey (subject to EPA requirements)	CALM (subject to licence conditions)

8 PUBLIC CONSULTATION

The public consultation programme consisted of meetings with government authorities and a public Open Day.

Government consultations involved:

- discussions with the City of Wanneroo about current zoning provisions and compatibility with long-term land use plans;
- meetings with the DPUD to discuss long-term land use plans for the north-west corridor;
- discussions with the Social Impact Unit about appropriate public involvement techniques.

An opportunity for local residents and landowners to contribute to the planning process was provided through an Open Day held at the proposed plant site on 12 January 1991, between 10 a.m. and 3 p.m.. Proponent and consultant representatives attended the public information session in order to explain the proposal and answer questions. Officers from the Social Impact Unit and the Department of State Development were also in attendance.

Fifty local residents/landowners were invited to attend the event, by way of a written invitation posted on 21 December 1990. The invitation included a two-page information leaflet, a copy of which is provided in Appendix F.

Approximately twenty-five residents/landowners attended the Open Day. A range of queries were raised; the largest number of questions related to perceived traffic problems and noise emissions.

8.1 MAIN ISSUES

8.1.1 TRAFFIC

Most of those who attended mentioned the potential for increased traffic flow on Gibbs Road. Questions were also asked about truck design and speed control. The issue of traffic on Gibbs Road is addressed in Sections 6.1.1 and 6.2.1.

8.1.2 NOISE EMISSIONS

Questions were asked about noise emissions from the proposed plant and from quarrying operations. The issue of noise is addressed in Section 6.3.6.

8.2 SECONDARY ISSUES

Queries were also raised about:

- the potential for dust emissions from the proposed plant and quarry (Sections 6.1.1, 6.2.1 and 6.3.5);
- the source of water for plant activities (Section 6.2.2);
- visual impacts (including lighting) associated with the plant (Section 6.2.1);
- atmospheric emissions (Section 6.2.3);
- possible employment (Section 4.12);
- future land use plans (Section 6.3.7);
- rehabilitation plans (Section 6.3.10).

No more than two queries were made in relation to each of the secondary issues.

9 SUMMARY OF ENVIRONMENTAL COMMITMENTS

This section presents a summary of the commitments made by Swan which have been presented in bold in preceding sections. Each commitment is numbered to assist with referencing during the period of review and EPA assessment.

9.1 CONSTRUCTION OF THE QUICKLIME PLANT

9.1.1 GENERAL

Commitment 1 All construction materials and practices would be in accordance with relevant Australian or international standards.

Commitment 2 All solid refuse and construction material wastes would be removed from site and disposed of in accordance with the requirements of the City of Wanneroo.

9.1.2 CONSERVATION

Commitment 3 Where practicable, native vegetation would be retained during site clearing operations within the plant site.

9.1.3 REHABILITATION

Commitment 4 Where practicable, vegetation and topsoil cleared during the construction phase would be used in the rehabilitation of disturbed areas within the plant site and the quarry.

9.1.4 PLANT/QUARRY SITES

Commitment 5 Swan would actively encourage its employees and contractors to drive safely in the area of the plant and quarry in order to minimize the risk of traffic accidents.

9.1.5 POLLUTION CONTROL

Air

Commitment 6 Dust suppression measures, including application of water from tankers, would minimize dust generation during site preparation and construction activities.

Noise

Commitment 7 All construction machinery would be fitted with appropriate noise suppression devices. Construction noise levels would comply with the requirements of the Department of Occupational Health, Safety and Welfare. In addition, noise levels would comply with the allowable community noise levels as set out in the Noise Abatement (Neighbourhood Annoyance) Regulations, 1979.

9.2 OPERATION OF THE QUICKLIME PLANT

9.2.1 GENERAL

Commitment 8 Swan would undertake an examination of practical means of reducing the demand for water through recycling and improvements in process technology.

9.2.2 CONSERVATION

Commitment 9 Areas of the leases containing populations of *E. 'argutifolia'* would not be quarried and would be protected from damage to the satisfaction of the EPA.

Commitment 10 Swan would ensure that no physical damage to any population of *E. 'argutifolia'* would occur as a result of its quarrying or associated operations, and would endeavour to prevent damage from other causes. A quarry management plan addressing the management of *E. 'argutifolia'* and other flora, water, and rehabilitation techniques would be prepared in consultation with CALM to the satisfaction of the Department of Mines and the EPA.

Commitment 11 Quarrying would not be undertaken within 10 m of any stem, plant or population of *E. 'argutifolia'*. No batter slope steeper than 1:3 would be established within 80 m of any stem, plant or population, apart from the access road.

Commitment 12 All areas within 80 m of the *E. 'argutifolia'* populations, apart from the access road, would be fully rehabilitated in order to re-establish indigenous species on the batter slopes. Rehabilitation would commence within 12 months of the cessation of quarrying in the area, and would be conducted as described in Section 6.3.10.

Commitment 13 A 1.5 m barrier fence would be constructed around each *E. 'argutifolia'* population, to restrict vehicular movement in the area. The fence for *E. 'argutifolia'* Population C would be erected within 3 months of project approval and before quarrying approached within 200 m of the population. For the other populations, fencing would be erected at least 1 year before quarrying approached within 200 m of any population.

Commitment 14 Swan would fund electrophoretic studies to establish the genetic relationship of individual plants within and between populations of *E. 'argutifolia'*.

Commitment 15 As the subsequent populations of *E. 'argutifolia'* would not be approached by quarrying for a considerable time after the first, it would be possible to assess the results of long-term monitoring of the first population. Should it then be considered necessary, management measures could be revised in consultation with CALM.

9.2.3 REHABILITATION

Commitment 16 Rehabilitation of the quarry area would be progressively undertaken to the satisfaction of the EPA, as detailed in Section 6.3.10. Rehabilitation would essentially involve the backfilling of silica reject material and the spreading of topsoil over the quarry floor and slopes. Topsoil may be supplemented by the placement of light brush from surrounding vegetation. Consideration would be given to the establishment from seedling of *E. 'argutifolia'* in the areas adjacent to existing populations, but this would not be undertaken without the agreement of CALM.

Commitment 17 A monitoring programme meeting the requirements of the EPA would be established to monitor the rehabilitation of the quarry area, including the populations of *E. 'argutifolia'*. Details of the monitoring programme are provided in Section 7 and, in particular, Table 7.1.

9.2.4 PLANT/QUARRY SITES

Commitment 18 The biological waste treatment system for domestic effluent would be constructed and operated in accordance with the appropriate regulations of the *Health Act, 1911,* and to the satisfaction of the EPA.

Commitment 19 The plant site would be secured by a 2 m high wire fence topped with three strands of barbed wire to prevent unauthorized public entry.

