STATE GRAVEL SUPPLY STRATEGY

GOVERNMENT OF WESTERN AUSTRALIA

FINAL REPORT
MARCH 1998

Foreword

The Government of Western Australia has acted to avert any possible shortage of gravel or other materials needed for the State's road construction and maintenance programs.

Gravel and other road building materials (RBMs), such as crushed hardrock and limestone, have played an important part in Western Australia's development over the past 150 years.

Expansion of the road network, rapid urban and other development, competing land uses and growing community concern for the environment have combined to produce shortages of readily accessible RBMs in some areas, and the potential for future shortages in others.

The situation has been exacerbated to some extent by an approaching need to commence a major road rehabilitation and maintenance program on the thousands of kilometres of sealed road built throughout the State in the 1950's and 1960's.

In 1994, the Western Australian Coalition Government established the State Gravel Supply Strategy Group (SGSSG), an expert body with wide government and industry representation.

In September 1996, the SGSSG released a Strategy for Public Comment. This latest document recognises the input and contributions from those public submissions. Its release marks the final stage in the development of a Strategy aimed at ensuring the availability of high quality readily accessible and reasonably priced Road Building Materials into the decades ahead.

The most significant changes from the document released for public comment are:

- The expansion of the Management Group to include a representative from the Western Australian Farmers Federation in addition to Main Roads Western Australia, Department of Minerals and Energy and the Western Australian Municipal Association.
- Review of sections involving the new Local Government Act to recognise implications of recent changes.
- Additional information on the spread of noxious weeds.
- Recognition of changes to operational procedures by Main Roads.
- Recommendations to protect strategically based sources of dieback-free gravel.

Main Roads has been requested to prepare a detailed action plan with full costing and clearly defined outputs that will achieve the objectives of the Strategy. These actions will be prioritised and the beneficiaries will be identified.

We are pleased to approve in principle, the final Strategy document, and authorise the establishment of the Management Group to report to the Minister for Transport within four months of the Group being established.

The Management Group has been requested to develop resourcing and funding alternatives taking into account the need for the beneficiaries to make an equitable contribution to the cost of the work.

Hon Eric Charlton, MLC
Minister for Transport

Hon Cheryl Edwardes, MLA
Minister for the Environment

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Steering Committee

STATE GRAVEL SUPPLY STRATEGY

STEERING COMMITTEE

Mr Ralph Moore	Chairman - Main Roads Western Australia (retired Dec 8, 1995)
Ms Jane Aberdeen	WA Chamber of Mines and Energy
Mr Frank Batini	Department of CALM
Mrs Marion Blackwell	National Parks and Nature Conservation Authority
Mr James Duggie	Conservation Council of WA
Mr Graham Higgins	Department of Land Administration
Mr Peter Kata	WA Municipal Association (resigned Aug 8, 1995)
Mr Frank Peczka	WA Municipal Association (commenced Oct 27, 1995)
Mr Gary Larkin	WA Chamber of Commerce and Industry
Mr Chris O'Neill	Ministry for Planning (resigned Aug 8, 1995)
Mr Max Poole	Ministry for Planning (commenced Aug 8, 1995)
Mr Brett Loney	Main Roads Western Australia (resigned Feb 17, 1995)
Mr Gary Norwell	Main Roads Western Australia
Mr Graeme Rundle	WA National Parks and Reserves Association
Mr Daryl Schorer	Department of Local Government
Mr Tony Smurthwaite	Department of Mines and Energy
Mr Warren Tacey	Department of Environmental Protection
Mr Alan Colegate	Secretary - Main Roads Western Australia

Executive Summary

1.0 INTRODUCTION

1.1 Gravel and other road building materials (RBMs) have traditionally been regarded in Western Australia as a readily available resource to which access is assured; but in recent times their availability and accessibility have diminished.

1.2 Because they are a finite resource, RBMs must diminish over time. Their reduced availability is compounded by historic attitudes which restrict the search for RBMs to materials which meet fixed quality criteria and which are near the point of use. One consequence of this is increased pressure for access to RBMs in national parks and nature reserves.

1.3 Accessibility to RBMs is also diminishing in the face of greater community awareness of environmental values, and the demands of competing land uses. This is particularly evident in South West WA.

1.4 The legislative framework for securing RBMs did not foresee these trends.

1.5 The State Gravel Supply Strategy Group (SGSSG) was established by the Hon. Minister for Transport and the Hon. Minister for the Environment in 1994 to address issues which are affecting the supply of gravel and other RBMs. The group was required to report on options for facilitating future access to these materials.

1.6 The following organisations are represented on the SGSSG:

- Main Roads Western Australia
- Department of Conservation and Land Management
- Department of Minerals and Energy
- Department of Land Administration
- Department of Environmental Protection
- Ministry for Planning
- WA Chamber of Commerce and Industry
- WA Chamber of Mines and Energy
- WA Municipal Association
- National Parks and Nature Conservation Authority
- Conservation Council of WA
- WA National Parks and Reserves Association

1.7 The SGSSG was set the following terms of reference:

(1) To conduct an audit to determine the present and projected requirements for RBMs in WA, and resources available.

(2) To identify issues and opportunities affecting State Government, local government and private operator access to materials for road building from Crown and private land.

(3) To examine options to improve access to, and make optimal use of, RBMs while ensuring protection of other values - including landscape and conservation - and providing for rehabilitation and compensation, as appropriate.

(4) To determine the adequacy of current and planned legislation, policies and procedures to achieve all of the above.

(5) To report and make recommendations to the Hon. Ministers for the Environment and Transport.

1.8 To meet the terms of reference, the SGSSG:

- identified key issues to be addressed,
- conducted a survey of Local Governments (LGs) to audit gravel resources and identify areas of current and possible future shortages,
- engaged consultants to undertake case studies which would augment the results of the survey, and to develop a strategy which addressed the key issues,
- distributed the draft strategy to stakeholders for comment, and
- considered the responses and modified the draft accordingly.

This document is the outcome of the above process.

2.0 SUMMARY OF FINDINGS

Definition

2.1 Because the present report deals with gravel and a range of other RBMs, the latter term is commonly used. The term "gravel" refers specifically to laterite gravel.

Potential Resource

2.2 An investigation of potential RBMs undertaken for the present study indicated that in most areas they were adequate to meet demands. However, supply problems do arise, stemming from a range of factors, including:

- Farmers' reluctance to permit access to their land because of perceived meagre compensation and/or concerns about inadequate rehabilitation, and an associated unwillingness by some LGs to seek gravel from freehold land.
- An expectation that Crown land, including the CALM-managed estate, should be readily accessible. Significant constraints affect access to the latter; and there is a particular concern to protect the CALM estate in the Wheatbelt, where it accounts for only 4.5 per cent of the total land area.
- Inadequate forward planning stemming from the ready availability in the past of gravel near the point of use.
- Lack of an adequate database on the location, quality and quantity of RBMs.
- Inadequate knowledge of alternatives to gravel, and of additives which can improve low-quality materials.
- Insufficient budgeting to meet the increasing costs of obtaining RBMs.

Demand

2.3 It is estimated that 5.4 million cubic metre of RBMs are used annually in WA, valued at between $50 and $60 million. Usage is unlikely to fall in the foreseeable future, and could rise to as much as 10 million cubic metres a year.

2.4 In the South West, the cost of gravel extraction ranges from $1 to $6 a cubic metre, or $9.90 to $14.00 delivered on site, placed and compacted. In the North West, costs are higher - $60.20 a cubic metre at Broome and $69.20 at Port Hedland.

2.5 For comparative purposes, the cost of obtaining laterite gravel for a recent project on the Great Eastern Highway was $6.40 a cubic metre, with an average 20 kilometre lead. If crushed rockbase had been used, the cost would have been $22.80 a cubic metre, with an average 80 kilometre lead. Each kilometre of this road required about 3,000 cubic metres of base course and cost $375,000 using laterite gravel. The cost would have been $406,000 a kilometre, or 14 per cent higher, if rockbase had been used.

2.6 As the road network becomes established, demand for gravel will focus on asset (road) replacement rather than building new roads. Sites which provided materials for original construction will be accessed again to provide materials for maintenance.

Legislation

2.7 Legislation in WA recognises the need to maintain access to RBMs, but competing land uses and emerging environmental values have altered priorities and exposed weaknesses in the legislative framework.

2.8 Legislative provisions vary in matters such as rights of access and compensation payable by the State Government, local government and private industry.

2.9 Current legislation offers little security of tenure during exploration for RBMs, and the option of creating a gravel reserve to provide security is too lengthy a process.

2.10 Regulation of extraction activities is inconsistent. In the Perth metropolitan area, multiple approvals are often needed; while in some rural LGs, there is little or no control.

Case Studies

2.12 Case studies involving 15 LGs revealed a variety of approaches to securing and using RBMs, a range of problems faced, and a range of initiatives taken to deal with the problems. Key observations included:

- lack of information on distribution of the resource,
- problems caused for some LGs by the loss of access to resources on Crown land,
- varying experience in gaining access to freehold land; with difficulties commonly stemming from a legacy of poor rehabilitation in the past and/or inadequate compensation, and access more readily available where these matters had been satisfactorily addressed,
- some LGs using alternatives or additives to broaden the available resource, but others lacking the knowledge or experience to do so,
- despite the strict policies on access to CALM-managed land, a number of LGs have worked cooperatively with CALM and met requirements to obtain access,
- while the standard of rehabilitation has improved, there is scope for further improvement, and
- LGs must have access to competent engineering and environmental expertise to allow sound forward planning and cost-effective use of RBMs, and to provide a satisfactory standard of environmental management and rehabilitation.

3.0 ISSUES AND ACTION

Five principal issues have been identified.

3.1 Issue 1

The lack of a comprehensive database on the potential resources of gravel and other suitable RBMs, and of current and on-going demand.

The study goes some way towards establishing use patterns and indicating the distribution of the resource. However, much remains to be done, including taking account of the changing nature of demand, locating materials to meet that demand, and looking at alternative materials and additives.

3.2 Issue 2

The reduced access to, and security of, RBMs because of competing land uses.

Conflicting land uses and growing environmental awareness have reduced the availability of, and accessibility to, RBMs - particularly in areas of high growth, where the demand for resources is greatest. Legislation allows access to resources and provides for compensation, but inequities exist and widely varying approaches to gravel extraction need to be addressed.

3.3 Issue 3

The increasing cost of securing, excavating and using RBMs.

As well-located, high-quality resources diminish - or are sterilised by competing land uses - the cost of RBMs will rise. Haul distances will increase, there will be greater recourse to costly alternatives or additives to upgrade lower quality materials, and there may be a need for higher quality materials to meet more demanding construction standards.

Some LGs are discouraged from seeking RBMs from private farmland because of costs or difficulties in securing approval. Others seeking material from the CALM-managed estate must meet strict requirements, which can raise objections and impose added costs.

Some LGs have inadequate machinery, which limits efficiency in extracting gravel and can affect the quality of subsequent rehabilitation.

Technical expertise is often lacking to assist planning, ensure efficient use of resources, assess options for alternatives and additives, and ensure appropriate environmental management and satisfactory rehabilitation.

Against this background, it must be recognised that past access to low-cost resources cannot be sustained, and that future access must be guided by an improved information base and by full assessment of the merits of competing land uses. Additional costs are inevitable.

3.4 Issue 4

The need to recognise environmental values when obtaining and using RBMs.

Road builders must become better environmental managers, recognising the value of remnant vegetation when targeting extraction areas. They must adopt responsible extraction techniques and improve the standard of rehabilitation so that resources are not unnecessarily sterilised by concerns that extraction will cause unacceptable environmental damage.

3.5 Issue 5

The lack of an appropriate legislative and administrative framework to ensure efficient procurement and use of RBMs.

Addressing the issues raised above requires development and application of both legislative and administrative measures.

Legislation must protect resources from sterilisation, ensure security of tenure, and provide for an adequate standard of rehabilitation.

Administrative support will encompass:

- developing an adequate database of needs and resources, which will require a cooperative effort,

- identifying important deposits in regional plans, and fostering co-operative exploration to prove resources to meet local requirements,

- securing improved environmental performance and rehabilitation,

- ensuring that the necessary engineering and environmental expertise is available to LGs, and promoting information sharing to assist the above objectives,

- developing guidelines on costs for securing gravel from the various land tenures, and establishing standard bases for compensating affected landowners, and

- developing appropriate by-laws to improve management of extraction sites.

4.0 THE RECOMMENDED STRATEGY

4.1 A continued expectation of low-cost materials for road construction is unrealistic in today's climate and cannot be sustained without continued conflict between road builders and landowners/land managers. The price of materials must reflect not only the economic cost of extraction, but the cost of environmental and productive values forgone, and the cost of satisfactory site rehabilitation. The least cost source of RBMs may no longer be the closest source.

4.2 A draft strategy has been developed which provides the foundation for a change of attitude by road builders and funding agencies. The strategy acknowledges that increases in the cost of RBMs are inevitable as easily accessible resources diminish. Cost increases can be minimised through a coordinated and focussed approach, which will produce a number of benefits:

- road builders will be assisted to plan their operations better by adopting improved exploration, operational and rehabilitation programs,

- road builders will be encouraged to offer equitable and consistent compensation to landowners, providing a greater incentive for cooperation and removing some of the current obstacles to access,

- the real cost of securing resources from both CALM-managed land and freehold land will be recognised; providing a sound basis for road builders to assess the merits of seeking resources from one source or another, and

- conservation and efficient use of resources will be encouraged, and use of alternatives and additives will be fostered.

4.3 To coordinate implementation of the strategy, the SGSSG proposes establishment of a management group comprising members of the corporate executives of Main Roads, the Department of Minerals and Energy, Western Australian Farmers Federation and the WA Municipal Association. It would employ a small body of specialist staff with executive support from Main Roads. The group should have achieved most of its tasks within three to five years; its role would be reviewed at the end of these two periods.

The group would require an annual budget of $500,000, which represents only 0.1 per cent of WA's road building budget of $500 million. This is a minor cost compared with the economic, environmental and social benefits that would flow from implementation of the strategy. In fact, the benefits would offset this cost many times over through better definition of resources, improved data on their availability, more efficient use, reduced incidence of disputes and improved processes for dispute resolution.

4.4 The key objectives and tasks of the management group would be:

Objective 1

To determine short, medium and long-term demands for RBMs, and identify resources to meet the demands.

The group would:

- compile and maintain a database of regional and local needs for RBMs,
- initiate field surveys and compile and maintain a database of RBMs, and
- encourage research into improved techniques for identifying RBMs.

Objective 2
To ensure availability of RBMs and security of supplies for asset replacement and growth estimates within land use planning and environmental constraints.

The group would:

- ensure that local/regional plans protect areas containing important deposits of RBMs, and allow for end uses following their extraction,
- assess the road building resource in areas being considered for inclusion in the CALM-managed estate so that, where justified, boundaries or management requirements are modified to permit access,
- assist negotiations between CALM, NPNCA and other affected LGs or Main Roads to secure balanced outcomes on resource availability,
- maximise availability of RBMs by developing guidelines on access to private land and an equitable system of compensation, and
- advise how existing legislation may be used more effectively to protect RBMs.

Objective 3
To improve efficiency in the extraction and use of RBMs, recognising them as a commodity of value.

The group would:

- prepare cost-benefit analyses for securing RBMs from CALM-managed land and land in other tenures,
- encourage shared regional exploration for RBMs by LGs,
- encourage LGs and Main Roads to improve efficiencies in extracting gravel through initiatives such as using common pits, equipment sharing and use of contractors,
- investigate potential for re-use of old gravel pits,
- encourage research into RBM alternatives and additives,
- facilitate information sharing on access and extraction, and
- encourage LGs to broaden their technical expertise.

Objective 4
To ensure that appropriate environmental standards are applied to extraction and use of RBMs, and to rehabilitation of extraction sites.

The group would:

- discourage extraction of RBMs from areas of remnant vegetation,
- encourage LGs to adopt adequate standards of dieback management when obtaining and using RBMs,
- encourage LGs and Main Roads to adopt practices for minimising the spread of noxious weeds by RBM extraction activities,
- foster rehabilitation of abandoned pits and progressive rehabilitation of current pits,
- modify rehabilitation guidelines to meet the varying environmental conditions and requirements in different regions,
- pursue the recommendations of the Working Party on Conservation and Rehabilitation in the WA Quarrying Industry,
- facilitate information sharing on environmental aspects of access and extraction, and on rehabilitation methods, and
- advise how powers in existing legislation can be used more effectively to improve rehabilitation performance.

1.0 Introduction

1.1 BACKGROUND TO THE PREPARATION OF THE STRATEGY

Lateritic gravel and other road building materials (RBMs) such as limestone, colluvium, and crushed hard rock have traditionally been regarded in WA as a readily available resource with access assured through appropriate legislation. However, in recent times the "availability" and the "accessibility" of RBMs have diminished.

Being a finite resource, the availability of the RBMs must inevitably diminish over time. This is particularly relevant when historic attitudes and expectations restrict the search for RBMs to resources meeting certain specific quality criteria, and which are close to the road project.

Accessibility to resources is also diminishing in the face of contemporary community expectations with regard to environmental values, and competing land uses. In the South West and Esperance regions, in particular, land alienation, increasing development and depletion of gravel resources have created concerns regarding the long-term availability (and hence increasing cost) of materials suitable for road construction and maintenance. One consequence is increasing pressure for access to gravel resources in national parks and nature reserves.The legislative framework developed for seeking and acquiring RBMs did not foresee these circumstances.