Commitment 20 The plant would incorporate a wide range of safeguards such as fire protection, instrument monitoring, back-up systems and provisions for emergency shut-downs. Where appropriate, personnel involved in the operation of the quicklime plant would be issued with protective clothing and safety equipment. The City of Wanneroo and the Bush Fires Board would be consulted for advice on the prevention and suppression of fires.

9.2.5 TRANSPORT

Commitment 21 Once the quicklime plant became operational, limestone for lime manufacture would no longer be required at Rivervale; therefore, no further use of Gibbs Road for the transportation of limestone to Rivervale for this purpose would be necessary.

Commitment 22 Although the use of Gibbs Road is preferred, quicklime would be transported from the plant via the planned extension of Wesco Road. In the short term, and until the extension has been constructed, Swan is prepared to use Pinjar Road and Flynn Drive for the transportation of quicklime.

Commitment 23 Prior to the development of the North Wesco lease, negotiations would be held with the City of Wanneroo concerning possible temporary diversion of Wesco Road and other measures to avoid conflict with public road users.

9.2.6 POLLUTION CONTROL

Air

Commitment 24 An electrostatic precipitator would be installed to ensure the levels of suspended particulates from the quicklime plant were below the limit of 100 mg/Nm^3 recommended by the National Health and Medical Research Council.

Commitment 25 Measures to be implemented at the quicklime plant to prevent dust generation would include the installation of mist water sprays and dust collection units, covering of conveyors and limestone stockpiles, sealing of internal roads, and retention of vegetation (where practicable) within the plant site.

Commitment 26 The plant site would be landscaped with native trees and shrubs to help reduce dust generation and provide a visual screen from Wesco Road.

Commitment 27 When considered necessary, water from mobile tankers would be applied to the quarry and haul roads to reduce dust levels.

Commitment 28 A monitoring programme would be established to monitor the air quality (particulate load and gases, and total suspended particulates). Details of the monitoring programme are provided in Section 7 and, in particular, Table 7.1.

Water

Commitment 29 Oil traps and impermeable bunding would be used to contain spills of fuels, oils, lubricants and chemicals. Oil trap sludges, spent containers and waste lubricants would be recycled or disposed of in accordance with the requirements of the City of Wanneroo and the Health Department.

Commitment 30 A monitoring programme would be established to monitor groundwater, the details of which are provided in Section 7.

Noise

Commitment 31 All potential noise-generating equipment associated with the quicklime plant would incorporate effective sound-proofing measures, such as mufflers and a range of enclosures, to minimize noise emissions.

Commitment 32 Quarrying would not be undertaken outside daylight hours, except in exceptional circumstances, at which time the nearest residents would be notified.

Commitment 33 All mobile equipment, such as dozers and trucks, would be fitted with silencers to reduce tonal and impulsive noise emissions.

Commitment 34 Quarrying would not be undertaken any closer than 200 m from the westernmost boundary of the Gibbs lease; therefore, actual noise levels would be less than the worse case predictions.

Commitment 35 A monitoring programme would be established to monitor noise emissions resulting from quarrying activities and quicklime plant operations. The details of the programme are provided in Section 7.

Commitment 36 Swan would meet all appropriate noise emission requirements set by the EPA.

Light

Commitment 37 All external lighting would be screened and would be directed inwards to minimize interference with residents.

9.2.7 DECOMMISSIONING

Commitment 38 Specific details of decommissioning are yet to be formulated; such details would be developed nearer to the end of the plant life. The plant site would be left in an unpolluted, stable, free-draining, vegetated condition, free from potential hazards and to the satisfaction of the EPA.

9.2.8 SOCIAL

Commitment 39 Social impact monitoring would be undertaken to address issues raised by members of the public. Details of this monitoring, together with the process through which these issues would be addressed, are provided in Section 7.

10 CONCLUSIONS

This CER has been prepared in accordance with the guidelines issued by the EPA. The potential environmental impacts associated with the project and the management measures proposed to ameliorate these impacts have been outlined (Section 6). In addition, Swan has made a number of commitments to ensure that the concerns of local residents and government authorities are satisfied (Section 9).

Adherence to the commitments to environmental management and monitoring described in this CER would ensure that the construction and operation of the quicklime plant and the associated quarrying operations would be undertaken with minimal environmental impact, both in a local and regional context.

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GLOSSARY

aeolian	sediments/formations that have been originally deposited by wind-driven processes
breakaway	geological formation having a near vertical face
caprock	impervious stratum overlying other strata
evapotranspiration	total amount of moisture that evaporates from soil and vegetation
herpetofauna	reptiles and amphibians
interstitial flow	groundwater movement between soil particles
isokinetically	sampling method that ensures that the linear velocity of the airstream being sampled is not altered
lignotuber	underground generative stem
mallee	type of shrub that has a lignotuber, enabling it to spread underground and appear like numerous individuals, rather than a single plant
outliers	populations occurring outside the 'normal' range of distribution
phreatophytic vegetation	species accessing the water-table
quicklime	unslaked lime, also known as caustic lime or burnt lime
recharge	water that reaches the water-table
rhizobium content	the amount of root-like stems in the soil
solution pipes	vertical structures or holes formed by the dissolution of in situ limestone
sterilized limestone	limestone that is no longer accessible, because of urban development, infrastructure, government policy, etc.
taxa	groups of organisms to which taxonomic names have been applied
unconfined aquifer	an aquifer that is not confined by impervious strata

ABBREVIATIONS

GENERAL ABBREVIATIONS AND ACRONYMS

AHD	Australian Height Datum
CALM	Department of Conservation and Land Management
CER	Consultative Environmental Review
DPUD	Department of Planning and Urban Development
EPA	Environmental Protection Authority
Health Department	Health Department of Western Australia
MRD	Main Roads Department of Western Australia
SECWA	State Energy Commission of Western Australia
Swan	Swan Portland Cement Limited
Water Authority	Water Authority of Western Australia

TECHNICAL ABBREVIATIONS

@	at
$CaCO_3$	calcium carbonate
$Ca(HCO_3)_2$	calcium bicarbonate
CaO	calcium oxide
CO_2	carbon dioxide
dB	decibel
dB(A)	decibel (ambient)
°	degree
°C	degree Celsius
h	hour
ha	hectare
ha/a	hectares per annum
H_2O	water
kL/a	kilolitres per annum
kL/d	kilolitres per day
kL/ha	kilolitres per hectare
kL/ha/a	kilolitres per hectare per annum
km	kilometre
km/h	kilometres per hour
kPa	kilopascal
kV	kilovolt
L	litre
m	metre

m^2	square metre
m^3	cubic metre
m^3/a	cubic metres per annum
m^3/h	cubic metres per hour
m/s	metres per second
mg/L	milligrams per litre
mg/m^3	milligrams per cubic metre
mg/Nm^3	milligrams per normal cubic metre
mm	millimetre
Mt	megatonne
MW	megawatt
Nm^3/h	normal cubic metres per hour
NO_2	nitrogen dioxide
%	per cent
pH	measure of acidity and alkalinity
t	tonne
t/a	tonnes per annum
t/h	tonnes per hour
TJ/d	terajoules per day
µm	micrometre