Accordingly, the Government has proposed to formulate a State Gravel Supply Strategy to address the above issues.

The State Gravel Supply Strategy Group (SGSSG) was convened to formulate the strategy based on the following terms of reference:

(1) To conduct an audit to determine the present and projected requirements for, and availability of, RBMs in WA.

(2) To identify issues and opportunities affecting the State Government, Local Government and private operators having access to RBMs on Crown and private land.

(3) To examine the options for improving access to - and making optimal use of - RBMs, while ensuring protection of other values, including landscape and conservation; and providing for rehabilitation and appropriate compensation.

(4) To determine the adequacy of current and planned legislation, policies and procedures to achieve all of the above.

(5) To report and make recommendations to the Ministers for the Environment and Transport.

The SGSSG identified a number of issues through preliminary investigations and conducted a questionnaire survey of Local Governments (LGs) to assist in determining present and projected requirements. Consultants were engaged to develop the strategy and carry out a series of case studies to augment the SGSSG's preliminary findings.

The consultancy team comprised:

LANDVISION
Urban and environmental planning

MUIR ENVIRONMENTAL
Environmental impact evaluation

QUILTY ENVIRONMENTAL
Environmental management

DAVID WILCOX & ASSOCIATES
Natural resource management and agricultural science

EVANGELISTI & ASSOCIATES
Civil and environmental engineers

This report was prepared by the consultants under the supervision of the SGSSG. It follows a preliminary draft which was issued to stakeholders for review. Their comments were considered when amending the draft to provide the present version, which is being released for public comment. Following public submissions, the strategy will be

modified, as appropriate, for presentation to the Ministers for the Environment and Transport.

1.2 APPROACH TO THE STRATEGY

The consultancy team conducted wide investigations to develop the preliminary issues identified by the SGSSG and to include additional issues. The investigations included an extensive review of relevant Main Roads Western Australia (Main Roads) files and of the local government survey. This provided a basis for an audit of the State's gravel resources on a Local Government area basis. The outcome of the audit is based on the best information currently available (see Sections 2 and 3).

Legislation affecting access to RBMs also was examined to determine its adequacy to meet current circumstances (Section 4). In addition, 15 case studies were undertaken in selected areas (Section 5) involving interviews with relevant State Government and Local Government officers. Representatives of the WA Farmers Federation, the Pastoralist and Grazier Association and the Chamber of Commerce and Industry also were interviewed.

The results of the audit, the case studies and the examination of legislation resulted in identification of a number of key issues; and suggested action to address them and meet the objectives of the strategy (Section 6).

Section 7 describes the recommended strategy. It provides the basis for a coordinated approach to achieve the strategy's objectives and suggests a funding mechanism to meet its requirements.

Recommendations on an administrative structure to implement the strategy are detailed in Section 7.

2.0 The Gravel Resource

2.1 WHAT IS GRAVEL?

For the purposes of this strategy, gravel is defined as "a naturally occurring material which is suitable for use as base (including shoulders) or sub-base in road construction". As this covers materials other than gravel, the term "road building materials" (RBMs) is used in this report rather than gravel.

The definition requires some explanation of the physical characteristics of materials needed for road-building and the component parts of a typical road pavement.

Apart from "gravel" or RBMs for use as base or sub-base, road construction may also require material for embankments, as well as sand for primer sealing and concrete, or rock for concrete and embankment protection.

2.2 PHYSICAL REQUIREMENTS FOR ROAD BUILDING MATERIALS

A typical road structure is depicted in Figure 1.

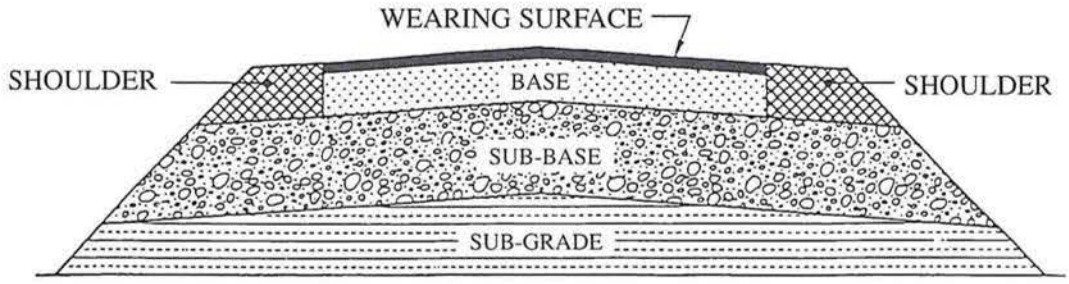


Figure 1 - Typical road structure

The **wearing surface** of a road may be asphalt, bituminous seal or, in the case of an unsealed road, the upper surface of the base material. The purpose of the wearing surface is to provide a seal which is resistant to deterioration from tyre friction and to prevent water from entering the pavement. The base is that part of the pavement which can support the load of traffic without permanent deformation. It reduces stresses and strains on the sub-grade to acceptable limits.

The **shoulder** is a compacted extension of the base material which extends the road width for safety purposes.

Sub-base is usually an inferior base-course material. Its purpose is to reduce the base thickness, and therefore cost. Sub-base material may have wider size distribution limits, can be coarser, and does not require the same high strength as the base. A greater range of materials are acceptable for sub-base, with a correspondingly lower cost.

Sub-grade is the material immediately below the sub-base. It may consist of the material at natural ground level, it may be material exposed in a cutting, or it may be fill material. It is not generally obtained from gravel supply sources, but is provided from road cuttings or borrow pits located out of sight of the road.

Embankment material is used to raise the pavement to improve drainage or to improve the vertical alignment of the road. Where possible, granular low-plasticity materials are used. However, most materials, including heavy clays, may be suitable for fill.

Ideal RBMs, as defined for this study, are materials with a particle size distribution which, during compaction, allows each particle size to fit into the voids created by the inter-particle contact with the next size in the range. This allows a dense matrix of material to be compacted easily to a state of high stability and strength.

A material with an excess of fines is difficult to compact and has a poor wet strength. Alternatively, if a material is deficient in fines, it will form a harsh and permeable surface.

Because clay provides cohesion, some clay is desirable in a pavement. This is especially so on shoulders or unsealed pavements where the clay tends to waterproof the surface and allow water to be shed. However, too much clay causes a material to weaken rapidly in response to small increases in moisture content.

A high proportion of silt will cause water to have an adverse effect on the strength of the road pavement. This results from the predominance of small size voids becoming filled with water.

A moderately angular particle shape is desirable, so that good mechanical interlocking occurs and the particles resist movement after compaction.

Particle size affects both stability and workability. In general, the biggest particles which can provide a good surface finish should be used. In practice, particle size should be no greater than 30mm. Individual particles should have sufficient strength to resist physical effects, and should be chemically durable.

Ironstone laterite is considered the best naturally-occurring gravel. Many laterites are well-graded and have strength characteristics and durability similar to base-course manufactured from crushed rock.

Laterite gravels are common in WA, but quality varies widely and deposits are often unsuitable. Although they are the most sought-after gravels, natural gravels of almost every common rock type have been used successfully as base-course in WA.

Some common base-course materials are described below.

2.3 TYPES OF ROAD BUILDING MATERIALS

2.3.1 Lateritic Gravels - Plates 1 to 3

Pisolitic laterite, which is known as lateritic gravel, is the product of peneplanation (erosion by rain and rivers which eventually removes all elevated sites) in the Tertiary period in a climate much different to that prevailing today. It has been the basic road-making material in WA since early settlement - except on the coastal strip, where limestone and marl are used as alternatives.

Typically, the laterite profile comprises a gravel layer less than one metre thick overlying clay, sometimes with an intervening hard layer of duricrust, or caprock. The limited thickness of the gravel layer means that large areas must be disturbed to obtain the quantities required for road building; a one-metre thick layer will yield only 10,000 bank cubic metres per hectare. Removal of this layer complicates subsequent rehabilitation because the underlying clay has a lower infiltration capacity and water storage characteristic than the coarse gravel.

Laterite gravel deposits traditionally have been freely available, occurring in low ridges and outcrops which are easy to access and quarry. Today, with agricultural development in the Wheatbelt and in the Southern Sandplains at its limit, remaining gravel deposits often occur in areas of remnant vegetation, uncleared because of their unsuitability for agricultural purpose or the fact that they were set aside for environmental reasons.

Much of the remnant vegetation, particularly larger areas, are preserved by the Department of Conservation and Land Management (CALM) as nature reserves. Smaller areas still exist on freehold land where, in many cases, they are jealously guarded by farmers and others who prize them for the intrinsic worth of the flora they support, their aesthetic appeal, their contribution to the support of native fauna, and for the protection they offer stock in periods of stress.

The geological process of landscape formation in the Wheatbelt and Southern Sandplains has hidden other reserves of laterite beneath a sandy mantle called - in agricultural terms - gravelly, grey or yellow sandplain. These remnants of the Great Plateau are potential sources of laterite gravels, although the depth of useful road-making material and its quality for this purpose varies.

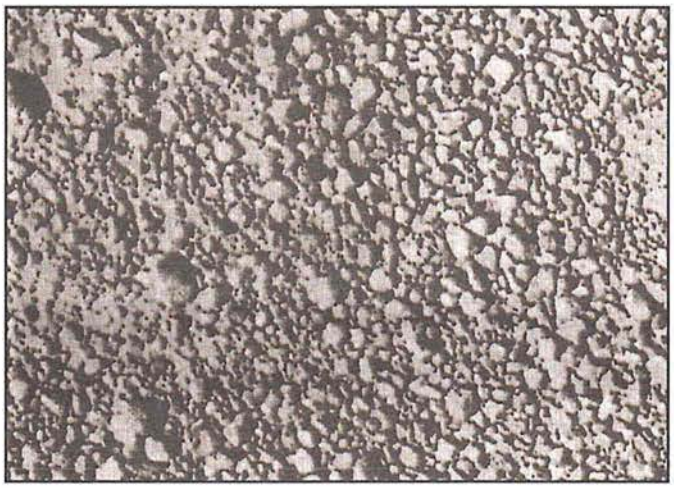


PLATE 1
Typical Laterite from the Darling Scarp, east of Perth

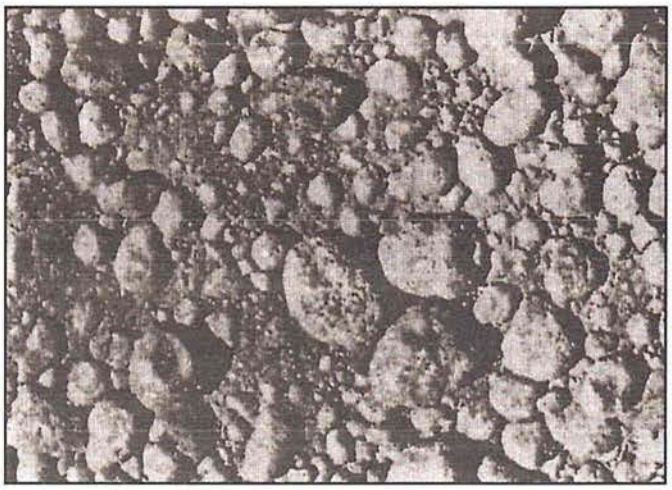


PLATE 2
Coarse Laterite Gravel from near Paynes Find on Great Northern Highway

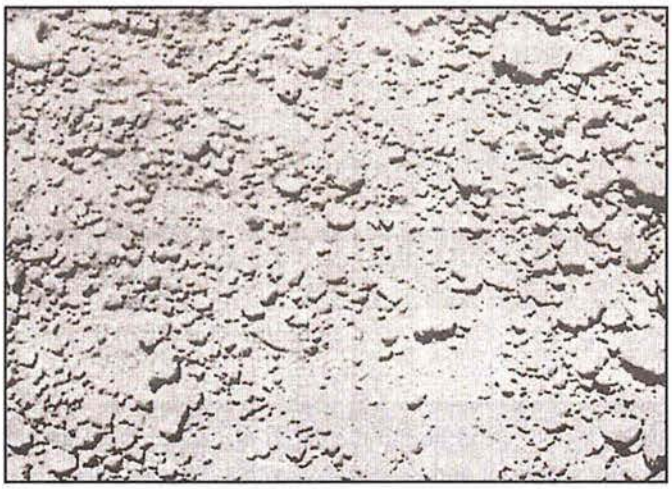


PLATE 3
Fine Plastic Laterite from near Meekathara on Great Northern Highway

PLATE 4
Limestone Gravel (Popcorn Gravel) from Bullara Station on the Minilya - Exmouth Road

PLATE 5
Limestone Gravel from Winning Pool Station on North West Coastal Highway

PLATE 6
Shelley Limestone Gravel from near Shark Bay on the Hamelin - Denham Road

Elsewhere on WA's Great Plateau, where Sandplains are not so well developed, massive ironstone duricrusts, or caprock, are common. Gravels are frequent in pockets in the more dissected terrain of this part of the State.

In the Goldfields, colluvial deposits (loose soil and rock material on slopes) of lateritic gravels up to five metres thick can be found. Generally, however, they lack the clay component which binds the ferruginised nodules together. In other parts of the pastoral areas, for example to the west of Wiluna, lateritic gravels are found in widely scattered remnants or in more extensive sheets in the remains of the Great Plateau surface.

2.3.2 Other naturally-occurring road building materials

Lateritic gravels are the most sought after materials for road building because they are well graded and have good strength characteristics. However, other naturally occurring RBMs can be used as base courses. They include:

Limestone gravel (Plates 4-7)

Limestone gravel is formed by the geological weathering of calcareous sedimentary rock and occurs over most of the State. The Oakover Beds in the Pilbara are an example. Some limestone gravels may be similar in appearance to lateritic gravel, but others are of marine origin.

Marl

In coastal areas of the Northern Sandplains, small deposits of marl are being used by LGs as road base. The Coorow and Carnamah Shires are two LGs which have had some success in its use as an alternative to lateritic gravel.

Scree gravels (Plates 8-11)

Scree gravels lie on the slopes of hills which are weathering naturally. They often contain oversize material which must be removed mechanically, or broken down using a grid roller. Screes produced from basic igneous rocks tend not to be suitable for road making because of their plasticity.

Hardpan (Plates 12 & 13)

Hardpan may be converted to materials suitable for road building during extraction. It is the laminated cemented layer beneath the thin soil veneer of the southern interior.

Colluvial materials

Stony, transported gravels in a matrix of fine material may also be used for road making where the formations are extensive enough and of sufficient quality.

Pindan sands or other clayey sand (Plate 14)

In some instances, clayey sands (commonly called Pindan) have been suitable for road-making purposes when processed and laid in association with stabilised sands.

River shingle (Plate 15)

River shingle on the banks of active rivers or in ancient drainages can be used if associated with suitable fine material. They can be improved by screening and crushing.

2.3.3 Additives and stabilisers

Additives are sometimes used with inferior RBMs to alter their properties so that they are suitable for road construction. There are three common types of stabilisation using additives - mechanical, chemical and bitumen.

Mechanical stabilisation involves blending in other materials to alter plasticity or to improve particle size distribution.

Chemical stabilisation involves altering material properties by mixing in small amounts of a chemical additive. The two most common additives for this purpose are lime and cement, both of which have the potential to reduce plasticity and increase shear strength. Laboratory investigation is usually necessary to determine which additive is appropriate for a given material.

Bitumen stabilisation involves addition of small quantities of bitumen, generally in the form of

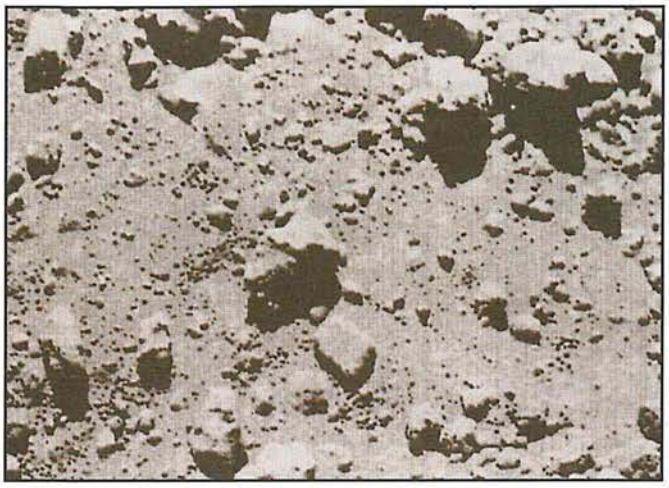


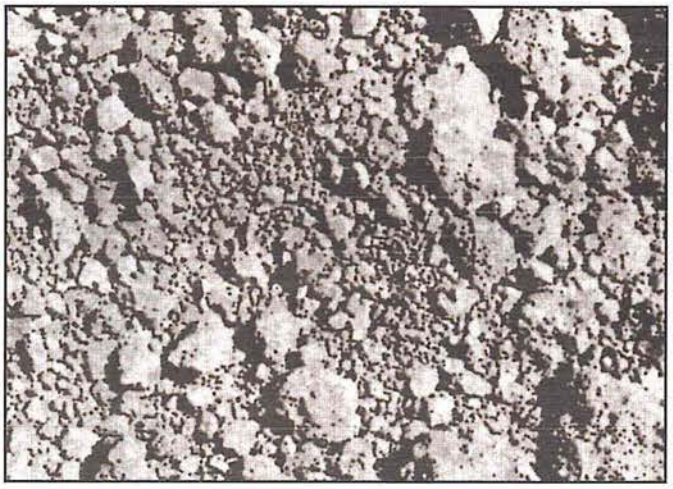
PLATE 7
Crushed Coastal Limestone from the Perth Metropolitan Area

PLATE 8
Banded Ironstone Scree Gravel from the Ord Ranges of Port Hedland

PLATE 9
Ironstone Scree Gravel from near Newman on Great Northern Highway

PLATE 10
Quartz and Scree Gravel from near Wickham

PLATE 11
Decomposed Granite from near Cranbrook on Albany Highway



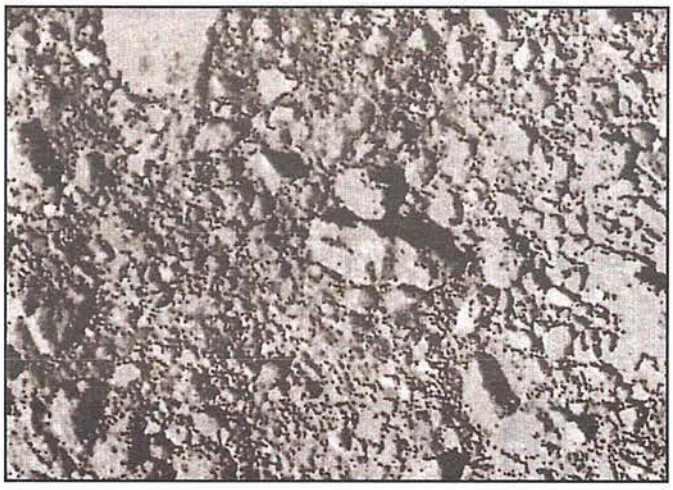


PLATE 12
Plastic Hardpan from near Meekatharra on Great Northern Highway

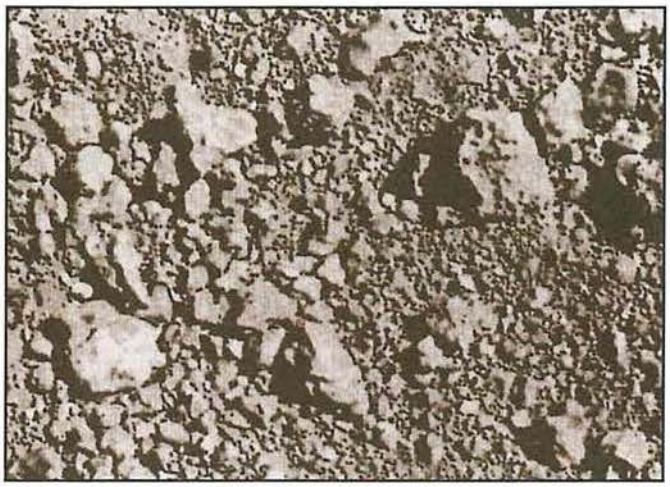


PLATE 13
Non Plastic Hardpan from near Cue on Great Northern Highway

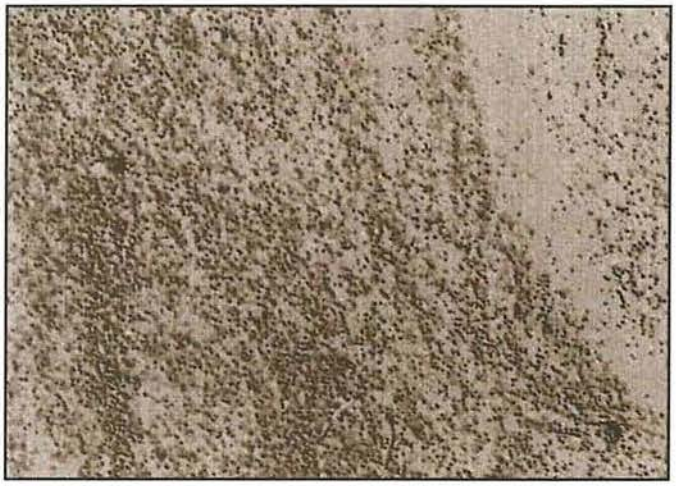


PLATE 14
Red Sand Clay from North West Coastal Highway south of Carnarvon

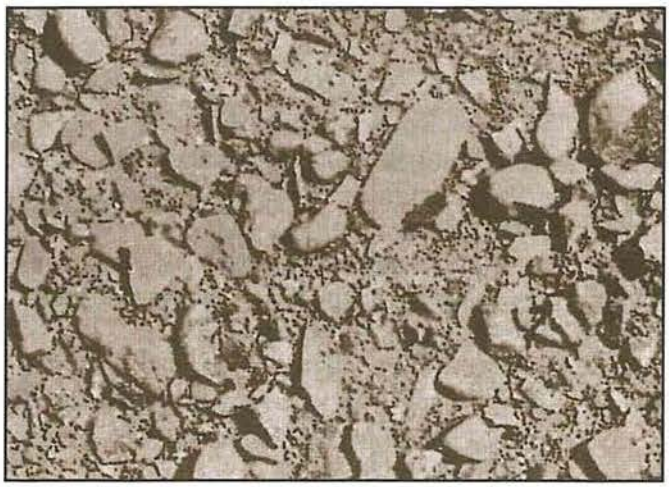


PLATE 15
River Shingle from the Jones River east of Roebourne on North West Coastal Highway

bitumen emulsion. The addition improves workability, assists seal adhesion and reduces moisture sensitivity.

2.4 THE POTENTIAL ROAD BUILDING RESOURCE

2.4.1 Methodology

A comprehensive investigation of the potential road-building resource was carried out for the South West of WA, including the Shires of Ravensthorpe and Esperance. For the rest of the State, the investigation was limited to case studies at Roebourne, Broome and Wyndham-Kununurra (see Section 5).

In each case, the investigation did not quantify the resource. Rather, it indicated where there were potential resources and provided an outline of the constraints to access.

Several sources of data were used for this purpose. They were:

(a) 1:250,000 geological series maps and explanatory notes produced by the Geological Survey Division (GSD) of the Department of Minerals and Energy (DME).

(b) Environmental geology series maps produced at various scales by GSD.

(c) Soils maps at 1:100,000 and 1:50,000 produced by Agriculture WA and the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

(d) Regional studies produced by the Departments of Conservation and Land Management (CALM) and Ministry for Planning (MFP), such as the Leeuwin-Naturaliste Ridge Study and the Albany Region Study.

(e) Atlas of Australian Soils (CSIRO) at 1:2,000,000.

(f) Questionnaire responses from LGs (see Appendix 1) and discussions with shire officers.

(g) Discussions with Main Roads officers.

The GSD's regional geological maps provided the primary source of data on alternative materials such as colluvium, limestone and other rock resources. However, there were problems with the use of these maps to determine the distribution of laterite resources. There were differing interpretations by geologists on the availability of resources, particularly beneath the sandplain veneer so common in the Wheatbelt, from the south coast to the Northern Sandplains.

Initially, lateritised ground was regarded as part of the weathered mantle (or regolith) obscuring crystalline rocks. Later map series tended to be more useful than earlier maps, but the approach taken by different authors when differentiating weathered mantle products (gravel and sand) was inconsistent.

The GSD's Environmental Geology Series maps were particularly useful as they identified all mineral resources with an economic content, and included gravel in the assessment. GSD's regolith maps (1:100,000) generally were not considered because they are for areas outside the South West Land Division.

Soil survey maps produced by Agriculture WA and CSIRO provided useful information on the distribution of laterite resources. They were available at a scale of 1:50,000 or 1:100,000. Their use permitted a higher level of discrimination of potential resources in areas of low overall potential. In particular, they enabled an assessment to be made of the potential of the Sandplains for laterite reserves. The soils information was supplemented with information from the Agriculture WA, CALM, the Atlas of Australian Soils, and regional studies.

The potential resource was then described for each LG and an assessment made of the available lateritic gravel resources.

Four classes of availability were adopted (Table 1).

Table 1

Potential Lateritic Gravel Resource - Availability Classes

Class	Description
1	Sufficient material; evenly spread throughout and with few constraints to use.
2	Sufficient material; evenly spread but with some constraints.
3	Scattered resources; a poor distribution of, and often limited, resources, necessitating long hauls from resource to area of operations.
4	Scarce resources; neither lateritic nor limestone resources available except in very limited quantities in the LG area.

While the assessment was made on the basis of lateritic gravel, including duricrust or caprock, it included limestone in areas where it was used freely and there was no lateritic resource available.

In the South-West and Esperance areas, laterite gravel resources are being depleted by rapid development and increasing land alienation. However, because the use of colluvial material and hard rock or scree materials is rare in the South West Land Division, it did not seem appropriate (or meaningful) for the assessment to include these materials because the information could give a misleading picture of the availability of conventional laterite gravel RBMs. However, the availability of alternative materials is indicated in Table 4.

2.4.2 Factors constraining access to the potential resource

The "potential" lateritic, limestone and marl resource is not the same as the resource actually available when social and other constraints restricting access are taken into account.

The available resource determined for each LG was therefore qualified by an accessibility factor (see Table 2). This takes account of a range of access constraints, including the presence of national parks, nature reserves and State forest, and freehold land, as well as resource distribution and quality.

Account is not taken of remnant native vegetation where it occurs outside the protection of national parks and nature reserves because there is insufficient data on its distribution. However, the importance of protecting this vegetation is recognised at 6.7.1 and 6.8.1.

Better definition of the location of remnant vegetation outside the reserves system, particularly in the Wheatbelt, may warrant consideration by the management group proposed in 7.1.

Table 2 Constraints Impinging Upon the Potential Resource in the South-West & Esperance Regions	
Constraint	**Description**
a1	Nature reserves and national parks where access to gravel for purposes other than those connected with the reservation (eg. maintenance of roads) is not permitted.
a2	CALM State forest block areas. There may be multiple land uses in these areas. Access varies from place to place and is always subject to negotiation with CALM under Special Policy Guidelines.
a3	Freehold land which LGs are unwilling to enter for RBMs. Some LGs regularly use resources on freehold land.
d	An uneven distribution of potential resource areas in LGs such that distance may make their use uneconomic.
q	Quality considerations where the potential resource is intrinsically unsuitable for road making or is not suitable in that particular environment.

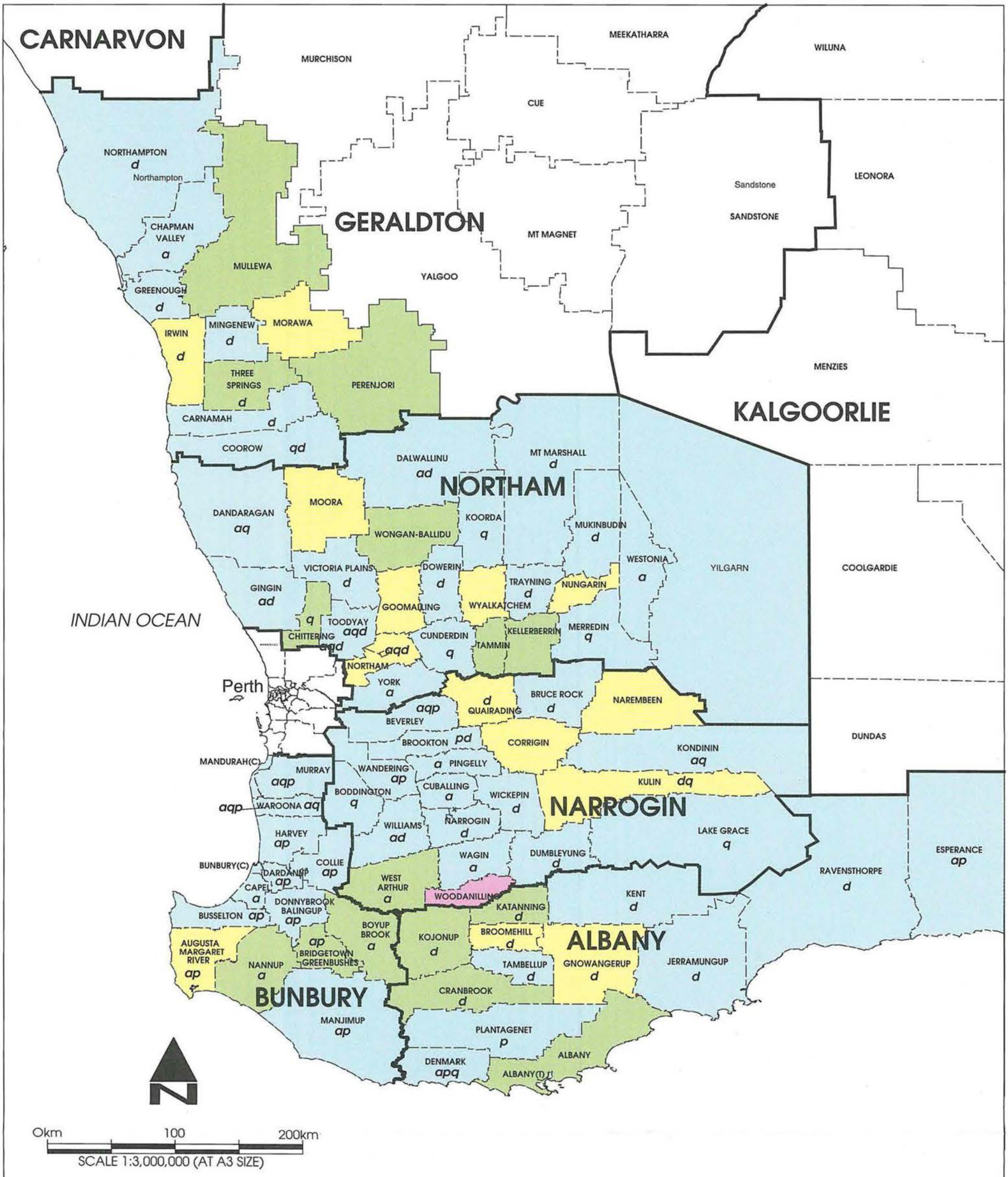
The same constraints would apply to the use of colluvial and hard rock resources, but they have not been considered in the classification.

2.4.3 Ranking LGs on the basis of available road building resources

The use of availability classes, qualified by accessibility constraints, made it possible to rank each LG area and to indicate the issues for a particular area. For example, a LG classified as 2a1d has adequate resources, but is constrained both by access problems (such as a nature reserve) and the comparatively poor distribution of the resources, which would increase the cost of road construction.

Figure 2 indicates the ranking given for each LG in the South West, including Ravensthorpe and Esperance. Table 3 summarises the information from which each ranking has been derived. This information includes the results of the audit, supplemented by Grants Commission estimates of the cost of installation of base-course and sub-base in each LG.

A distinction should be recognised between reference to gravel supplies in the "commentary" column and to gravel reserves in the "shire comments" column of Table 3. The first has been determined for the present study as outlined at 2.4.1, while the second is shire opinion based on local knowledge, which (as indicated in Section 6.1) can be formed on inadequate data.



AVAILABILITY CLASSES

- Sufficient resources - evenly spaced, few constraints.
- Sufficient resources - evenly spread, constrains exist.
- Scattered resources - poor distribution.
- Scarce resources.

CONSTRAINTS

- *a* - Access is difficult or not possible. (CALM managed lands or freehold land)
- *d* - Distribution is irregular across Local Authority.
- *q* - Quality is suspect in some parts of Local Authority
- *p* - Dieback control provisions are constrain access.