APPENDIX A

CONSULTATIVE ENVIRONMENTAL REVIEW GUIDELINES ISSUED BY THE ENVIRONMENTAL PROTECTION AUTHORITY

GUIDELINES FOR THE CONSULTATIVE ENVIRONMENTAL REVIEW ON THE PROPOSED QUICKLIME PRODUCTION FACILITY AND LIMESTONE QUARRIES NEAR WANNEROO

These Guidelines are issued to assist in identifying matters that should be addressed within the Consultative Environmental Review (CER). They are not exhaustive and other relevant issues may arise during the preparation of the document; these should also be included in the CER.

The CER should facilitate review of the key environmental issues. The CER is intended to be a brief document: its purpose should be explained, and the contents should be concise and accurate as well as being readily understood. Specialist information and technical description should be included where it assists in the understanding of the proposal. It may be appropriate to include ancillary or lengthy information in technical appendices.

Where specific information has been requested by a Government Department or the Local Authority, this should be included in the document.

1. Summary

The CER should contain a brief summary of:

- salient features of the proposal;
- alternatives considered;
- conservation values of proposed mining areas;
- description of receiving environment and analysis of potential impacts and their significance to this development;
- environmental monitoring and management programs, safeguards and commitments; and
- conclusions.

2. Introduction

The CER should include the following:

- identification of proponent and responsible authorities;
- background and objectives of the proposal;
- brief details of the scope and timing of the proposal;
- relevant statutory requirements and approvals; and
- scope. purpose and structure of the CER.

3. Need for the Proposal

The CER should examine the justification for the proposal, particularly in relation to current and future demand for quicklime production. Broad costs and benefits of the proposal at local and regional levels could also be discussed.

4. Evaluation of alternatives

The proponent should discuss alternative resources, locations and scales of operation for the proposed mine and plant site, including use of the Rivervale site operated by the company at the moment.

The impact on the operation of omitting those areas which are shown to have high conservation values from the mining area should be considered. Alternative mine planning strategies and the future land uses for the rehabilitated mine sites should be discussed.

5. Description of proposal

The document should provide detailed descriptions of the important elements of the proposal. Use of uncomplicated plans, diagrams and maps is encouraged, to facilitate review of the data.

The descriptions should specifically include:

- cadastral information on proposed mining sites, gas pipeline alignment and plant site;
- mining operation, mining rate, workforce requirements;
- overburden management and rehabilitation practices;
- mine site and plant facilities and services;
- transport of limestone from mine sites to plant site;
- plant construction;
- plant process description;
- storage of limestone and quicklime product;
- plant input requirements;
- anticipated noise levels, emissions, waste products and disposal methods;
- product transport;
- project schedule; and
- anticipated project life.

An indication of the ultimate proposed capacity of the plant should be provided. Changes at a later date to the ultimate capacity as stated in the CER may require additional assessment.

6. Description of existing environment

The CER should provide an overall description of the environment at the proposed mining areas, gas pipeline alignment and quicklime production facility. An appraisal of the physical and ecological systems likely to be affected by the proposal should be made.

Specific items to be addressed are:

- regional setting of the mine sites, gas pipeline and plant site;
- physical environment, including climate, landforms, soils, geology, quality and distribution of the limestone resource, hydrology and ground water resources;
- biological environment, including the distribution of any rare species of flora and fauna and an assessment of conservation values in a regional context; and
- human environment, including the location of nearby residents, relevant planning issues, historical, aboriginal archaeological and ethnographic sites, background noise levels. land uses, infrastructure, landscape values.

In particular, aspects of the environment relevant to, or impacted by, mining, transport, processing and the project workforce should be discussed.

The existence of a rare eucalypt species has been established and the proponent must fully describe the distribution and ecology of this species within the area to be affected and relate this to the overall status of the species. Details of proposed research work should be defined in consultation with the Department of Conservation and Land Management.

7. Environmental impact and management

The CER should describe the overall effect on the environment of the mine sites, gas pipeline and quicklime plant. Impacts during the construction and commissioning should be addressed separately from impacts of the plant once it is fully operational. Impacts should be quantified where possible, and criteria for making assessments of their significance should be outlined. Compliance with relevant

standards and statutes should be demonstrated. The CER should indicate approaches that will be adopted to ameliorate and manage the identified impacts.

The following potential impacts should be considered:

- effects on geomorphology, land stability and landscape;
- effects on drainage and water quality (surface and ground);
- effects on biota, particularly on any rare or endangered species;
- effects of emissions (air and noise);
- management of solid and liquid wastes;
- Impact on conservation and recreational values at the proposed mining sites, gas pipeline route, and plant site and adjacent areas;
- effects on access and transport systems including degradation of road pavements;
- effects on existing contingency planning, safety, and emergency services; and
- visual impact, including the use of buffer zones and appropriate siting and orientation of access and haul roads.

There should be detailed discussion of plans for progressive restoration of the mining areas and management strategies for the rare flora populations.

Details of the likely chemical and physical composition of any gaseous solid and liquid wastes should be given, along with detailed plans for their containment and disposal. An estimate of the type and quantity of gases likely to contribute to the greenhouse effect should be made.

If significant air pollutants are likely to be released from the plant, then predictions should be made of likely ground level concentrations. Unless it is shown by "worst case" analysis that ground level concentrations will be below acceptable levels by a reasonable margin, the proponents will need to carry out a detailed computer modelling exercise of air emissions using meteorological data representative of the area. Discussion should also include identification of any odour-producing processes and details of the measures to be taken to control their emission to the atmosphere.

There should be predictions of the levels of noise emissions from the operating plant. These levels should be compared with current background noise levels in all likely affected areas for all times of night and day. Reference to residential locations should be made when identifying noise impacts. Predicted noise emissions should indicate the likely presence of special characteristics (eg tonal components) which may affect the level of annoyance generated by the noise.

"Worst case" scenarios should be described, with the rate of occurrence of these conditions being indicated.

The discussion of air, dust and noise emissions should make special reference to the way in which seasonal wind patterns are likely to modify the impacts. Interaction with the impacts of other existing developments should be addressed.

Compatibility of the project with structure and basic raw materials planning for the north west corridor by the Department of Planning and Urban Development and the City of Wanneroo should be addressed, particularly in relation to future regional road, open space and urbanisation proposals.