LEGEND

- MRWA Divisional boundaries
- Local Government boundaries

LANDVISION

STATE GRAVEL SUPPLY STRATEGY
DISTRIBUTION OF LATERITIC GRAVEL RESOURCES BY LGA AND MRWA DIVISIONS - SOUTH WEST

2

TABLE 3

Potential Lateritic Gravel Resource & Ranking by LG in the South West of WA including Ravensthorpe and Esperance

	MRWA REGION: GREAT SOUTHERN	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Albany	There are adequate supplies of lateritic gravel throughout the shire, with the exception of the coastal zone where limestone may be used	Yes	28,000	23.3	34.3	1
Denmark	Lateritic gravel supplies are adequate, though most are in massive ironstone which requires in situ processing and some treatment after placement. The cost of treatment is about $4.50 per cu metre. Hard rock and limestone are also available. State forest and CALM lands pose access difficulties.	Yes	30,000	17	28	2qpa2
Plantagenet	Lateritic gravel supplies are adequate throughout including the Sandplains where there is plenty of gravel on residual rises. Hard rock resources may also be used, if required. Stirling Range and Porongorup National Parks, although large, do not impose constraints on supply. CALM estate lands are scattered throughout in small reserves but are not considered available.	No	22,000	19.4	30.4	2p
Cranbrook	Lateritic gravel supplies are adequate in the western half of the shire. Fair supplies of good quality lateritic gravel are present in the eastern half, with deposits being well separated. Hard rock resources are also present.	Yes	16,000	14.6	25.6	1d
Gnowangerup	Lateritic gravel supplies are scattered throughout, decreasing towards the east of the shire area. Supplies near Ongerup are limited but plentiful 18 km north of the town. Hard rock is also present. There are few CALM reserves with the potential to limit access.	No	30,000	17	28	3d
Jerramungup	Lateritic gravel supplies are adequate throughout the shire, although more scattered in the west approaching Ongerup. Colluvial resources and limestone are also available. CALM reserves and national parks impose restrictions.	N/A	N/A	17	28	2d
Kent	Lateritic gravel supplies are adequate throughout, but are less frequent towards the north east. Some hard rock resources can be used if necessary.	No	150,000	14.9	25.9	2d

	MRWA REGION: GREAT SOUTHERN	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Ravensthorpe	There are adequate supplies of lateritic gravel throughout although it occurs in small pockets. Supplies are limited within 15 km of Ravensthorpe town, but are adequate elsewhere. Limestone is used where lateritic supplies are not freely available. Hard rock resources are abundant.	Yes	110,000	21.7	32.7	2d
Kojonup	Lateritic gravel is generally available throughout the shire, although it tends to be scattered on the eastern side. Hard rock resources are abundant.	No	28,000	14.6	25.6	1d
Katanning	There are moderate to good supplies throughout the shire. Hard rock resources are present but scattered. A number of small conservation reserves preclude access to some potential resources.	Yes	15,000	16.1	27.1	1d
Tambellup	There are adequate supplies of lateritic gravel throughout. There are scattered hard rock resources. CALM reserves should have no impact on access.	N/A	N/A	20.2	31.2	2d

	MRWA REGION: SOUTH WEST	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	**Commentary**	**Are reserves sufficient for 15 years**	**Annual use cu m**	**Sub-base $/cu m**	**Base course $/cu m**	**Category**
Murray	In the western half of the shire, there are no lateritic gravels; limestone is used for sub-base purposes. Lateritic gravels are available in state forests in the east above the Darling Scarp and could be used if processed. Deposits are not large, about 5,000 cu metre in size. In addition to the restrictions imposed by state forest land, the eastern section also contains potential reserves identified in the System 6 strategy and by a proposed regional park along the scarp.	No	15,000	23.5	34.	2a1a2pq
Waroona	Lateritic gravels in small, localised deposits are available in the eastern half of the Shire though availability is constrained by their occurrence in State forest. The System 6 report recommendations and the proposed regional park along the scarp further constrain the ready availability of these gravels. In the western half there are no lateritic gravels, road base either being imported or instead limestone may be used as sub base.	No	65,000	21.2	22.2	2a1a2pq
Harvey	Lateritic gravels are restricted to that part of the Shire east of the Darling fault line. Their availability is restricted by the State forest and by proposals for nature conservation contained in the System 6 report and in the recommendations for the regional park along the scarp. There are no gravels in the western part, limestone is the common sub base material.	Yes	9,600	23.6	34.6	2a1a2p
Collie	Lateritic gravels are in adequate supply throughout the Shire area. Hard rock resources are plentiful. State forest and System 6 reserves cover much of the Shire and will severely restrict access to potential resources.	No	3,000	17	28	2a1a2p
Capel	There are adequate supplies of lateritic gravel east of the shire. There are few in the west. Limestone is used as a road base and commercial road base use is also anticipated.	No	5,000	22.5	33.5	2a2
Donnybrook-Balingup	There are adequate supplies of lateritic gravel in the shire as well as abundant hard rock. Access to resources is restricted because of state forest land. A number of small CALM reserves also restrict access.	No	11,000	19.4	30.4	2a2p

	MRWA REGION: SOUTH WEST	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Boyup Brook	There are adequate supplies of lateritic gravel throughout the shire. There are well distributed hard rock resources. Access may be restricted in the north west of the Shire where there is State forest land.	No	20,000	18	29	1a2
Bridgetown-Greenbushes	There are adequate supplies of lateritic gravel throughout the shire. Hard rock resources are plentiful. The north west corner is occupied by state forest land which could limit access.	N/A	N/A	18	29	1a2
Busselton	There are supplies of lateritic gravel over most of the shire, except for the northern coastal strip.	No	50,000	18.3	29.3	2a2p
Augusta-Margaret River	The northern third has adequate supplies of lateritic gravel, but quality and quantity sharply grade off to the south. All lateritic reserves require processing. Limestone resources are variable in quality and often not suitable. The Whicher Ridge Nature Reserve, other CALM reserves and state forest land limit in various degrees access to the resources, as does size of landholding on freehold land. CALM encourages the processing of massive duricrust in abandoned pits in State forests.	No	50,000	20.6	31.6	3a1a2p
Nannup	There are adequate but patchily distributed supplies of lateritic gravel throughout the shire, except for the sunklands area and south coast which is largely National Park. Because of its nature, the gravel requires limited processing. Large areas of state forest land will limit access.	N/A	N/A	23.1	34.1	1a2p
Manjimup	There are adequate lateritic gravel resources in the northern two thirds. Gravel resources are scarce in the southern third. Colluvial resources are also plentiful, though scattered in distribution.	Yes	60,000	17	28	2a2p

	MRWA REGION: GOLDFIELDS - ESPERANCE REGION	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Esperance	Adequate supplies of lateritic gravel and limestone available throughout shire, except within 25 km of Esperance town and near Dalyup. In the north limestone is used where lateritic gravel is scarce. National parks on the south coast impose dieback hygiene restrictions and limit access for materials.	No	200,000	22.4	33.4	2a1p

	MRWA REGION: WHEATBELT SOUTH	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Dumbleyung	There are adequate supplies of lateritic gravel in the eastern half of the shire. Supplies are scattered in the western half. There are few constraints to access. There are scattered hard rock resources.	No	25,000	16.1	27.1	2d
Wickepin	There are adequate supplies of lateritic gravel throughout this shire, although the resources are discontinuous. There are scattered hard rock resources. The only constraints to access are along the south west where some reserves will limit the availability of potential resources.	Yes	20,000	14.9	25.9	2d
Corrigin	Laterite gravel supplies are in scattered pockets only. Some supplies will be found beneath sandplain. Elsewhere abundant colluvial materials could be used.	N/A	N/A	19.4	30.4	3
Brookton	Lateritic gravels are adequate throughout the shire, although decreasing in abundance towards the east. Colluvial and hard rock resources are plentiful. Much of the western third of the shire is within state forest and other reserves which are a significant constraint on potential resources.	N/A	N/A	17	28	2pd

	MRWA REGION: WHEATBELT SOUTH	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Narembeen	There are adequate supplies of laterite gravels in the north and east of the shire. Supplies are less frequent in the centre and south, though colluvial materials could provide suitable alternatives along with hard rock. CALM reserves do not limit access to resources.	N/A	N/A	16.1	27.1	3
Kulin	Lateritic gravels are scattered in the shire and there are some quality constraints. Stabilisation with amendments including enzymes, cement and bitumen is being investigated. Colluvial resources are abundant. Several large reserves affect access in the east of the shire, while smaller reserves scattered throughout cause some resources to be unavailable.	No	50,000	18	29	3qd
Lake Grace	There are adequate supplies of lateritic gravel beneath the sandplain, although quality is variable. There are scattered hard rock resources. CALM reserves cover about one-fifth of the shire and will limit access to some resources.	Yes	70,000	18	29	2q
Wandering	Lateritic gravels are adequate over most of the shire, except for the south-east corner where alternative resources can be used. There are abundant hard rock resources. Most of the Shire consists of state forest where access is not freely available.	No	N/A	14.6	25.6	2pa2
Beverley	There are adequate supplies of lateritic gravel, although tending to be less plentiful in parts of the shire. There are scattered hard rock resources. Large areas of state forest make access difficult in the west.	Yes	20,000	20.8	31.8	2a2dp
Quairading	Lateritic gravels are scattered and are not readily available in parts of the shire. Colluvial resources are plentiful throughout.	No	12,000	19.4	30.4	3d
Bruce Rock	Lateritic gravel is available in the north-east area, but is scattered and less available elsewhere. Colluvial resources are plentiful.	N/A	N/A	15.4	26.4	2d
Woodanilling	Lateritic gravel supplies are scarce. Hardrock resources are now being used. These include gneiss and other igneous rocks.	No	25,000	20.6	31.6	4

	MRWA REGION: WHEATBELT SOUTH	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
West Arthur	There are adequate supplies of lateritic gravel throughout the shire. Hard rock can also be used. Much of the western half is occupied by State forest which imposes some limitations on access.	Yes	25,000	14.6	25.6	1a2
Williams	There are adequate supplies of lateritic gravel throughout the shire, though distribution is uneven in the east. There are abundant hard rock supplies. State forest land occupies a major portion of the west and is a restraint on access to some resources.	No	18,000	14.9	25.9	2da2
Boddington	There are adequate supplies of lateritic gravel throughout, although quality may be poor in some instances. Almost all of the shire is state forest, except for the south-east. This imposes significant limitations on access to potential resources.	N/A	N/A	18	29	2q
Cuballing	There are adequate supplies of lateritic gravel throughout the shire, either in the form of residuals or under the sandplain. There are scattered hard rock resources. Restricted access to CALM reserve land is an issue.	No	20,000	18	29	2a1
Narrogin	Lateritic gravel supplies are adequate although irregularly distributed either in residuals or beneath sandplain. Hard rock resources are also available.	N/A	N/A	14.6	25.6	2d
Wagin	There are adequate supplies of gravel throughout, particularly beneath the sandplains and on ridges. There are adequate hard rock resources as well. Access to some of the resources may be limited by reserves held by CALM.	No	8,500	14.9	25.9	2a1

	MRWA REGION: WHEATBELT NORTH	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	**Commentary**	**Are reserves sufficient for 15 years**	**Annual use cu m**	**Sub-base $/cu m**	**Base course $/cu m**	**Category**
Dandaragan	The eastern two-thirds has adequate gravel supplies, some which require processing as they are in the massive duricrust form. In the western third, limestone is available, but there are some technical difficulties in its use and extraction. The eastern half is largely free of constraints on use. Nature reserves and national parks affect access on the west.	No	110,000	19.4	30.4	2a1q
Moora	There are some lateritic gravels in the far north of the shire and in the east. Around Moora, New Norcia and Miling towns there are few resources. The resource is also poor in the centre of the shire. It is necessary there to haul RBMs long distances. Moora Shire Council pay up to $5/cu metre for gravel supplies. There are plentiful hard rock resources. A national park encroaches into the north-west of the shire, but elsewhere there are only scattered reserves.	No	60,000	16.1	27.1	3
Dalwallinu	Gravel supplies are adequate north and east of Wubin. There are poor supplies near Dalwallinu and Pithara towards Wubin. Some scattered colluvial resources could be used. Some scattered reserves may inhibit availability of some potential resources.	No	43,000	15.4	26.4	2a3d
Goomalling	Lateritic gravel is available only in scattered pockets. Hard rock is in plentiful supply as an alternative.	N/A	N/A	16.6	27.6	3
Dowerin	There are adequate supplies of lateritic material, although distribution tends to be uneven. Colluvial resources are also distributed throughout and hard rock resources are present. Small reserves are scattered throughout.	Yes	20,000	15.4	26.4	2d
Cunderdin	There are adequate supplies of lateritic gravel throughout the shire, although gravels near the highway are of poor quality. There is little lateritic gravel within 8km of either Cunderdin or Meckering. Colluvial materials are available for use together with scattered hard rock resources. There are a few very small reserves which are of little consequence to access.	No	20,000	16.1	27.1	2q

	MRWA REGION: WHEATBELT NORTH	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	**Commentary**	**Are reserves sufficient for 15 years**	**Annual use cu m**	**Sub-base $/cu m**	**Base course $/cu m**	**Category**
York	Lateritic gravel supplies are adequate in the south although often present as massive diricrust. There are adequate hard rock resources throughout. Much of the Shire is occupied by State Forest which creates an access problem.	Yes	2,070	19.4	30.4	2a1
Wyalkatchem	Lateritic gravels are scattered throughout, but not in plentiful supply. Colluvial materials are in moderate supply. The few small reserves have little impact on availability of supplies.	N/A	N/A	14.6	25.6	3
Koorda	There are adequate supplies of lateritic gravel throughout. These gravels are very hard. Conservation reserves in the southern quarter and two larger reserves in the north may affect access to some supplies.	N/A	N/A	19.4	30.4	2q
Wongan-Ballidu	There are adequate supplies of lateritic gravel throughout, with some isolated hard rock resources. There are numerous reserves in the south-western quarter which could affect access to some resources.	Yes	40,000	16.1	27.1	1
Victoria Plains	There are adequate supplies of lateritic gravel in the shire, except in the south-east corner. Hard rock supplies are plentiful. There are few constraints from CALM-managed land.	Yes	30,000	14.6	25.6	2d
Northam (Shire)	Lateritic gravels are scattered in the shire. The town has to rely upon a commercial quarry. Lateritic material which is available is of poor quality, being highly plastic. Hard rock resources are available. In the south-west, where lateritic material is available, state forest and nature reserves limit access.	No	31,500 with Town	17.6	28.6	3a1a2qd
Toodyay	The western half of the shire has adequate resources though the quality is suspect. In the east the resources are very scattered but hard rock is plentiful. Much of the Shire is subject to reservation under System 6 proposals. These cover the area where gravels are adequate.	Yes	20,000	19.4	30.4	2a1qd

	MRWA REGION: WHEATBELT NORTH	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	**Commentary**	**Are reserves sufficient for 15 years**	**Annual use cu m**	**Sub-base $/cu m**	**Base course $/cu m**	**Category**
Chittering	There are adequate supplies of lateritic gravel in the shire, some of which require processing. Hard rock supplies are adequate. There are few reserves to limit access.	Yes	15,000	19.9	30.9	1q
Yilgarn	There are adequate resources of lateritic gravels over the southern half. There are scattered resources elsewhere, but are insufficient between Southern Cross and Bullfinch. Colluvial materials and hard rocks are adequate in this area. Jilbadji Nature Reserve to the south of Southern Cross and smaller reserves in the southern half may limit access to some potential resources.	N/A	N/A	18.6	29.6	2d
Westonia	There are adequate supplies of lateritic gravel throughout. Colluvial material and hard rock are also present. Lack of access to CALM estate limits the use of some potential supplies.	No	63,000	19.4	30.4	2a1a3
Merredin	There are adequate supplies of lateritic gravel throughout the shire, although supplies around the town of Merredin have been depleted. Quality is questionable in some instances. Colluvial materials is scattered throughout and could be used. Hard rock resources are adequate.	No	50,000	18	29	2q
Nungarin	Supplies of lateritic gravel are scattered. Colluvial materials are fairly widespread.	N/A	N/A	20.8	31.8	3
Mukinbudin	There are adequate supplies of lateritic gravel throughout the shire, although distribution may be uneven. Colluvial materials of good supply in the south westquarter.	Yes	1,100	17	28	2d
Trayning	There are adequate supplies of lateritic gravels in the south and west but they are scarce in the north east. Colluvial materials are in moderate supply throughout. There are few reserves constraining access.	No	50,000	21.2	32.2	2d
Kellerberrin	There are adequate supplies of lateritic gravel throughout the shire, except in the salt lake chain. Colluvial materials are also available, although distribution is scattered.	N/A	5,000	17	28	1
Tammin	There are adequate supplies of lateritic gravel throughout the shire. Colluvial material is also present, although distribution is scattered.	Yes	10,000	14.6	25.6	1

	MRWA REGION: MID WEST	SHIRE COMMENTS		GRANTS COMMISSION DATA		SGSS RANKING
Shire	Commentary	Are reserves sufficient for 15 years	Annual use cu m	Sub-base $/cu m	Base course $/cu m	Category
Perenjori	There are adequate lateric resources throughout the shire. Colluvial and hard rock materials are also available. Access to supply is not constrained by CALM reserves.	Yes	30 000	17.5	28.5	1
Carnamah	There are limited supplies of lateric gravels in pockets in the east. The sandplain zone contains little gravel but it occurs on ridges in the east and centre and towards the west and the Brand Highway. It is difficult to extract and is not suitable on clayey sub-base. CALM reserves severely limit access to potential supplies..	No	30 000	21.2	32.2	2d
Three Springs	There are adequate supplies of laterite gravel throughout the shire. Colluvial resources are adequate, though somewhat scattered.	No	45 000	19.4	30.4	1d
Irwin	The eastern portion of the shire has adequate supplies of lateritic gravel. Limestone resources are not suitable for road construction although plentiful. Base course is usually hauled to the site over long distances. In the south-west, CALM reserves limit access to potential resources.	No	10 000	20.8	31.8	3d
Mingenew	There are adequate supplies of lateritic gravel throughout the shire, though some sections are poorly served with resources and road materials having to be carted. Colluvial materials are in adequate supply, though scattered in distribution.	Yes	25 000	18.0	29.0	2d
Morawa	Laterite gravel resources have a scattered distribution and their size is not known. Colluvial materials are available and may be exploited.	N/A	N/A	16.1	27.1	3
Greenough	There are adequate laterite resources in the eastern two-thirds beneath sandplain and on ridges. Much of the resource near Geraldton has been used. Haulage routes are now up to 20 km in the western half. Limestone has been used, but its potential is controlled by the nature of the terrain. CALM reserves limit access to potential supplies.	No	50 000	23.6	34.6	2d
Mullewa	There are adequate resources of lateritic gravel throughout. Colluvial materials are available and may be exploited.	N/A	N/A	16.1	27.1	1
Chapman Valley	There are adequate resources of lateritic gravel throughout the shire, though reserves from Geraldton to Nanson are depleted. Limestone is available along the coast. There are also scattered colluvial materials throughout. CALM reserves limit access to some resources.	No	60 000	18.0	29.0	2a1
Northampton	There are adequate supplies of lateritic gravel in the shire, but they are poorly distributed in parts. Colluvial material supplies are adequate. Kalbarri National Park is a major restriction on potential resources.	No	27 000	19.4	30.4	2d

2.4.4 Alternative Road Building Resources

To supplement the above information, estimates were made of the availability of alternative resources using geological information at a scale of 1:250,000. Table 4 shows the percentage of the surface area of each shire containing colluvium, limestone/marl or readily-available hard rock resources.

"Hard rock" refers to igneous and metamorphic rock, but excludes incompetent rock. The definition must be qualified by recognition that suitable hard rock for road building purposes is not readily determined and will be influenced by geology, petrology and engineering characteristics of the material.

Colluvial material will generally be preferred to hard rock because it is considerably cheaper. Hard rock is used only if available colluvium is of inferior quality and unsuitable for road building. Even then, amendment of colluvium by use of stabilisers, if feasible, may be preferred as a cheaper alternative to using hard rock.

In estimating quantities of alternative materials, an upper limit of 40 per cent of a shire's area has been applied to each class of material. The data developed on this basis show there are sufficient reserves of alternative materials in virtually all LGs. Reference to Table 3 shows that for LGs lacking alternatives, there are adequate lateritic resources.

Table 4
Alternative road building materials in South West Local Governments

Region	Local Government	% of Surface Area*		
		Colluvium	Limestone	Hard Rock**
Great Southern	Albany		10	5
	Denmark			40
	Plantagenet			15
	Cranbrook			10
	Gnowangerup			25
	Jerramungup	10	10	20
	Kent			5
	Ravensthorpe			40
	Kojonup			40
	Katanning			30
	Broomehill			15
	Tambellup			30
South West	Manjimup	5		40
	Bridgetown			40
	Nannup			40
	Augusta/Margaret River		20	na
	Busselton			-
	Boyup Brook			40
	Donnybrook-Balingup			40
	Capel			na
	Dardanup			40
	Collie			40
	Harvey		15	35
	Waroona			20
	Murray		20	

Table 4
Alternative road building materials in South West Local Governments

Region	Local Government	% of Surface Area*		
		Colluvium	Limestone	Hard Rock**
Wheatbelt South	Dumbleyung			10
	Wickepin			15
	Corrigin	40		10
	Brookton	30		40
	Narembeen			20
	Kondinin			15
	Kulin	30		10
	Lake Grace			5
	Wandering			30
	Beverley			25
	Quairading			15
	Bruce Rock			10
	Woodanilling			30
	West Arthur			30
	Williams			40
	Boddington			10
	Pingelly	10		40
	Cuballing			40
	Narrogin			10
	Wagin			40
Wheatbelt North	Dandaragan		25	
	Gingin		15	40
	Moora			35
	Victoria Plains			20
	Chittering			40
	Toodyay			20
	Northam			40
	York			40
	Cunderdin	30		30
	Goomalling			40
	Wongan Hills			5
	Dalwallinu	5		40
	Koorda			40
	Dowerin	30		20
	Tammin	30		15
	Wyalkatchem	40		
	Mt Marshall	10		10
	Trayning	40		
	Kellerberrin	15		40
	Merredin	20		10
	Nungarin	40		10
	Mukinbudin	15		10
	Westonia			40
	Yilgarn			40

Table 4 Alternative road building materials in South West Local Governments				
Region	**Local Government**	**% of Surface Area***		
		Colluvium	**Limestone**	**Hard Rock****
Mid West	Coorow		10	5.
	Carnamah		25	-
	Three Springs	40		10
	Irwin		30	-
	Greenough		20	20
	Chapman Valley	25	5	10
	Northampton	15	5	10
	Mullewa	25		25
	Mingenew	30		
	Morawa	40		10
	Perenjori	10		20

* Percentage of LG area in which limestone, colluvium and hard rock resources may be obtained, estimated from 1:250,000 geological map sheets and notes.

** Schist and other geotechnically incompetent rocks were excluded.

While limestone may be equated with laterite as a suitable material for road making, and is used for this purpose by some LGs, few LGs - if any - were making use of colluvial materials or hard rock resources for road making. They preferred to widen their search for laterites and to cart it longer distances. Less frequently, they preferred to use resources on freehold land, whereas in the past they used gravel resources on various types of reserved land.

2.5 SUMMARY

It is difficult to reconcile the expressed concerns of some LGs in the South West - including most of those east of the Darling Scarp - about the availability of RBMs with the generally plentiful supply of suitable lateritic road-making materials indicated by this investigation. Alleged problems of supply appear to stem from one or more of the factors listed below, rather than an inadequate supply of the resource:

- disinclination to use gravel resources on freehold land,
- no established policy governing the acquisition of supplies,
- disinclination to increase haul distances beyond 10 kilometres, even though nearer alternative resources are exhausted,
- a perception that gravel supplies in some areas are inexhaustible, and that there is no need to plan,
- inadequate information on the location of potential resources and an inability to explore for further reserves,
- inadequate "in house" skills in the use of modifications and stabilising agents to improve low-quality resources,
- insufficient financial resources to maintain existing road improvement and maintenance programs as lateritic gravels become more expensive to obtain,
- unwillingness by some landholders to give LGs access to potential resources,

- reluctance to explore opportunities for use of materials other than lateritic gravels or limestone, and

- the poor record of LGs in rehabilitation of abandoned pits.

In particular, the gradual exclusion of some LGs from reserved land and State forest over the past decade has compelled them to look to alternative sources of RBMs. The alternatives occur almost exclusively on freehold land.

Some LGs have accommodated the changed circumstances and established policies which provide for negotiated access to private land. Others have found it difficult to adjust to the new circumstances. They cite difficulties of access to CALM-managed land as one of the principal causes of gravel supply problems, even when it is clear from the above analysis that alternative sources are available.

These issues are discussed in Section 6 of this report.

3.0 The Demand for Road Building Materials

3.1 THE WESTERN AUSTRALIAN ROAD NETWORK

The Task Force on Road Funding (Report on Road Funding Needs and Issues in Western Australia, 1991) has tabulated the length of the road network in WA. The lengths and classification are shown in Table 5.

The length of rural roads is about 150,000 kilometres, of which about 23,500 kilometres is the responsibility of Main Roads. LGs have responsibility for the remaining 126,500 kilometres.

A large part of the LG network consists of earth-formed roads, the maintenance of which is restricted to grading and limited amounts of new road formation. The amount of new work undertaken each year depends on the size of annual road grants and the capacity of LGs to raise income.

The Task Force on Road Funding reported that the rural road network was ageing and deteriorating, and that LGs did not have the resources to rectify this situation.

Table 5
Length of Roads by Type in Western Australia (km)

			Total
Declared roads			
National highways		4,641	
Other highways and main roads			
Urban	532		
Rural	10,547	11,079	
Secondary roads		8,538	
			24,258
Undeclared roads			
Unclassified roads			
Urban arterial	1,120		
Urban local	8,440		
Rural local	100,040		
Forests & national parks	29,490	139,090	
		TOTAL	163,348

3.2 ANNUAL USE OF ROAD BUILDING MATERIALS

An estimate of the annual use of RBMs can be made from data supplied by Main Roads regions and some LGs (see Table 6). Because the response from LGs was incomplete, estimates of LG usage have been made on a regional basis in proportion to the responses received.

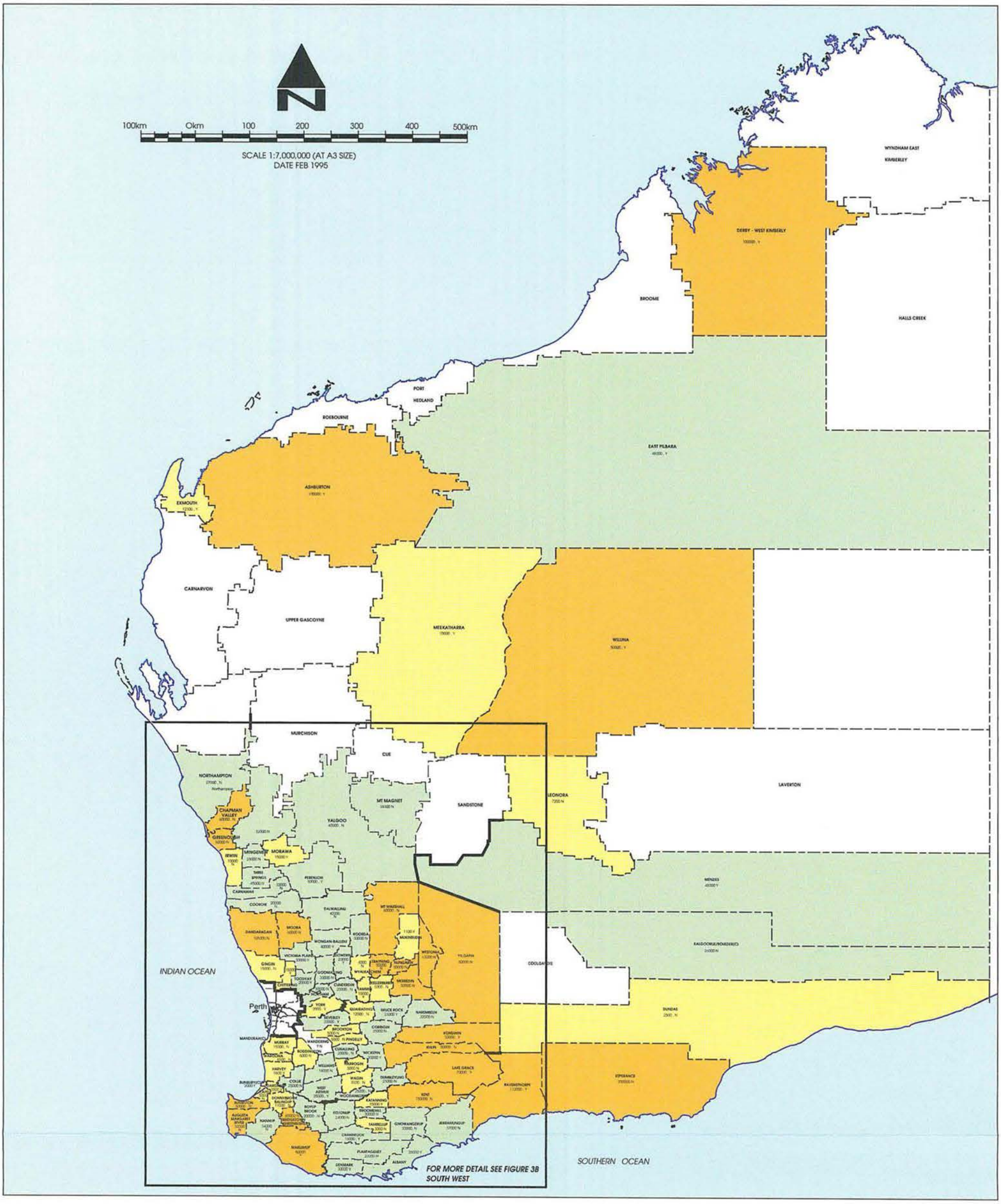
* Shire of Esperance usage is approx 200,000 m3

** CALM, the timber industry and Alcoa of Australia also use substantial amounts of laterite gravel, but data are not available at present.

Table 6
Annual Gravel Use (1993)

Main Roads Region	LG use (from questionnaire) 000 m3	Proportion LGs responding/ Total LGs	Est total LG use 000 m3	Main Roads use 000 m3	Total 000 m3
Great Southern	429	9/12	572	122	694
South West	292	11/13	345	150	495
Wheatbelt North	646	19/24	815	390	1205
Wheatbelt South	348	13/20	535	140	675
Mid West	297	9/11	363	60	423
Pastoral areas	622	14/27	1200*	700	1900
TOTAL	2,634	75/107	3,830	1,562	5,392**

Figures 3A and 3B indicates low, medium and high category users and the LGs perceptions of whether they have adequate supplies for the next 15 years. This is also indicated in Table 3. The complete questionnaire summary is contained in Appendix 1.



GRAVEL USE

- 15000 & below cu metres
- 16000 - 49000 cu metres.
- 50000 + cu metres
- No response to questionaire

ADEQUACY OF SUPPLY

- Y Sufficient for the next 15 years.
- N Not sufficient for the next 15 years.

LEGEND

- Main Roads Divisions
- Local Authority Boundaries

LANDVISION

STATE GRAVEL SUPPLY STRATEGY

GRAVEL USAGE AND ADEQUACY OF SUPPLIES- WESTERN AUSTRALIA

3A

The above summaries show that the annual use of gravel for road making in WA is about 5.4 million cubic metres a year. Of this, 3.8 million cubic metres - or 70 per cent - is used by LGs.

Virtually all of the material is won from shallow pits, pursuing a resource which lies in narrow bands up to 1.5 metres deep, but usually about one metre deep. This equates to land clearing for gravel extraction at a rate of about 910 hectares a year.

3.3 ESTIMATED FUTURE USE OF THE GRAVEL RESOURCE

It is appropriate to consider whether the figure of 5.4 million cubic metres a year represents a peak or a trough in demand. Future use will be subject to fluctuations arising from funding allocated by LGs and Federal and State Governments to road construction and maintenance.

The report of the Task Force on Road Funding provides some guide to future needs in its discussion of maintenance of the declared road network. It is pointed out that asset (road) replacement will become a serious issue because roads built between 1950 and 1970, when there was heavy investment in sealed construction, will require major restoration and possible replacement. The growth of the sealed road network from 1950 to 1993 is shown in Figure 4.

The task force also estimated the cost of replacing the road asset. Figure 5 shows the estimated costs of road replacement between 1989 and 2069, in 1991/92 dollars. Because of the nature of the data, it is an estimate only and cannot readily be converted to a cost per cubic metre of material.

Because a fixed proportion of these costs includes provision of gravel supplies for new sub-base and base-course, it may be deduced that demand is likely to rise from 5.4 million cubic metres a year in 1994 to about 10 million cubic metres in 2009. A similar peak is likely to occur in 2049.

It is also possible to predict from this data that demand will be not less than 5.4 million cubic metres in any future year. An analysis of the case studies and questionnaires also suggests that LGs are unlikely to reduce their annual use of gravel for resheeting and road construction.

While funds for road making remain as they are, construction of new sealed roads should not make any impact on the predicted demand.

3.4 THE CAPACITY OF GRAVEL RESOURCES TO MEET FUTURE NEEDS

Of 80 LGs in the South West Land Division (the Perth metropolitan area was excluded), 61

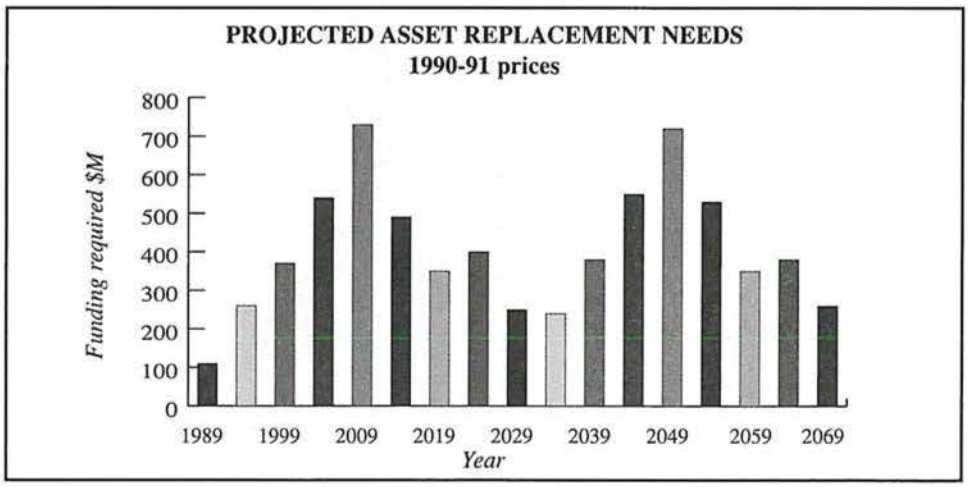
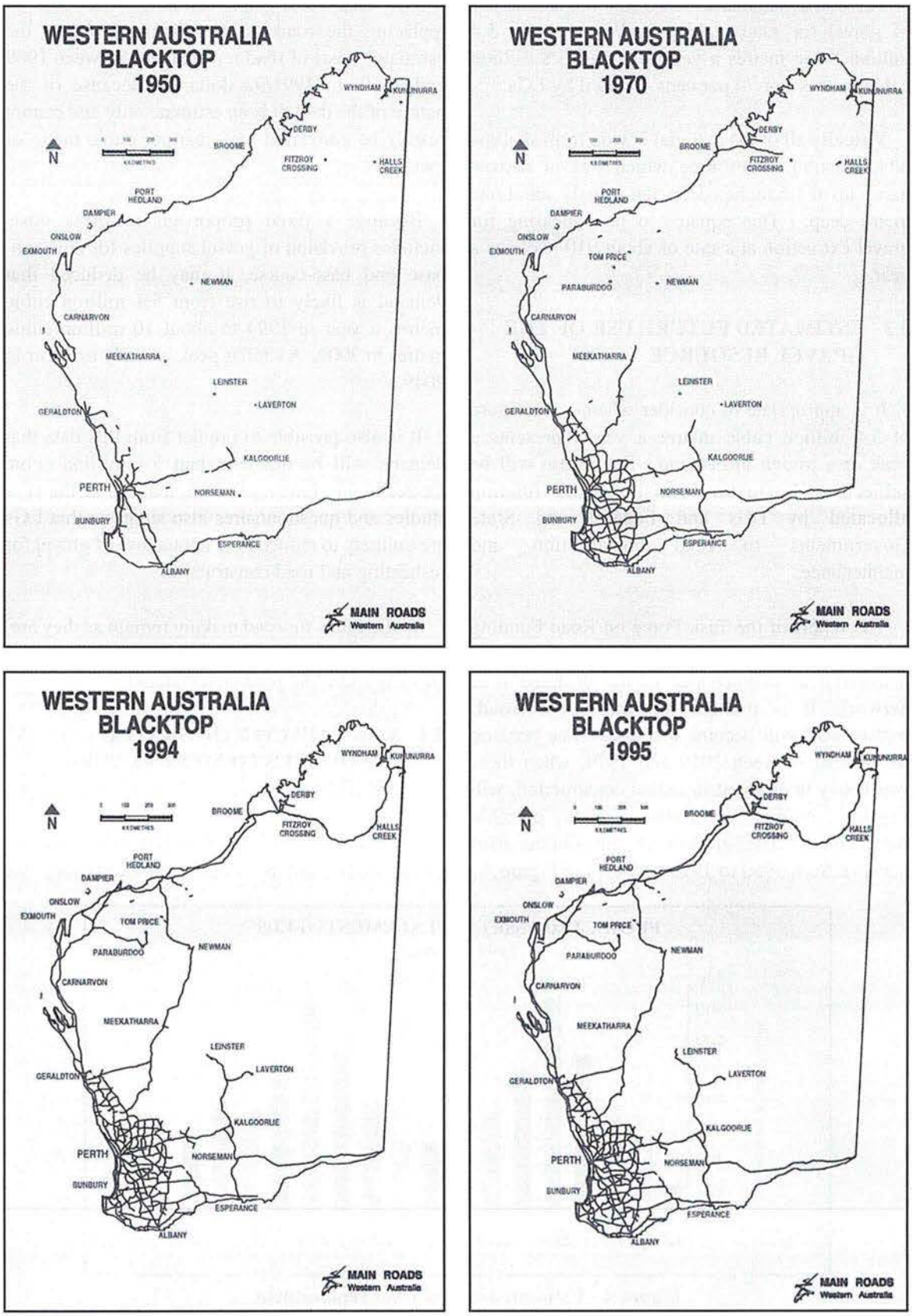


Figure 4 - Estimated cost of road replacement

Figure 5 - Growth of the WA Sealed Road Network 1950 - 1993



replied to the questionnaire. Of these, 23 - about 38 per cent - considered they had sufficient gravel for the next 15 years.