An environmental management programme should be described, based on and cross-referenced to the potential impacts, to demonstrate the manner in which those impacts can be ameliorated. Those persons responsible for the management should be clearly identified, as should management administration, costs and funding.

Specific commitments should be given to all components and procedures of the environmental programme.

The CER should include an indication of the likely life of the project and preliminary plans for the decommissioning of the plant and rehabilitating the site should be given.

8. Monitoring

The systems for the treatment and control of air noise and water pollution will require monitoring to ensure that they are operating effectively and efficiently. The receiving environment will also require monitoring to ensure that the environmental impacts are constrained to an acceptable level.

The specification of the monitoring systems should be given and responsibility for the operation of that system should be assigned. Emphasis should be placed on how the environmental management programme and operations at the plant and mine will be adapted where necessary in the light of monitoring or auditing results.

Procedures should be outlined for reporting the results of the monitoring of environmental impacts to the appropriate authorities.

The proximity and density of the population around the operations may increase in future, hence any commitment to frequency and types of monitoring programmes should reflect this.

9. Public consultation

A description should be provided of public consultation activities undertaken by the proponent in preparing the CER. This should outline the activities, the groups or individuals involved and the objectives of the activities. A summary of concerns raised should be documented along with how each of these concerns has been addressed.

10. Commitments

Where an environmental problem has the potential to occur the proponent should cover this potential problem with a commitment to rectify it. Where appropriate, the commitment should include:

(a) who is responsible for the commitment and who will do the work;

(b) what is the nature of the work;

(c) when the work will be carried out;

(d) where will the work be carried out (if relevant); and

(e) to whose satisfaction the work will be carried out.

A set of well written commitments covering the key environmental issues of the proposal will help to expedite assessment of the proposal.

In addition, a standard commitment regarding decommissioning the plant is requested by the Authority. The substance of the commitment can be seen in the recommendations of recent Environmental Protection Authority assessment reports.

11. Conclusions

Conclusions of the overall impacts of the proposal should be stated, together with an assessment of the environmental acceptability of the project.

Additional Information

Guidelines

A copy of these guidelines should be included in the document.

References

All references should be listed.

Appendices

Where detailed technical or supporting documentation is required, this should be placed in appendices.

Glossary

A glossary should be provided in which all technical terms, and unfamiliar abbreviations and and units of measurement are explained in everyday language.

How to make a Public Submission

The CER should include instructions to members of the public as to how they can make a submission to the Environmental Protection Authority. These instructions should be at the beginning of the document.

APPENDIX B

RESULTS OF THE MAY 1990 BOTANICAL SURVEY OF THE WESCO LEASE

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Acacia alata						1				1						1												1	1						1	
Acacia lasiocarpa																							1				1	1	1	1	1					
Acacia pulchella	1	1			1		1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1		1				1		1		1
Acacia rostellifera		1	1		1	1																														
Acacia saligna																																				
Acacia truncata		1			1	1				1						1																			1	
Acanthocarpus preissii								1	1					1				1				1					1									
Allocasuarina fraseriana	1			1				1																												
Allocasuarina humilis	1									1		1	1	1		1	1		1	1	1	1	1	1		1	1			1		1	1	1		1
Anigozanthos humilis																																				
Anigozanthos manglesii									1									1	1							1							1	1		
Astroloma humifusum										1				1		1		1											1						1	
Astroloma pallidum																				1																
Banksia attenuata				1									1	1				1		1	1			1	1								1			1
Banksia grandis	1			1									1							1																
Banksia menziesii																									1											1
Bossiaea eriocarpa		1			1	1							1		1					1	1					1	1	1			1					
Burchardia umbellata				1		1		1		1		1		1									1		1		1	1	1	1	1	1	1			1
Calothamnus quadrifidus	1	1			1	1			1				1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1
Carpobrotus edulis				1										1																						
Cassytina recemosa					1		1	1		1			1						1				1	1					1		1					
Comesperma confertum																																				
Conostephium pendulum												1									1															
Conostylis aculeata ssp. preissii	1											1								1							1									
Conostylis pauciflora		1	1	1	1	1		1	1			1		1	1		1		1			1	1	1					1	1	1	1				1
Conostylis setigera	1				1							1	1	1				1	1	1	1			1		1						1		1		
Cryptandra arbutifolia																																				
Dianella revoluta							1																							1						1
Diplolaena grandiflora																																				
Diplopeltis huegelii																1																				
Drosera erythrorrhiza	1	1	1		1	1	1	1	1	1		1	1	1	1		1	1	1	1	1	1	1			1	1	1	1	1	1	1		1		1
Drosera macrantha	1	1			1		1					1				1				1						1		1	1			1		1	1	
Dryandra nivea		1	1		1		1	1	1	1		1	1	1	1		1	1	1	1		1		1		1	1		1	1	1	1		1		1
Dryandra sessilis	1	1	1	1	1	1	1	1	1	1		1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Eriostemon spicatus																																				
Eucalyptus calophylla																																				
Eucalyptus decipiens																									1			1								
Eucalyptus foecunda																																			1	
Eucalyptus marginata																																				
Eucalyptus petrensis																																				
Gompholobium capitatum	1	1			1	1	1				1		1		1																					
Gompholobium tomentosum	1												1				1				1															
Grevillea thelemanniana ssp (?)		1			1		1	1		1	1				1	1			1			1				1	1		1	1	1				1	
Grevillea vestita var vestita																																				
Hakea costata																	1					1		1			1				1		1			
Hakea lissocarpha					1	1						1		1	1		1		1	1		1		1		1					1					1
Hakea prostrata		1		1					1					1			1	1					1	1		1		1						1		1	
Hakea ruscifolia																																				
Hakea trifurcata	1	1			1	1		1	1	1		1	1		1	1	1	1	1	1	1	1	1		1		1	1		1	1	1	1	1	1	
Hardenbergia comptoniana		1			1		1	1				1																	1							
Hemiandra pungens	1				1	1			1	1	1		1		1		1	1	1			1	1					1						1		
Hibbertia glaberrima			1		1	1											1	1			1		1			1					1					1
Hibbertia hypericoides	1	1	1	1	1	1		1	1	1		1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hovea trisperma																		1		1								1								
Hybanthus calycinus	1																1										1									
Hypocalymma angustifolium				1																																1
Isotropis cuneifolia													1																							
Jacksonia sternbergiana				1																				1												
Jacksonia ulicina	1	1	1	1					1	1		1	1	1			1	1		1	1		1	1		1	1	1		1	1	1		1		1
Kennedia prostrata	1									1																										
Lepidosperma angustatum	1		1		1		1			1				1	1	1		1	1							1			1						1	1
Leptospermum laevigatum																	1																			
Leucopogon oxycedrus		1							1	1			1				1							1						1	1					
Leucopogon parviflorus		1			1	1	1	1		1					1	1						1				1			1					1	
Leucopogon polymorphus		1								1		1	1	1			1			1	1	1	1	1			1	1	1	1	1	1	1	1	1	
Leucopogon propinquus																																				
Leucopogon reflexed																																				
Lomandra sp.	1	1								1				1	1		1			1										1			1			
Loxocarya cinerea	1	1			1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1		1			1	1	1					1		1
Lyperanthus nigricans												1								1	1															
Lysinema ciliatum										1																										
Lysinema ciliatum																																				
Macrozamia riedlei																																				1
Melaleuca acerosa	1	1	1		1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1	1	1
Melaleuca huegelii										1						1																			1	
Mesomelaena stygia	1	1			1				1			1	1	1	1		1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1		1
Mirbelia spinosa									1																											
Nuytsia floribunda					1								1		1								1		1							1	1	1		
Olax benthamiana																																				
Olearia axillaris		1																																		
Olearia rudis					1																															
Opercularia vaginata																																				
Pattersonia occidentalis																					1															
Pelargonium capitatum		1					1											1		1		1	1												
Petrophile linearis																																				
Petrophile media				1								1																								
Petrophile serruriae					1				1							1	1			1	1			1				1							1	
Petrophile striata												1						1		1		1		1	1								1			1
Phyllanthus calycinus	1	1		1		1	1	1		1																										
Pimelea ferruginea																																				
Pimelea floribunda																																				
Pithocarpa pulchella																			1																	
Prasophyllum parvifolium																																		1		
Pterostylis vittata																																				
Scaevola canescens												1								1																
Scaevola crassifolia						1	1				1																									
Scaevola dielsii						1				1	1					1			1																1	
Schoenus grandiflorus			1			1																														
Sphaerolobium vimineum						1				1																										
Stylidium sp. A																																				
Stylidium sp. B					1																															
Stylidium striatum													1	1			1			1						1										
Templetonia retusa		1			1		1				1																									
Thomasia triphylla					1	1										1																				
Thyanotus patersonii																							1				1									
Thysanotus dichotomus																																				
Trymalium ledifolium					1	1	1				1					1													1							
Verreauxia reinwardtii																																				
Xanthorrhoea preissii	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
Xanthosia pusilla	1									1			1														1									

SPECIES	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
Acacia alata																	1				1						1								1	
Acacia lasiocarpa	1		1	1	1			1	1	1		1	1	1	1	1		1	1	1	1	1	1			1				1		1	1	1		1
Acacia pulchella						1		1					1	1					1					1	1					1					1	1
Acacia rostellifera																																				1
Acacia saligna																																				
Acacia truncata								1									1	1	1	1	1					1	1								1	1
Acanthocarpus preissii			1																		1											1				
Allocasuarina fraseriana											1																									
Allocasuarina humilis	1					1		1				1	1							1			1	1	1					1			1			
Anigozanthos humilis																								1						1						
Anigozanthos manglesii							1																									1				
Astroloma humifusum		1						1	1										1		1					1									1	1
Astroloma pallidum																																	1			
Banksia attenuata											1			1															1							
Banksia grandis											1																	1			1					
Banksia menziesii																																				
Bossiaea eriocarpa	1	1	1				1	1											1	1		1			1								1		1	
Burchardia umbellata	1	1	1	1			1	1		1	1	1	1		1	1		1	1	1		1		1	1	1			1	1			1		1	1
Calothamnus quadrifidus	1	1	1	1	1	1	1	1				1	1	1	1	1		1	1	1		1	1	1	1	1			1	1	1	1	1		1	1
Carpobrotus edulis																																				
Cassytina recemosa					1	1			1	1						1	1	1	1	1	1					1	1							1		
Comesperma confertum															1							1														
Conostephium pendulum																																				
Conostylis aculeata ssp. preissii														1																1						
Conostylis pauciflora			1			1		1			1					1		1				1			1	1		1				1	1	1	1	
Conostylis setigera						1								1										1												
Cryptandra arbutifolia									1	1																										
Dianella revoluta																																				
Diplolaena grandiflora																																		1		
Diplopeltis huegelii									1	1											1															1
Drosera erythrorrhiza	1	1	1	1		1	1	1			1	1	1	1	1	1		1	1	1		1	1	1	1	1		1	1	1	1	1	1	1	1	1
Drosera macrantha	1	1							1	1	1						1	1	1		1	1				1	1		1	1	1	1		1	1	1
Dryandra nivea	1		1	1	1			1	1	1			1		1	1			1				1	1	1	1	1					1	1	1	1	1
Dryandra sessilis	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Eriostemon spicatus																																				
Eucalyptus calophylla											1																	1								
Eucalyptus decipiens	1					1	1															1								1						
Eucalyptus foecunda																																				
Eucalyptus marginata																																				
Eucalyptus petrensis																	1																			
Gompholobium capitatum																		1																		
Gompholobium tomentosum																									1						1	1				
Grevillea thelemanniana ssp (?)	1	1	1	1	1				1	1						1	1	1	1	1	1	1				1	1					1	1	1		1
Grevillea vestita var vestita																																				
Hakea costata							1	1					1	1						1		1	1	1	1								1			
Hakea lissocarpha	1		1										1	1	1	1		1		1		1			1		1	1	1			1	1	1	1	1
Hakea prostrata	1	1		1				1							1							1		1	1				1				1			
Hakea ruscifolia																						1														
Hakea trifurcata	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1		1	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1
Hardenbergia comptoniana									1	1		1					1				1						1	1							1		1
Hemiandra pungens			1				1			1					1			1					1		1	1		1		1		1	1			
Hibbertia glaberrima		1				1	1	1					1				1		1							1				1	1	1	1		1	1
Hibbertia hypericoides	1	1	1	1	1	1	1	1			1	1	1	1	1	1		1	1	1	1	1	1	1	1	1			1	1	1	1	1		1	1
Hovea trisperma		1											1	1					1												1					
Hybanthus calycinus																						1										1				
Hypocalymma angustifolium																																				
Isotropis cuneifolia																																				
Jacksonia sternbergiana																																				
Jacksonia ulicina	1			1			1	1			1		1	1		1								1									1			
Kennedia prostrata											1						1																		1	1
Lepidosperma angustatum				1				1							1				1		1	1				1						1	1			
Leptospermum laevigatum																																				
Leucopogon oxycedrus	1					1							1		1							1								1						
Leucopogon parviflorus		1	1		1								1		1		1		1	1	1						1								1	1
Leucopogon polymorphus	1		1	1	1	1	1	1					1	1	1	1				1	1		1	1		1			1	1		1			1	1
Leucopogon propinquus																																				
Leucopogon reflexed																				1																
Lomandra sp.																																				
Loxocarya cinerea	1	1	1		1	1		1	1		1	1	1		1	1	1	1	1	1	1	1				1	1								1	
Lyperanthus nigricans																							1			1	1				1	1	1			
Lysinema ciliatum																																			1	
Lysinema ciliatum	1				1	1	1	1																												
Macrozamia riedlei																																				
Melaleuca acerosa	1	1	1	1	1	1	1		1	1		1	1	1	1	1		1	1	1	1	1	1		1				1	1	1	1		1		1
Melaleuca huegelii		1			1				1								1	1		1	1					1	1							1		
Mesomelaena stygia	1			1			1				1		1	1	1	1						1			1					1		1				
Mirbelia spinosa																							1													
Nuytsia floribunda						1	1				1			1									1					1		1	1					
Olax benthamiana										1																										
Olearia axillaris																																				
Olearia rudis																																				
Opercularia vaginata								1																												
Pattersonia occidentalis																																				
Pelargonium capitatum																	1					1														
Petrophile linearis																																				
Petrophile media																																				
Petrophile serruriae	1							1								1																				
Petrophile striata								1																												
Phyllanthus calycinus																1																				
Pimelea ferruginea																	1	1			1					1	1									
Pimelea floribunda																																				
Pithocarpa pulchella																																				
Prasophyllum parvifolium	1																															1				
Pterostylis vittata				1																											1					
Scaevola canescens																																				
Scaevola crassifolia										1																								1		
Scaevola dielsii										1							1				1					1	1									
Schoenus grandiflorus																																				
Sphaerolobium vimineum			1				1	1																		1						1				
Stylidium sp. A																														1		1				
Stylidium sp. B																																				
Stylidium striatum																								1	1							1				
Templetonia retusa			1						1								1																1		
Thomasia triphylla		1															1			1															
Thyanotus patersonii				1					1					1					1																	
Thysanotus dichotomus																																				
Trymalium ledifolium									1	1							1	1		1	1					1								1		
Verreauxia reinwardtii																																				
Xanthorrhoea preissii	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Xanthosia pusilla																														1						