In the pastoral areas, four LGs out of nine respondents - about half - considered they had adequate supplies for the future.

It is not known if the responses from LGs in the South West accurately portray the true situation of future supplies because the responses did not indicate whether all potential resources, including those on freehold land, were included in the assessment.

If the assessment is correct, it can be concluded that reserves of accessible laterite gravel are almost exhausted and RBMs will have to be obtained from alternative resources, including colluvium and hard rocks, both of which require screening and treatment.

However, it is difficult to reconcile this apparent lack of material with the geological knowledge that much of the South West has adequate resources of laterite, although much is hidden. It also is abundantly clear that there is an urgent need to quantify the size and distribution of laterite gravel resources.

Because of the huge area which would have to be surveyed, it may be sufficient in the first instance to investigate the presence of suitable materials by ground truthing surveys of areas selected for their representation of different types of geology and landform. The principal objective would be to record the distribution of laterite gravel resources. The data accumulated could be extrapolated to infer resources elsewhere and simplify the search for them.

3.5 THE COST OF GRAVEL

Estimates of the cost of providing sheeting for gravel roads, and for sub-base and base-course in the case of sealed road construction, have been made by the State Grants Commission.

The cost of gravel in LGs in the South West ranges from $9.90 to $14.80 a cubic metre delivered on site, including placement and compaction. In pastoral areas, the cost ranges from $10.90 to $22.00 a cubic metre. These costs include a notional amount of $1.50 for the material itself, except where higher costs are known to be paid. In each case, the cartage cost is the major component of the difference.

Computed to road construction, the cost of gravel is about $1,200 a kilometre in the South West, but ranges from $9,500 to $20,000 a kilometre in pastoral areas where problems with supply result in high cartage costs.

Similarly, the cost of cartage, spreading and compacting base-course and sub-base materials has been estimated for rural LGs. There are very large differences in base-course costs, ranging from $25.60 a cubic metre in Pingelly and Narrogin to $69.20 in Port Hedland and $60.20 in Broome. Again, the major component of the higher cost is crushing and cartage, with haulage leads of up to 80 kilometres.

Table 7 indicates the actual range of costs of gravel by Main Roads region, as well as the cost of rehabilitation.

3.6 THE COST OF ALTERNATIVE MATERIALS

There is little use made of the alternatives to lateritic gravel and limestone in the South West Land Division, except in Bunbury-Mandurah and Esperance, where manufactured sub-base and base-course is used because of the lack of nearby suitable alternatives. Greater use is made of alternative materials in the pastoral areas, where conventional gravels are scarce. Weathered limestone and hardpan mixtures are among materials which have been used successfully.

Should supplies of lateritic material become exhausted, the data show that there are abundant supplies of alternatives, such as colluvium and hard rock. However, these materials are not uniformly distributed and the cost of road making will rise significantly when they are used. The increased cost will be compounded by the need to treat alternatives before they can be used.

Table 7 Cost of Gravel (Source: MRWA)					
MRWA	**Stockpile Gravel $/m3**		**Rehabilitate Pits**		
MRWA	**Range**	**Average**	**$/ha**	**Ave Depth Gravel removed**	**$/m³**
Northam	$1.50 - $2.00	$1.75	$3000 + compensation	1000 mm	$0.30 + compensation
Geraldton	$0.75 - $1.50	$0.94	$2500	500 mm	$0.30
Albany	$1.00 - $3.00	$1.80 (inc. $0.33 strip topsoil)	$2000 inc compensation	450 mm	$0.45 inc compensation
Narrogin	$0.50 - $1.30	$0.75	≈ $1600 inc compensation or ≈ $1000 not inc compensation	800 mm	$0.20 inc compensation or ≈ $0.13 not inc compensation
Bunbury	–	$6.00	$3500	600 mm	$0.60
Kalgoorlie	–	$1.00	–	–	$0.40
Kimberley	–	$2.00	$1700/ha	800 mm	$0.21

* Includes clearing, stripping and stockpiling topsoil and overburden, and stockpiling gravel.

It has been calculated that to substitute manufactured materials would result in an additional annual cost of $11.74 million in the South West Division for Main Roads. The potential cost increase can be illustrated by comparing the price of a manufactured road base at, say, $17 a cubic metre (1992 price in the Perth metropolitan area) and the cost of natural material at, say, $2 a cubic metre (including stockpiling and rehabilitation). In these circumstances, a kilometre of typical rural road requiring 3,000 cubic metre of pavement material would cost an additional $45,000.

However, it needs to be recognised that a manufactured rock base is expected to be non-variable and to behave in a predictable and well-understood manner. Natural materials are usually variable and often do not behave ideally; although this problem can be minimised by careful quality control during stockpiling and careful mixing during road construction. Other deficiencies can be overcome by modifying the material with small amounts of lime or cement which, although they add to the cost, still permit large savings through the use of naturally-occurring materials.

3.7 COMPETING USES FOR GRAVEL

The availability of gravel needs to recognise demands on the resource for other uses. Gravels are used for hard standing areas, packing gas pipelines, airstrip construction, house foundations, rammed earth buildings and various other commercial applications. Laterite gravel is also mined for bauxite and gold extraction.

Should gravel become scarce, decisions will have to be taken on priorities for its use.

3.8 SUMMARY

From the information above, estimates can be made of the cost of gravel to meet future road building needs.

The cost of supplying gravels for road making currently is about $30 million a year for LG road maintenance and about the same for base-course, sub-base and shoulder work by Main Roads. This is based on assumptions that all LG use is at a cost of $12 a cubic metre and that Main Roads use is at a cost of $25 a cubic metre, reflecting its principal use by Main Roads for base-course and sub-base and the generally higher compaction and level tolerance required for Main Roads work.

4.0 Legislation and Current Practices

4.1 OVERVIEW

There is no specific legislation dealing with the extraction of gravel and other basic raw materials. Accordingly, all government legislation relating to land has the potential to impact on quarrying for gravel. The effect of each Act varies according to site location and local circumstances, but many have a direct effect on access to the gravel resource.

The prime determinant of access is the tenure of the land on which the resource is located.

Under the Land Act, there are basically four categories of land:

- Vacant Crown Land,
- Reserves,
- leases, and
- easements.

The predominant land tenure distribution in WA is illustrated in Figure 6A and 6B. Crown land and reserved land is owned by the Government and alienated land is privately owned. Crown land can be either Vacant Crown Land or leased Crown land. Reserves are areas of Crown land which have been vested in various authorities for a multitude of purposes, such as national parks, nature reserves, reserves for Aborigines, reserves for drainage, educational institutions, golf links and cemeteries.

Crown land may be granted in a number of ways. Grants of rural lands reserve to government instrumentalities include the right of access to RBMs.

Other Acts can give secondary tenure over the four basic classes of land, including water catchment, forestry or mining tenure. Where land is held under a specific Act, consent of the management authority must be obtained before any activity can commence.

Access to the gravel resource on Crown land and reserved land is largely determined by the provisions of the Land Act and the Mining Act, but on private land access must be negotiated with the landowner. However, in most rural areas, access is a right reserved to government instrumentalities in the Deed of Grant.

The Mining Act excludes gravel and other basic raw materials - such as sand, limestone, clay and rock - from the definition of "mineral" when it occurs on private land. However, where it occurs on Crown land or reserved land, it is regarded as a "mineral"; although DME is considering an amendment to the Mining Act to exclude gravel from its jurisdiction.

On Crown land, few mining leases (or quarry areas under the former Mining Act) are taken out for gravel because of the short lifespan of the quarrying operation. If a quarry is of reasonable size, a more common option is to create a quarry reserve under the Land Act at the request of either the LG or Main Roads.

When a Crown reserve or State forest administered by CALM is involved, the department has developed specific policies for the extraction of raw materials, including gravel (see Appendix 2).

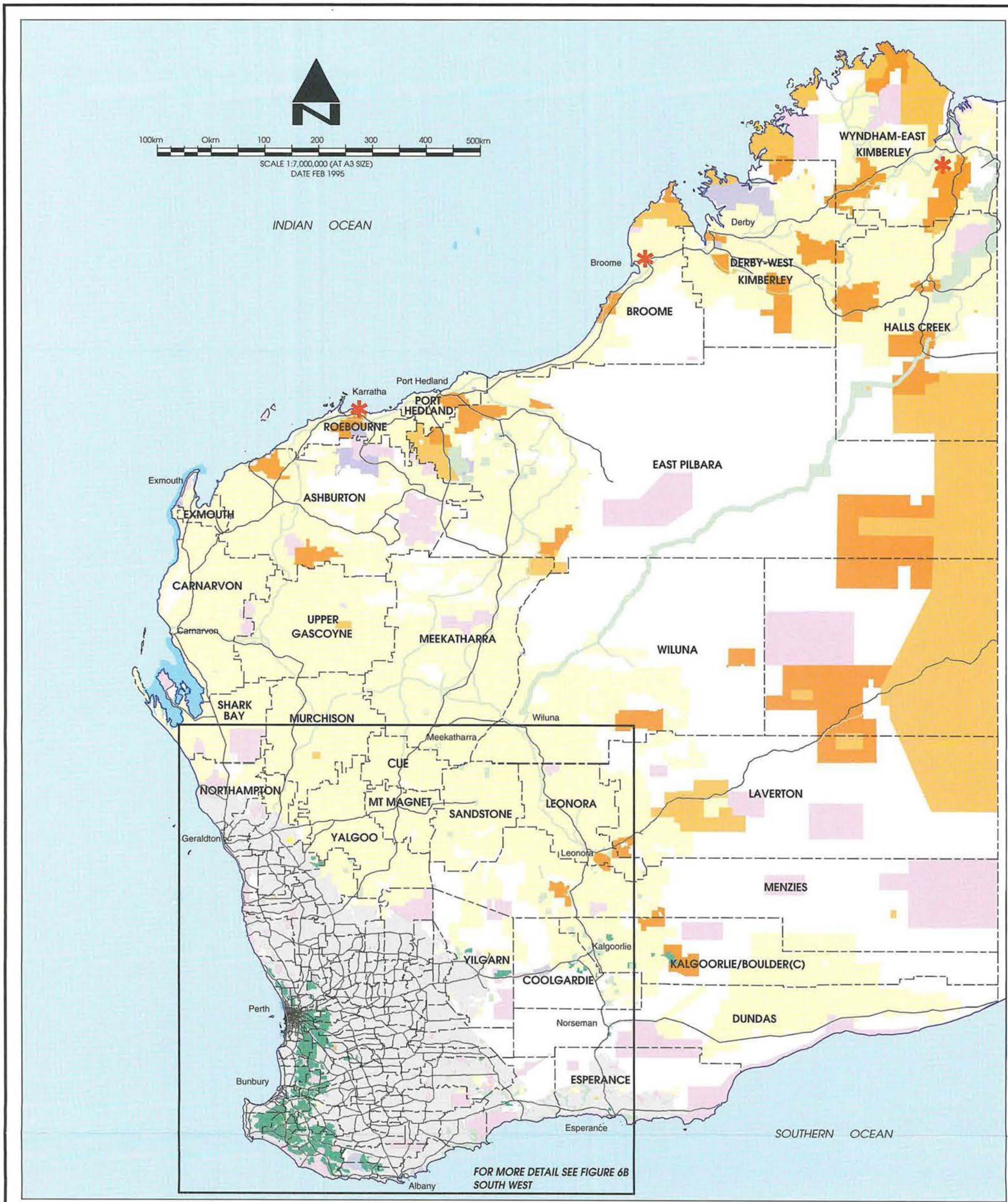
Regardless of whether a quarry is to be sited on Crown, private or reserved land, quarry operations need to comply with the general provisions of a number of Acts. This section details the general and specific provisions affecting gravel operators in a range of circumstances.

4.2 GENERAL LEGISLATIVE PROVISIONS AFFECTING QUARRY OPERATIONS

4.2.1 Environmental protection

All quarries are potentially affected by the provisions in Part IV of The Environmental Protection Act (1986) which requires projects or proposals that may have a detrimental effect on the environment to be referred to the Environmental Protection Authority (EPA) for assessment.

The EPA may require a formal assessment before advising, through the Minister, on the acceptability of the project and recommend conditions that should be applied. If the EPA's



LAND TENURE

ABORIGINAL AND TORRES STRAIT ISLANDERS LAND

- Freehold
- Leasehold
- Reserve

NOTE: - Only areas of 0.1 km2 or more shown.

- Freehold or Leasehold represents land held by Aboriginal land trusts, the Aboriginal and Torres Strait Islander Commission or incorporated Aboriginal and Torrens Strait Islander groups. Excludes land held by individuals.
- Reserves represent Crown land reserved for Aboriginal people. Excludes archaeological and historic sites.

PUBLIC LAND

- Nature Conservation Reserves (includes national parks)
- Other Crown Land
- Vacant Crown Land
- Crown Leasehold (mainly pastoral)
- Forestry Reserve
- Other Reserves

PRIVATE LAND

- Private Land (mainly freehold)

NOTE:
- Only areas of 50 km2 or more shown.
- Stock route information which is part of Other Crown Land is not necessarily complete.

LEGEND

- Roads
- Local Authority Boundaries
- Case study areas

SOURCE OF DATA

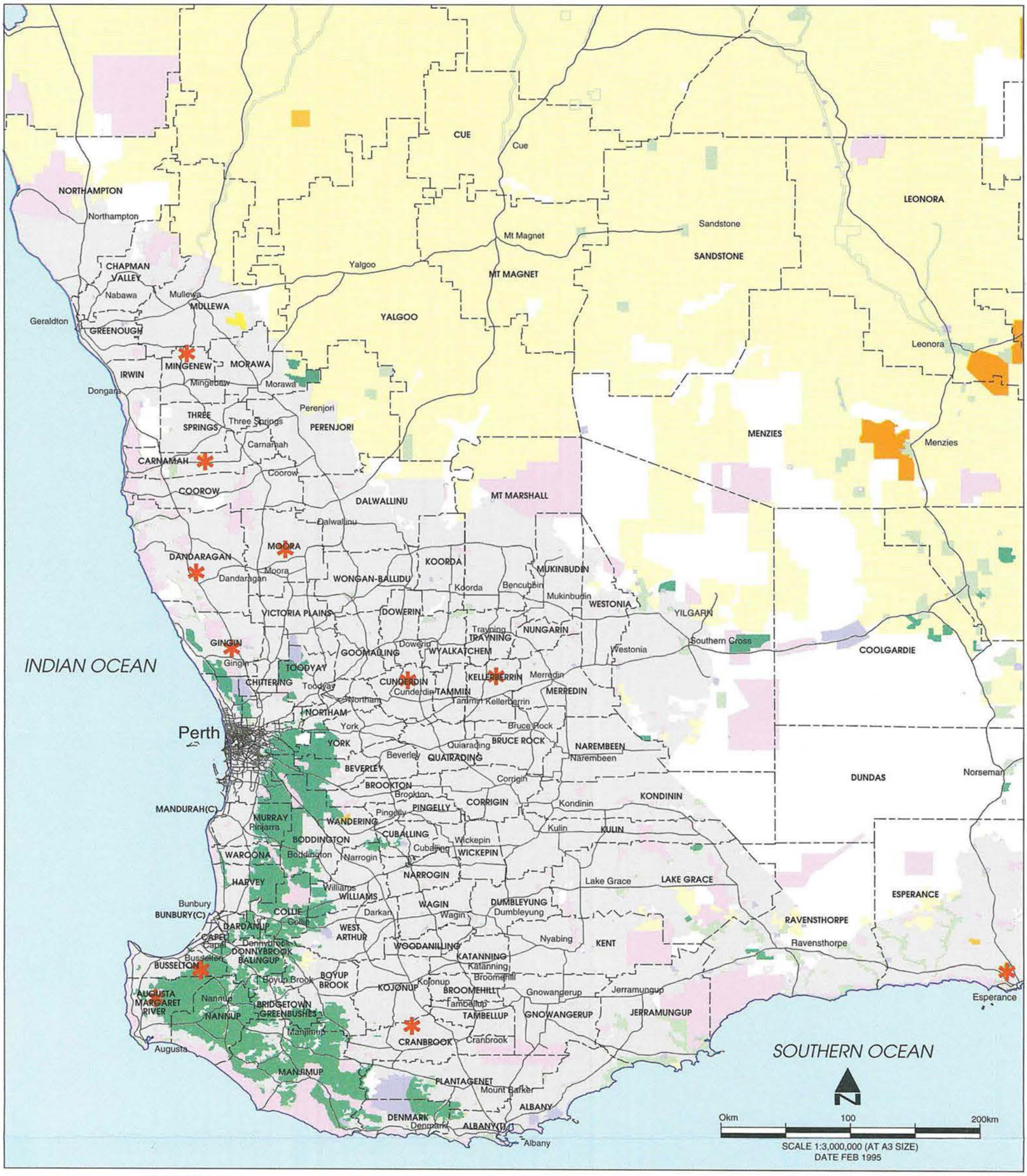
1. Land tenure data supplied by AUSLIG. Derived primarily from gazettal information.
2. Road Network digitised from 1:3,000,000 mapping.
3. LGA boundaries supplied by DOLA. Derived from digital cadastral information.
4. Base mapping supplied by Main Roads WA.