SPECIES	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	103	104	105	106	107	108	SUM
Acacia alata																																	1	1		12
Acacia lasiocarpa		1		1	1		1	1						1			1				1			1			1		1			1	1	1		44
Acacia pulchella						1			1			1			1							1		1	1	1				1					1	44
Acacia rostellifera												1																								6
Acacia saligna																		1																		1
Acacia truncata								1																												17
Acanthocarpus preissii		1			1		1		1						1																					14
Allocasuarina fraseriana									1									1																		6
Allocasuarina humilis			1			1				1					1	1		1			1		1		1	1		1			1	1				44
Anigozanthos humilis																																				2
Anigozanthos manglesii									1						1	1	1				1							1			1					15
Astroloma humifusum								1									1																			16
Astroloma pallidum																																				2
Banksia attenuata						1				1					1			1				1				1									1	20
Banksia grandis																									1	1										9
Banksia menziesii										1								1																		4
Bossiaea eriocarpa	1													1																						24
Burchardia umbellata	1	1				1					1		1	1			1	1							1	1			1			1		1	1	54
Calothamnus quadrifidus	1	1	1	1	1	1	1		1	1		1	1	1	1	1			1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	84
Carpobrotus edulis																																				2
Cassytina recemosa		1	1					1																			1		1			1	1	1	1	32
Comesperma confertum																																				2
Conostephium pendulum																										1										3
Conostylis aculeata ssp. preissii				1					1										1	1	1	1	1					1	1							15
Conostylis pauciflora		1	1				1	1									1	1																		40
Conostylis setigera					1					1				1		1							1													21
Cryptandra arbutifolia																																				2
Dianella revoluta								1	1									1																		6
Diplolaena grandiflora																	1																			2
Diplopeltis huegelii																																				5
Drosera erythrorrhiza	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	92
Drosera macrantha	1			1				1	1		1	1	1	1										1	1	1	1		1		1		1			47
Dryandra nivea			1	1	1	1			1			1	1	1		1	1		1		1	1					1	1	1	1	1	1	1	1		67
Dryandra sessilis	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1		1	1	1	1	1	1	1		1	1	1	1	1	1	1		1	100
Eriostemon spicatus			1																																	1
Eucalyptus calophylla																										1										3
Eucalyptus decipiens									1					1											1						1				1	12
Eucalyptus foecunda																																				1
Eucalyptus marginata										1																										1
Eucalyptus petrensis																																				1
Gompholobium capitatum																																				9
Gompholobium tomentosum				1																																8
Grevillea thelemanniana ssp (?)				1	1			1						1		1	1		1				1	1			1	1	1			1	1	1		51
Grevillea vestita var vestita																													1							1
Hakea costata						1	1																						1	1		1				21
Hakea lissocarpha	1		1	1	1				1	1	1		1	1		1	1		1		1	1	1		1		1	1		1	1			1		52
Hakea prostrata					1							1		1	1			1			1					1										29
Hakea ruscifolia										1																										2
Hakea trifurcata	1		1			1	1	1							1	1			1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	81
Hardenbergia comptoniana		1							1		1						1					1											1	1		22
Hemiandra pungens	1			1	1		1										1				1	1			1					1	1			1		38
Hibbertia glaberrima	1				1		1				1			1			1						1		1	1						1			1	35
Hibbertia hypericoides	1		1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	96
Hovea trisperma				1						1		1																								11
Hybanthus calycinus																																				5
Hypocalymma angustifolium						1																				1										4
Isotropis cuneifolia																		1																1		3
Jacksonia sternbergiana									1									1								1				1						6
Jacksonia ulicina			1						1					1				1			1	1			1	1				1						42
Kennedia prostrata													1																					1		8
Lepidosperma angustatum					1		1												1													1				27
Leptospermum laevigatum																									1											2
Leucopogon oxycedrus							1																							1	1	1				18
Leucopogon parviflorus		1		1	1			1					1				1				1	1					1	1			1		1	1		37
Leucopogon polymorphus	1					1	1				1	1					1		1		1				1	1	1	1		1					1	55
Leucopogon propinquus									1										1							1										3
Leucopogon reflexed																																				1
Lomandra sp.																																	1			10
Loxocarya cinerea	1	1	1	1	1			1	1	1		1	1		1	1	1		1	1	1			1				1	1			1	1	1		68
Lyperanthus nigricans				1		1								1						1		1	1		1	1	1	1	1		1					21
Lysinema ciliatum																																				2
Lysinema ciliatum																																				5
Macrozamia riedlei									1									1								1										4
Melaleuca acerosa	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1		1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	90
Melaleuca huegelii		1						1									1										1						1	1		19
Mesomelaena stygia		1	1	1	1	1			1			1				1							1			1				1					1	49
Mirbelia spinosa						1																														3
Nuytsia floribunda	1													1						1			1	1	1						1				1	24
Olax benthamiana																																				1
Olearia axillaris																																				1
Olearia rudis																																				1
Opercularia vaginata																											1									2
Pattersonia occidentalis																																				1
Pelargonium capitatum																					1			1					1							11
Petrophile linearis									1																											1
Petrophile media																																				2
Petrophile serruriae			1		1									1										1				1							1	18
Petrophile striata						1								1				1												1						13
Phyllanthus calycinus									1								1	1	1		1	1		1	1		1		1			1	1	1		21
Pimelea ferruginea																																				5
Pimelea floribunda																																				0
Pithocarpa pulchella																																				1
Prasophyllum parvifolium																																				3
Pterostylis vittata																	1																			3
Scaevola canescens									1					1				1								1										6
Scaevola crassifolia																	1																			6
Scaevola dielsii																																				11
Schoenus grandiflorus																																				2
Sphaerolobium vimineum									1							1					1															10
Stylidium sp. A				1									1																							4
Stylidium sp. B																																				1
Stylidium striatum																1					1							1								11
Templetonia retusa								1																			1							1		11
Thomasia triphylla																																				6
Thyanotus patersonii			1		1			1								1																		1	1	12
Thysanotus dichotomus									1																											1
Trymalium ledifolium								1									1																1	1		18
Verreauxia reinwardtii									1									1																		2
Xanthorrhoea preissii	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	102
Xanthosia pusilla																																				5

APPENDIX C

RESULTS OF THE JULY-AUGUST 1990 BOTANICAL SURVEY OF THE WESCO ROAD LEASES

	SITE NUMBER (SCORE IS RELATIVE ABUNDANCE/SITE)																			
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**16**	**17**	**18**	**19**	**20**	**24**	**25**	**26**	**27**		
Scaevola canescens														1						
Scaevola crassifolia	2	+					2													
Scaevola thesiodes		4	2	2		1	1				1									
Senecio sp.				1	1															
Stipa compressa	1							+												
Stipa trichophylla																				
Stipa sp.											1							1		
Stylidium piliferum										1	+	1						2		
Stylidium repens					+	1						1								
Stylidium schoenoides	2	1		2	1															
Templetonia retusa			+			+					1		1							
Tetraria octandra									1	1	1			1			1	2		
Thomasia triphylla	1	+																		
Thysanotus arenarius	2	1	2	2																
Thysanotus asper										+										
Trycoryne elatior			1																	
Trymalium ledifolium	1	2		1	1		2	1												
Xanthorrhoea preissii	2	2	2	2	1	2	2		3	3	3	2	2	2		3	2	2		
* Identified as the common northern form, not the priority listed species																				
** Identified by the Western Australian Herbarium as Jacksonia stricta																				
+ very few / scarce																				
Rare, restricted, poorly known taxa, etc. in bold.																				

				SITE NUMBER (SCORE IS RELATIVE ABUNDANCE/SITE)																
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**16**	**17**	**18**	**19**	**20**	**24**	**25**	**26**	**27**		
Hemiandra pungens (lilac)	1			+		1		1	1				1				1	1		
Hibbertia racemosa	2	1	2	1	1	1			1		2	2		2		2	2			
Hibbertia hypericoides				2	2	3	2			2	3	3	3	3			3	3		
Hovea trisperma	1								1	1		1		1						
Hakea lissocarpha	1	1		1		1	1		2	2	1	2	1	1		1	1			
Jacksonia sericea**					1	2								1		2	1	1		
Kennedia coccinea														+						
Hypocheris glabra					2	3														
Lepidosperma angustatum	1	2	1	2			1			2	2	2	1	2		2	2	1		
Leptomeria preissiana	1		1	1					1	1	1		1	1		1		1		
Leucopogon oxycedrus												1					1			
Leucopogon parviflorus	2	2	2	2		2	2		1		2		2		2			2		
Leucopogon polymorphus	2	1	2	2		1	2		2	2							2	2		
Lomandra hermaphrodita	1		2			1	2		3	2	2	2		1		2	1			
Lomandra preissii												1								
Loxocarya cinerea	2	1	3		3	2	1	1	2	2		1	1	2		2	2	2		
Lysinema ciliatum											1									
Meleleuca acerosa	3	3	4		3		3	2		3	3	2		1		3	2	2		
Melaleuca huegelii	1	2	2					2			+		2							
Mesomelaena pseudostygia						1						1		1			1	1		
Nuytsia floribunda														1				1		
Olax benthamiana			+																	
Olearia axillaris					1															
Orobanche minor	+																			
Pelargonium capitatum							1											1		
Petrophile serruriae												1								
Phyllanthus calycinus					+	1														
Pimelia feruginea	1	1	1	1			1													
Pimelia floribunda				1					1											
Pithocarpa pulchella										1										

	SITE NUMBER (SCORE IS RELATIVE ABUNDANCE/SITE)																	
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**16**	**17**	**18**	**19**	**20**	**24**	**25**	**26**	**27**
Acacia alata	1	3	4	4	1				+									
Acacia rostellifera								3										
Acacia pulchella var. reflexa	1	1		2	1	2	1		1	1	2	2	2	2		2	2	3
Acacia truncata	2	2	1	2			2		2	2	1							
Allocasuarina humilis					1		1			2	1	2	2	1		1		2
Astroloma microcalyx	1	4	+	2		+			2									2
Astroloma pallidum												1						
Anigozanthos manglesii														3		2	1	3
Acanthocarpus preissii																	1	
Bossiaea eriocarpa						1	1		1	2	1	1	2	1			1	
Burchardia umbellata	1			+		1				1		1	1				2	
Calothamnus quadrifidus	1	2			1	2	3	2		2	2	2	2	2		2	2	2
Carpobrotus edulus														+		1		
Cassytha racemosa	1	+	2	1	1	1	1	1		1	1	1						
Conostylis pauciflora*		+		2	2	1	2			1		1	2	1		1	1	2
Conostylis setigera												1					1	
Cryptantra arbutiflora		+			+													
Danthonia caespitosa					1	1							1	2		1		1
Drosera sp.	1	2	2															
Dryandra nivea	2	+		1	3	2	2		2	2	2	1	2			2		2
Dyandra sessilis	2	2	1	1	2	2	2		3	2	2	2	3	2		2	2	2
Chamelaucium uncinatum	1																	
Eriochilus cullcullatus	+	+						+					1	1				1
Eucalyptus 'argutifolia'				1														
Eucalyptus foecunda			+	2														
Eucalyptus 'petrensis'				2		2												
Gompholobium tomentosum												1		2				
Grevillea thelemanniana		1	1	1	2			2			1	2	1	1			1	
Hakea costata					1	2										1		
Hakea prostrata					1		1		+		1	1			1	2	1	
Hakea trifurcata					2	1										1	2	1
Hardenbergia comptoniana	1																	