LANDVISION

STATE GRAVEL SUPPLY STRATEGY

PREDOMINANT LAND TENURE- PASTORAL AND REMOTE AREAS

6A



LAND TENURE

ABORIGINAL AND TORRES STRAIT ISLANDERS LAND

- Freehold
- Leasehold
- Reserve

NOTE: - Only areas of 0.1 km2 or more shown.

- Freehold or Leasehold represents land held by Aboriginal land trusts, the Aboriginal and Torres Strait Islander Commission or incorporated Aboriginal and Torres Strait Islander groups. Excludes land held by individuals.
- Reserves represent Crown land reserved for Aboriginal people. Excludes archaeological and historic sites

PUBLIC LAND

- Nature Conservation Reserves (includes national parks)
- Other Crown Land
- Vacant Crown Land
- Crown Leasehold (mainly pastoral)
- Forestry Reserve
- Other Reserves

PRIVATE LAND

- Private Land (mainly freehold)

NOTE:
- Only areas of 50 km2 or more shown.
- Stock route information which is part of Other Crown Land is not necessarily complete

LEGEND

- Roads
- Local Authority Boundaries
- Case study areas

SOURCE OF DATA

1Land tenure data supplied by AUSLIG. Derived primarily from gazettal information.
2Road Network digitised from 1:3,000,000 mapping.
3LGA boundaries supplied by DOLA. Derived from digital cadastral information.
4Base mapping supplied by Main Roads WA.

LANDVISION

STATE GRAVEL SUPPLY STRATEGY

PREDOMINANT LAND TENURE- SOUTH WEST

6B

recommendations are accepted by the State Government, conditions to safeguard the environment are applied through appropriate legislation.

Part V of the Act provides for the control of air, water, and noise pollution associated with emissions from process work on mine and quarry sites. Approvals and licensing can be required before extraction operations begin. The EPA has prepared a draft code of practice for use by extractive industry if crushing and screening is undertaken.

The Mining Act (1978) includes provisions for environmental matters. They apply irrespective of the land tenure over which the tenement is granted, and include provisions for special classes of land.

When a mining lease is approved, the Minister for Mines grants it on the terms and conditions considered reasonable, including protection of the environment and ensuring the progressive rehabilitation of mined areas and other disturbed ground.

Under Section 84 of the Mining Act, the Minister may impose further conditions at any time "for the purpose of preventing or reducing, or making good, injury to the surface of the land". In other words, rehabilitation conditions may be added throughout the period of tenure of a lease to meet changing circumstances and, in particular, to take advantage of additional knowledge and experience gained during operations, as well as changed end-use requirements. Section 84 requires a bond to be lodged to ensure compliance with rehabilitation conditions.

In addition, every lease certificate issued by DME requires the operator to fill in or otherwise make safe all holes, pits, trenches and other disturbances to the surface of the land made during exploration or mining, which, in the opinion of the State Mining Engineer, are likely to endanger the safety of any person or animal.

Section 95(2) of the Mining Act provides that, in the event of a tenement being surrendered, the liability of the holder to meet conditions that existed prior to the surrender (such as rehabilitation requirements) continue in force.

Current legislation requires a mining leaseholder to modify operations to ensure there are no breaches of any covenants or conditions, including environmental conditions. Environmental officers appointed under the Mining Act ensure compliance.

Guidelines prepared by DME for the environmental management of quarries provide information for proponents on acceptable practices in the development, operation and rehabilitation of quarries and gravel pits.

The Mines Regulation Act is in the process of being repealed. It will be replaced by a Mines Safety and Inspection Act. One consequence will be that small quarrying operations will no longer be monitored by DME for safety and health.

4.2.2 Soil and land conservation

Quarrying operations, including those on freehold land, are subject to the provisions of the Soil and Land Conservation Act (1945-1982). The Commissioner of Soil Conservation has powers under the Act to prevent and reduce land degradation, and to promote soil conservation.

Through the Act, the Commissioner may become involved in the assessment of quarrying activities if dust or run-off on to surrounding lands is thought to be significant. In such cases, the Commissioner or appropriate officers from Agriculture WA provide advice to LGs and landowners. Any recommended standards, especially on rehabilitation measures, may then be incorporated in an extractive industry licence.

Land Conservation Districts constituted under the Act can have a role in monitoring the operation and rehabilitation of quarries.

4.2.3 Wildlife conservation

Section 23 of the Wildlife Conservation Act (1950-1979) requires the protection of rare or

endangered flora on Crown and private land. It is therefore preferred that all new quarry sites are subject to a flora survey before mining commences.

4.2.4 Aboriginal heritage

The Aboriginal Heritage Act (1972) makes provision for recording and, where appropriate, preservation of places and objects customarily used by, or traditional to, the original inhabitants of Australia. It defines the legal obligations of the community relating to such places and objects.

The Act is presently administered by the Trustees of the WA Museum. Advice from the Aboriginal Affairs Department's Heritage and Culture Division must be sought about the need for a site survey of any new project area. Project proponents are required to make a commitment to follow the recommendations of the museum trustees in regard to any sites of significance which may be affected.

Where special action is required under the terms of the Act to record or preserve an Aboriginal site, representatives of the department's Heritage and Culture Division may visit the site to supervise or confirm that the requirements have been met by the proponent.

4.2.5 Native title

As a consequence of a High Court decision in March 1995, WA's Land (Titles and Traditional Usage) Act is considered to be inoperative and the Commonwealth Native Title Act (NTA) operates in its place. Under this Act, Native Title is presumed to exist over land which is the subject of Crown tenure, unless that title has been extinguished by some past valid action of the Crown. This can include issue of a grant of incompatible tenure, a past use which is inconsistent with native title, or the assumption of ownership of natural resources by the Crown.

Native title is not an issue for land held in freehold title granted before 1 January 1994, unless the title is a Crown grant to a government agency, LG or Aboriginal interests. Native title also is unlikely to be an issue over land held under exclusive or private leasehold. In this respect, the NTA refers to extinguishment of native title by validation of pastoral, agricultural, commercial or residential leases, except where these are to a government agency, LG or Aboriginal interests.

However, each lease must be addressed individually to determine its effect on native title - having regard to conditions applying to that lease, including whether rights of access are reserved to people other than the lessee, and the legislation under which the lease was granted.

There is some doubt about the status of previously valid pastoral leases in WA, particularly where there has been statutory reservation of certain Aboriginal rights under Section 106 of the Land Act. The State holds that WA pastoral leases extinguish native title, this is still subject to resolution by current Federal Court action.

Leases under vesting order powers also probably have extinguished Native Title where exclusive possession has been granted and where the purpose and use of the reserve is inconsistent with the existence of native title; but again, each lease must be assessed individually.

Where native title has not been extinguished, applications for mineral title or for an extractive industry licence are subject to NTA procedures. These require advertising of the intent to grant the mineral title or extraction licence, notification of the Native Title Tribunal and representative Aboriginal interests, and subsequent negotiation if a native title claim is lodged within two months of the notification.

When advertising its intent to grant a Mining Act tenement or extractive industry licence, DME may include a statement that the intended action attracts an expedited procedure. The inclusion of this statement implies that the granting of the tenement or licence will not interfere directly with native title or sites of Aboriginal significance, or that the proposed level of activity will not involve major ground disturbance.

Greater detail on the impact of the NTA can be obtained through the Land Access Unit of DME or the Native Title Unit of the Department of Land Administration (DOLA). DOLA has produced a pamphlet, "Native Title in Western Australia", which is a useful and more detailed guide to the implications of the NTA.

4.2.6 Water resources protection

The Water Corporation (WC) manages the water resources of the State under the Water Authority Act (1984), using proclaimed catchment areas and groundwater protection areas to assist its objectives. Where water resources are not covered by one of these mechanisms, some protection against pollution is possible under Part V of the Environmental Protection Act (1986).

Historically, planning for the protection and use of water resources involved informal liaison between the former water supply agencies, the Public Works Department and the Metropolitan Water Authority, and other planning agencies. Recent changes to the legislative roles and structures of the planning agencies require more formalised statutory planning procedures.

The Rights in Water and Irrigation Act (1914) administered by WC requires quarry operators to obtain licences for bores, dams, pipelines, effluent discharge and other activities that could adversely affect groundwater or surface water.

For assessment purposes, WC prefers to receive the following information:

- particulars of quarry proposals and details of drainage proposals to limit discharge of silt to surface waters,
- measures for the storage and disposal of potential water contaminants, and
- the location and proposed yield of bores.

A hydrogeological report in support of a proposal assists assessment and is likely to ensure reasonable conditions are placed on approvals.

4.2.7 Land use planning

Where a quarry is on land subject to a town planning scheme (and/or the Metropolitan Region Town Planning Scheme Act (1959-1988) in the Perth metropolitan region) use and development of land must comply with the zone in which it falls. Town planning schemes once approved under the provisions of the Town Planning and Development Act (1928) have the statutory power of an Act of Parliament.

LGs, through the provisions of their town planning schemes, generally incorporate "extractive industry" as an "AA" use in appropriate zones; that is, a use that is not permitted without the approval of council. An application to commence a quarry operation in such a zone carries with it a right of appeal against refusal, or against any approval conditions.

If the application requires advertising (generally categorised as an "SA" use), the opportunity exists for objections to be lodged by members of the public. Once an approval is granted, the operator is required to apply for an extractive industries licence to carry out the excavation.

LGs can permit, refuse or conditionally allow extractive industries within specific zones. Conditions of approval may relate to:

- dust abatement,
- duration of operation,
- noise attenuation,
- setbacks,
- rehabilitation, and
- visual impact.

In addition to statutory provisions in LG town planning schemes, many schemes contain the facility to adopt policies or guidelines for particular areas or issues. For example, areas of landscape protection may be designated within which a quarry operation would be considered incompatible.

LGs are more likely to be responsive to local, rather than regional, considerations. Accordingly, their decisions and the conditions they impose may

be significantly different to those imposed by DME on Crown land, or CALM on reserved land.

In the Perth Metropolitan Region, the State Government retains the right to determine applications for certain types of development on "rural" zoned land, but this option is available only where the relevant LG has not precluded it in a town planning scheme. In cases where the WA Planning Commission is to determine the application, LGs refer the application to the Commission with its recommendations.

In obtaining approvals, advice from the EPA would normally be sought and a level of assessment of the operation would be determined. Following the assessment, EPA recommendations might be incorporated as conditions on either, or both, the planning/development approval and the licence. Accordingly, in most cases, multiple approvals are needed, culminating in a planning/development approval (to permit the use) and an Extractive Industry Licence (to permit the operation).

Before obtaining approvals on private land, proponents of operations must reach agreement with the landowner. In the case of a private operator, this requires normal negotiation on a commercial basis. In the case of Main Roads and LGs, rights of access are available under the Public Works Act (1902) and the Local Government Act respectively (see Section 4.5).

At the State Government level, provisions exist under Section 5AA of the Town Planning and Development Act (1928) for the Government to prepare and adopt Statements of Planning Policy, which must be given appropriate recognition by LGs in the preparation and administration of town planning schemes.

An informal policy has already been adopted for the protection of basic raw materials in the Perth Metropolitan Region. The policy provides various levels of protection to identified extraction sites and to future resource areas, depending on their strategic importance. This is currently under review as a Section 5AA policy.

No gravel extraction sites have yet been considered significant enough to warrant protection, but a Statement of Planning Policy could be prepared to ensure suitable recognition of the State's gravel resource, if warranted. This could be done as a product of the State Planning Strategy prepared by the WA Planning Commission to serve as a basis for guiding government agencies and local authorities in planning matters. Finally, the Minister for Works under Section 112 if the Public Works Act can give state agencies or LG's access to RBM's on Vacant Crown Land or Crown reserves.

One of the initiatives envisaged is the preparation of the state policies to guide the management of natural resources, such as basic raw materials, land and water. It is envisaged that these policies will be developed cooperatively by all agencies with an interest in the use of the particular resources.

The WA Planning Commission Act allows for the preparation of statutory Regional Amendments to the State Planning Commission Act. They will allow preparation of statutory Regional Planning Schemes for areas outside Perth, and will enable the same recognition to be given to regional planning in country areas as exists in the metropolitan region.

This will allow for protection for designated resources (including strategic gravel reserves) from competing land uses where the WA Planning Commission and the Minister for Planning consider it appropriate to do so.

The consultation procedure involved in preparation of Regional Planning Schemes will provide an opportunity for relevant government agencies to ensure that their particular interests are considered.

4.3 LEGISLATIVE PROVISIONS AFFECTING QUARRY OPERATIONS ON CROWN LAND

Under the Mining Act, gravel, rock, limestone, sand and clay are "minerals" only on Crown land,

which is defined as including pastoral leases, commons and timber reserves. A road building authority can apply for a mining tenement on Crown land for the purpose of gravel extraction.

Quarrying of gravel on Crown land is regulated by the Minister for Mines through the provisions of the Mining Act (1978) and the Mines Regulation Act (1945). Division 1 of Part III of the Mining Act sets out provisions for mining on Vacant Crown Land (VCL) and Crown land leased for pastoral, Aboriginal or timber purposes.

Section 20 covers the issue of a Miner's Right and authorises the holder to prospect for minerals on VCL which is not already covered by a tenement. The Miner's Right includes requirements for refilling excavations and preventing damage to vegetation, conditions applying to tenements on pastoral leases to protect leaseholders' interest, and provision for compensation for damage to improvements, such as fences, wells and buildings.

Land alienated from the Crown before Federation in 1899 is not covered by the Mining Act. Land around Toodyay, Australind, Pinjarra and an area south-east of Kalgoorlie comes into this category. Quarry and mining operations on this land require the agreement of the landowners because they also own the mineral rights.

Applications for mining leases on Crown land within the South West Mineral Field are referred to the Ministry for Planning (MfP). Applications for Mining Act tenements for quarries in the metropolitan region are uncommon because of the extent of freehold land.

Mining Act tenements are not a form of land tenure. They provide for the short-term requirements of prospecting, exploration and mining (for two, five and 21 years respectively). Retention licences (five years) are available if market forces, financial restrictions or environmental constraints prevent a company or individual from mining a measured or indicated resource.

DME routinely assesses all Main Roads applications for gravel reserves and, if approved, marks them on public plans. The department is presently formulating a response to a State Government directive that gravel is no longer to be considered a mineral under the Mining Act.

An alternative procedure for private road builders, Main Roads and LGs is to seek the creation of a quarry reserve under Section 29 of the Land Act (1933). Quarrying is one of many specific purposes allowed for a reserve under the Land Act.

Other reserves vested in a LG may be available for quarrying under the provisions of the Parks and Reserves Act if quarrying of the material is compatible with the purpose for which the reserve was created.

Section 33 of the Land Act allows the person or authority in whom a reserve is vested to lease the whole or part of the land if there is a separate statement in the vesting order and the lease is consistent with the purpose of the reserve. Section 34A allows the Minister for Lands to request any person in whom land is vested (or is proposed to be vested) to submit a management plan for the development, management and use of the land.

Under section 3.27 and Schedule 3.2, item 3 of the Local Government Act 1995, LGs may take earth, stone, sand or gravel for road-building purposes subject, under Subdivision 3, to the consent of the owner or occupier to enter.

Finally, the Minister for Works under section 112 of the Public Works Act can give state agencies or LGs access to RBMs on Vacant Crown Land or on Crown reserves.

A shortcoming of this facility is the lack of a requirement in the case of a reserve for prior referral to the Minister responsible for CALM, or to the authority in whom the land may be vested. There also is no requirement for post-quarrying rehabilitation. Theoretically, a safeguard exists under Section 38 of the Environmental Protection Act, which allows referral of planned activities to the EPA, but this may not be sufficient by itself.

4.4 LEGISLATIVE PROVISIONS AFFECTING QUARRY OPERATIONS ON RESERVED LAND

The Mining Act (1978) makes provision for mining on reserved land. Section 24 sets out the procedures that apply to the application for, and granting of, Mining Act tenements for particular classes of reserved land administered by CALM and other government agencies. The Act stipulates that before a tenement is granted, concurrence is required from the Minister who has legislative responsibility for the reserved land.