APPENDIX D

WESTERN AUSTRALIAN MUSEUM LISTING OF MAMMAL AND HERPETOFAUNA SPECIES

APPENDIX D

WESTERN AUSTRALIAN MUSEUM LISTING OF MAMMAL AND HERPETOFAUNA SPECIES

MAMMALS

Bos taurus
Ovis aries
Cercartetus concinnus
Macropus fuliginosus
Macropus irma
Mus musculus
*Isoodon obesulus**
Trichosurus vulpecula
Tachyglossus aculeatus
Tarsipes rostratus

HERPETOFAUNA

Pogona minor minor
Tympanocryptis adelaidensis adelaidensis
Liasis stimsoni
Demansia psammophis reticulata
Notechis coronatus
Notechis curtus
Notechis scutatus occidentalis
Pseudonaja affinis affinis
Rhinoplocephalus gouldii
Vermicella bertholdi
Vermicella bimaculata
Vermicella calonotos
Vermicella semifasciata
Crenadactylus ocellatus ocellatus
Diplodactylus granariensis granariensis
Diplodactylus polyophthalmus
Diplodactylus spinigerus spinigerus
Phyllodactylus marmoratus marmoratus
Underwoodisaurus milii
Litoria adelaidensis
Litoria moorei
Heleioporus eyrei
Myobatrachus gouldii
Aprasia repens
Delma grayii
Lialis burtonis
Cryptoblepharus plagiocephalus
Ctenotus fallens
Ctenotus impar
Cyclodomorphus branchialis
Egernia napoleonis
Hemiergis quadrilineata
Leiolopisma trilineatum
Lerista elegans
Lerista lineopunctulata
Lerista praepedita
Menetia greyii
Morethia lineoocellata
Morethia obscura
Ramphotyphlops australis
Varanus gouldii
Varanus tristis tristis

* *Fauna rare or declared likely to become extinct.*

APPENDIX E

SOUND POWER LEVELS ESTIMATED FOR MOBILE AND STATIONARY PLANT AND EQUIPMENT

APPENDIX E

SOUND POWER LEVELS ESTIMATED FOR MOBILE AND STATIONARY PLANT AND EQUIPMENT IN dB(A)

Item no.	Description	Surface area (m^2)	Octave band frequency									
			32	63	125	250	500	1k	2k	4k	8k	Overall
Stationary plant and equipment												
1	Elevator drive	24	80	80	83	85	88	88	87	82	74	94.3
2	ID fan	24	106	109	109	106	103	99	96	93	85	114
3	ID fan building	250	96	99	99	96	93	89	86	83	75	104
4	Belt elevator	54	83	83	86	88	91	91	90	85	77	97.3
5	Dispatch fan	54	91	91	89	87	86	84	85	79	62	96.9
6	Air compressors	124	91	91	90	88	88	90	94	93	89	100
7	Conveyor drive from crusher	54	83	83	86	88	91	91	90	85	77	97.3
8	Mill drive	124	97	97	100	102	107	107	106	99	91	113
Total			107	110	110	108	109	108	107	101	94	117
Mobile equipment												
9	35 t off-road trucks (6)		104	112	119	119	118	120	119	113	106	126
10	D9 dozers (2)		99	107	114	114	113	115	114	108	101	122
11	Front-end loaders (2)		99	107	114	114	113	115	114	108	101	122
Total			106	114	121	121	120	122	121	115	108	129

APPENDIX F

INFORMATION LEAFLET OUTLINING PROPOSAL FOR LOCAL RESIDENTS/ LANDOWNERS

SWAN PORTLAND CEMENT LTD

PROPOSED QUICKLIME PRODUCTION FACILITY, NOWERGUP

GUIDELINES FOR COMMUNITY INPUT

WHAT IS BEING PROPOSED?

Swan Portland Cement Ltd proposes to construct a quicklime manufacturing plant on a 4 hectare site just south of Wesco Road at a point approximately 1.6 km from its junction with Gibbs Road. Limestone for the plant will be supplied from nearby freehold land and mineral leases. The attached map provides siting details.

WHAT IS INVOLVED?

Since the early 80's the demand for quicklime in the alumina, gold, mineral sand, wastewater treatment and other process industries has increased. Second only to sulphuric acid as a base chemical, quicklime and by-products from quicklime are one of the most widely used group of chemical materials in today's economy.

The production of quicklime (also known as calcium oxide) is achieved by the heating of limestone or other materials which are rich in calcium carbonate.

Swan Portland proposes to produce 230,000 tonnes of quicklime per year by mining 450,000 tonnes of limestone from its Nowergup leases every year.

WHEN WOULD WORK START?

Subject to obtaining environmental approval, and all other approval requirements being met, construction of the quicklime production facility would commence in the third quarter of 1991, with plant commissioning scheduled for the third quarter of 1992. Limestone would be delivered to the plant for processing in the third quarter of 1992.

The twelve month construction phase would employ 120-150 people and ongoing operations would provide permanent jobs for 20-25 people.

HOW IS THE PROPOSAL BEING EXAMINED?

The project is subject to decision making by Swan Portland and by Government authorities. Swan has conducted an internal feasibility study whilst referring the project to the State Government under the Environmental Protection Act 1986.

HOW IS THE ENVIRONMENTAL ASSESSMENT CONDUCTED?

Swan Portland advised the Environmental Protection Authority of its intentions in August 1990. Based on this advice, the EPA determined that a formal assessment of the potential environmental impacts was required. This assessment will be compiled in a Consultative Environmental Review (CER).

The CER will be produced by Swan Portland in accordance with EPA guidelines and submitted to the EPA. The CER will then be available for public comment for a period of four weeks. Matters raised by organizations, government departments and the public will be referred to Swan Portland by the EPA for the company's response.

WHAT WILL THE CER CONTAIN?

The CER will consider the environmental and social implications of such aspects of the project as:

- Fauna and flora
- Groundwater
- Solid and liquid wastes
- Emissions to the atmosphere
- Future land use/rehabilitation
- Social impacts
  - dust
  - noise
  - traffic
  - visual impact
  - landscaping
- Local economic effects.

HOW CAN I GIVE MY VIEW?

A public information session will be held at the proposed quicklime plant site at Wesco Road on 12 January 1991 between 10.00 a.m. and 3.00 p.m. Signs will be in place on Wesco Road indicating the location of the public information session.

You are welcome to attend the session and to talk with Swan Portland representatives.