Section 26 provides for conditions to be imposed on Mining Act tenements on reserved land to ensure that "injury to the surface of the land" is made good. If necessary, the costs of such work may be recovered from the tenement holder. Section 26 also enables securities to be required covering mining operations on public reserves. The Act has the power of forfeiture in case of non-compliance with any of the covenants or conditions, and allows the imposition of fines for breaches.

The provisions of this section of the Mining Act have a very important role in regulating exploration and mining in environmentally important or sensitive areas. They can be used to prevent these activities, or to direct that they be carried out in accordance with requirements specified by the authority in which the land is vested.

4.4.1 Quarrying on CALM-managed land

Mining Act tenements may be created on CALM-managed land subject to the concurrence of the Minister responsible for CALM, and may include any conditions the Minister requests. The CALM-managed estate comprises State forests, timber reserves, national parks, nature reserves and conservation parks.

Under the existing provisions of the Mining Act, mining leases can be granted in national parks or Class A nature reserves only with the specific approval of both Houses of Parliament.

Exploration tenements can be granted only with the concurrence of the Minister for the Environment. Exploration and mining on CALM-managed lands and other environmentally sensitive areas is administered by DME in accordance with State Government policy (ie. under the provisions of the Mining Act, which in turn is closely integrated with the CALM and Environmental Protection Acts).

Interdepartmental procedures are aligned with memoranda of understanding approved by Chief Executive Officers. They ensure referrals are made and that environmental safeguards and conditions are set and complied with. Current changes to the Mining and CALM Acts underwrite these arrangements.

In 1993, CALM and DME agreed to a policy covering the extraction of basic raw materials from land managed by CALM. Under the policy, gravel and other basic raw materials occurring on CALM-managed land can be used by CALM or its authorised agents for any agricultural, pastoral, household, road making or building purpose on that land, provided no Mining Act tenement has been granted over the area concerned.

CALM may authorise gravel extraction from part of a State forest, national park or nature reserve to carry out road work in other parts of that reserve. For material to be excavated from conservation reserves - that is, national parks and nature reserves - Section 100 of the CALM Act stipulates that its use must be "necessary" for the management of the national park or nature reserve.

Requests for gravel or other basic raw materials by LGs, Main Roads, Western Power, Alinta Gas or other agencies for services adjacent to, within, or serving State forest and timber reserves may be accommodated by CALM issuing a lease under Section 97 of its Act. For public works not servicing State forest and timber reserves, a royalty is applicable.

The creation of such a lease on State forest and timber reserves means that the land falls within the Mining Act's definition of private land. Accordingly, the materials are no longer regarded

as minerals and the provisions of the Mining Act do not apply.

All operations of a commercial nature involving basic raw materials are controlled under the Mining Act, and a Mining Act tenement must be obtained by the commercial operator. Mining Act tenements are issued by the Minister for Mines, subject to the concurrence of the Minister responsible for CALM, using any conditions negotiated between CALM and DME.

CALM and the National Parks and Nature Conservation Authority (NPNCA), in consultation with LGs, have developed policies in recent years on access to gravel on CALM-managed conservation estates. The NPNCA's Basic Raw Materials Policy permits limited access under provisions of the Local Government Act, the Public Works Act, or by excisions under the Land Act.

Under this policy, each application is considered on its merits. The proponent must first gather comprehensive biophysical information as well as data on alternative resources to permit the NPNCA to make a considered decision on the costs to conservation, and the merits of the case to be put to the Minister for consideration. Evaluation costs are borne by the proponent.

Depending on the alternatives and the values at stake, road reserves within the boundaries of the conservation estate, and roads directly contributing to the management and protection of the estate, usually will be more favourably considered. Offering suitable replacement land as compensation will also assist a proponent's case.

4.4.2 Quarrying on other reserved land

Proposals for quarries on proclaimed water catchments, water reserves and underground water pollution control areas are assessed by the Water Corporation.

For quarries located on water catchments or water reserves, DME encourages direct regulation by WC of operational procedures relating to water quality. DME intervenes under the powers given to it by the Mining Act when the requirements of WC are not being properly addressed by the operator.

In the Perth Metropolitan Region, development on land reserved in the Metropolitan Region Scheme (MRS) is determined by the State Planning Commission. In reality, many of these reserves are vested in other authorities, or are proclaimed water catchments or State forest.

It is commission policy that any extractive industry application be referred to appropriate government instrumentalities prior to a formal decision being made. The commission's powers are generally considered to be subordinate to those of CALM and WC for their respective areas. In other MRS reserves, the recommendations of the authority in whom the reserve is vested generally would be adopted.

Where land is vested in a LG, section 3.54 of the Local Government Act 1995 empowers the LG as a "board" under the Parks and Reserves Act. This Act provides boards with wide powers, including the authority to "grant licences for the removal of any sand, gravel, or other earth or mineral...". Where a reserve is not subject to an existing mining tenement, the Minister for Lands may approve a quarrying operation under the powers of the Parks and Reserves Act.

Exploration or mining tenements are granted on Aboriginal Reserves only with the agreement of local Aboriginal communities, the Aboriginal Lands Trust and the Minister for Aboriginal Affairs. When a mining tenement is granted on an Aboriginal Reserve, the holder must ensure that all non-Aboriginal personnel who enter the reserve obtain an entry permit under the provisions of the Aboriginal Affairs Planning Act (1972).

4.5 LEGISLATIVE PROVISIONS AFFECTING QUARRY OPERATION ON PRIVATE (FREEHOLD) LAND

As "gravel" is excluded from the definition of a mineral when it occurs on private land, the administration of the State's gravel resources on

private land is regulated by the relevant LG through its town planning scheme and its extractive industry local laws.

LGs use the provisions of section 3.27 and Schedule 3.2, item 3 of the Local Government Act 1995 to acquire basic raw materials for roads, while they can use the provisions of section 3.5 to control by local laws, extraction operations within their district boundaries.

Section 3.5 enables a LG to make local laws to allow it to perform any of its functions under the Act. This can include the regulation of quarry operations and the associated issuing of extractive industry licences for such operations.

Some LGs adopted model extraction industry by-laws under the former Local Government Act, making amendments to these to suit their individual circumstances. These will continue to apply as local laws under the new Act.

Where LGs have not adopted extractive industry by-laws under the old Act and do not adopt such local laws under the current Act, little practical control is available to regulate quarry operations. However, there is power for LG's to regulate under other laws including Town Planning Schemes and the operations of the Environmental Protection Act.

4.6 GAINING ACCESS TO THE GRAVEL RESOURCE

4.6.1 Freehold land

Ownership of land does not usually include the materials on or under it; they generally belong to the Crown. However, land titles granted before Federation in 1899 indicate that the landowner owns materials to a specified depth below the surface. For titles granted after that date, no payment is made for the materials extracted, apart from compensation for loss of earnings.

The landowner has no right of veto over extraction of RBMs from the land, and such a right is not advocated by this report.

Appendix 3 details the legislative provisions which enable road builders to gain access to RBMs.

Main Roads WA

Power of entry on to freehold land is available to Main Roads in three ways:

- An Order in Council published in the Government Gazette (20 June 1930) via Section 5(2)(c) of the Main Roads Act. This includes search and exploration powers, but can be used only when land is held under Crown grant (rural land only), conditional purchase lease or pastoral lease. This method is not recommended because the Land Act regulations have been repealed.

- Under Section 112 of the Public Works Act via Section 16(4) of the Main Roads Act. Under Section 113, a claim for compensation may be made, but this is limited to the amount which would have been payable had the land been acquired. No compensation is payable for any materials taken.

- Under Subdivision 3 of the Local Government Act 1995, which Main Roads is empowered to invoke through Sec 16(1)(b) of the Main Roads Act. In this case, compensation is not payable unless the owner or occupier requests compensation.

The preferred method is to use Sections 112 of the Public Works Act, which provides for any person authorised by the Water Resources Minister to temporarily occupy and use any land to construct or repair a public utility. To do this work, it may be necessary to extract stone, gravel, earth and other materials.

The Commissioner of Main Roads may exercise the power delegated by the Minister under Section 16 of the Main Roads Act. This allows Main Roads access to private property, and to extract gravel without compensation.

Main Roads has prepared a manual of acceptable practices for extraction and rehabilitation.

Main Roads' first contact with the landowners is usually made by staff with good communications and negotiation skills. The aim at this stage is to explain to the landowner that Main Roads requires access to the land to prove resources and later to establish borrow pits to improve roads for the benefit of the community at large. Initial investigations using geographic maps identify prospective areas and all landowners of property showing potential in the vicinity of the project are contacted, so that there can be no accusation of bias.

The issue of a Notice of Entry (NOE) is a legal requirement. It is served on the owner of the land after appropriate discussion and prior to taking any material. Entry is not made for a minimum of seven days after issue of the NOE. The initial search is undertaken using a borer or excavator to penetrate sub-surface layers, with minimal land disturbance.

Main Roads normally acquires gravel from cleared private land or CALM-managed land.

If gravel for a particular project is available from both private land and CALM-managed land, Main Roads would generally try to acquire gravel from the source that provides it at the lowest total cost, taking into account factors such as clearing, winning, carting and rehabilitation. If that happens to be CALM-managed land, an environmental assessment is carried out to determine whether the proposal is environmentally acceptable. If it is considered acceptable, permission is sought from CALM to remove gravel.

Landowners are normally compensated for damage to, or loss of, any improvements, including seed and fertiliser. Areas are adequately rehabilitated, using topsoil stockpiled before gravel is extracted. Compensation is in two categories:

- Compensation for loss of improvements. Payment is made to the landowner to apply seed and fertiliser to borrow pit areas to ensure good pasture is re-established as quickly as possible.
- Compensation for loss of profit. Payment may be made to the landowner for lost earnings for a period from pit commencement until production is re-established. This payment is based on the stock carrying capacity of the land.

In lieu of a compensation payment, the option of providing a quantity of gravel in stockpile or works to the equivalent value such as carting and placing in a farm road or grading driveways would be discussed with the landowner. The costs involved are limited to the value of compensation under the provisions above.

While rehabilitation is commonly directed at pre-existing land use, the landowner may request that pits be planted with trees or seeded with native trees and shrubs. Fencing is usually necessary.

A catchment for a dam or proposed dam may be made from part or all of a pit.

Local Government

LGs have access to gravel under section 3.27 of the Local Government Act 1995. Where necessary, it is also possible for a LG to take land compulsorily under the Public Works Act 1902 to do work for which it is authorised.

Under section 3.27 of the Local Government Act 1995, a LG "...may, in performing its general function, do any of the things prescribed in Schedule 3.2, item 3 even though the land on which it is done is not local government property". Schedule 3.2, item 3 provides, *inter al,* for taking of earth, stone, sand or gravel that is required for LG works.

A significant restriction in subsection (3) of section 3.27 is that it precludes LG activity on land that is "being used as a site or curtilage of a building or has been developed in any other way" or is cultivated. Subsections (2) and (4) allow for regulations to amend subsection (3), but at present no such regulations exist.

In entering land, LGs are required under section 3.31 to have the consent of the owner or occupier,

or to have given a Notice of Entry under section 3.32. If the owner or occupier objects on receipt of this Notice of Entry, the LG cannot enter the land. In this event, there is recourse under section 3.33 to a Justice who may issue a warrant to allow entry if he deems that it is reasonably required by the LG in the performance of its functions.

Under section 3.22, a LG taking materials from land, other than that covered by pastoral or timber leases, must pay compensation for damage if the owner or occupier requests such compensation. The amount paid is to include compensation for the value of material removed.

The provisions of section 3.27 differ substantially from the previous Local Government Act in that it is not specified as to what is meant by "developed" or cultivated land. That Act gave LGs power for entering land other than land used for specific purposes to take materials. Those specified purposes were gardens, yards, orchards, plantations, parks, recreational grounds or cemeteries and did not impose the broad restrictions to cultivated and developed land which apply under the present Act. Payment of compensation was, however, compulsory, whether or not it was requested.

The following describes the general approach which might be used by LGs to procure RBMs, although the procedure and approach can vary:

The Chief Executive Officer, shire engineer or works supervisor - with or without the councillor for the area in which road works are to be carried out - might visit landowners to seek their assistance in the supply of gravel.

Should the landowners not cooperate at this stage, the LG can issue a Notice of Entry under section 3.32. If the landowner again objects, the LG might seek a warrant for entry from a local Justice, provided it can demonstrate that the gravel sought is essential to its road building requirements.

Prior to issuing a Notice of Entry or seeking a warrant, it would be prudent for the LG to advise the landowner of its intention and, where possible, to seek cooperation rather than compulsion.

A letter of agreement may be drawn up specifying the terms and conditions of the temporary quarry operation. However, some LGs may not wish to enter into a formal agreement, preferring to conduct business on a verbal "gentleman's agreement" basis.

LGs should assure property owners that the work will be carried out in the most economical manner, and should try to avoid creating environmental problems such as:

- unnecessary clearing of vegetation,
- invasion of annual grasses into worked areas, creating a fire hazard,
- increases in soil salinity, and
- soil erosion.

Reinstatement of worked areas, and of any old gravel pits, should be carried out using topsoil stockpiled ahead of the gravel extraction operation. Pit reclamation is carried out at the LGA's expense, either upon completion of each extraction operation, annually or as specifically agreed.

Agreement will usually be reached between the landowner and LG to prevent other persons or groups extracting materials from the designated area. The materials to be extracted should be used only to improve the public road system in the locality where the pit is situated, or to carry out authorised municipal works in the public interest, unless otherwise agreed.

The landowner may use free of charge small quantities of the materials stockpiled by the LG. Where larger quantities are required, the two parties must agree on terms of extraction and how the material is to be used.

Where no compensation is paid to the landowner, the LG may agree to undertake "work in kind" to the satisfaction of the landowner. Where compensation is payable, the amount will be determined by agreement. Currently, sums paid vary from $0.10 to $3.50 a cubic metre.

Private industry

Under Section 112 of the Mining Act, private road contractors are generally required to restrict their extraction operations to private land where negotiations have taken place with the landowner. Contractors pay royalties, generally ranging between $0.50 and $3.00 a cubic metre. The level of royalty often depends on the volume and quality of gravel reserves available in the district.

Where a LG has adopted Extractive Industries Model Local Laws, the contractor is required to apply for a licence to operate the proposed gravel pit. In many instances, this requirement is loosely controlled.

Throughout the industry, operators are experiencing difficulty gaining access to quality gravel reserves. With the introduction of quality assurance, especially in the government tendering process, the specification required often is difficult to achieve. Some contractors are hesitant to commit themselves to a supply arrangement they may not be able to achieve. They may also face difficulties in locating and pricing economic sources of gravel within a limited tender period. The above factors could lead to a premium being charged on gravel supply. It may therefore be preferable for the road building authority to retain the role of supplying the material to the successful contractor.

4.6.2 Pastoral land

Section 106(1) of the Land Act enables the Minister for Lands to lay out public roads on pastoral leases and to extract RBMs. Section 105(1) allows for non-payment of compensation, except for damage to improvements.

Section 112 of the Public Works Act allows for the temporary use of pastoral lease land and the removal of material for road works.

Where Main Roads seeks to create a gravel reserve on a pastoral lease, the site must be excised from the lease. This is a laborious and time consuming process. An agreement with the lessee cannot be protected by caveat, and an agreement can apply only to the lessee with whom it is made.

4.6.3 Crown land subject to a mining tenement

Section 9(2) of the Mining Act allows access to RBMs on Crown land if the land is not subject to a Mining Act tenement. The Mining Act overrides the Local Government, Main Roads and Public Works Acts in respect to access to minerals; that is, the more specific Act overrides the general Act.

Section 85(2)(b) of the Mining Act states that the "lessee of a mining lease owns all minerals lawfully mined from the land under the mining lease". While it is possible for DME to exclude surface rights, it is reluctant to exempt gravel because this may disadvantage the tenement holder. Accordingly, gravel may be acquired from a mining lease only by negotiation with the lessee.

However, this does not apply to exploration licences and prospecting licences not on private land, where Section 112 of the Mining Act reserves the right of access to RBMs to any authorised person. The licensee can also explore for gravel and exercise a right to convert a prospecting licence to a mining lease. Therefore, gravel stockpiled on Crown land which is awaiting reservation could be lost through approval of a mining tenement lease over the area.

A common procedure used by Main Roads is to have DME consider the use of Section 19 of the Mining Act, which allows the Minister for Mines to exempt Crown land from mining. This can occur only on land not already subject to a Mining Act tenement.

An agreement with DME allows Main Roads to seek exemption for areas for up to 12 months to allow assessment. If warranted, the conversion of the area into a gravel reserve under the Land Act is then possible; but this avenue should not be pursued unless a gravel reserve is essential because the process is laborious and can take many years.

4.7 SUMMARY

While government legislation has recognised the need to maintain the right of access to natural materials for the purposes of road building, competing land use demands and greater recognition of environmental values have restricted this access and have exposed weaknesses in the legislative framework.

Furthermore, legislative provisions vary with respect to rights of access and compensation provisions for the State Government, LGs and private industry.

In recent times, more landowners are objecting to entry on to their land for gravel extraction, and it is more difficult to find an agreeable landowner.

In addition, current legislation provides little security of tenure during the exploration phase of an operation. If security is sought by establishing a gravel reserve, the procedure is lengthy and inappropriate for a project of short duration.

Inconsistencies also occur in the regulation of operations. In the Perth Metropolitan Region, multiple approvals are often needed, while in some rural LGs there is little or no control over extraction.

5.0 Case Studies Findings

5.1 METHOD

Fifteen case studies were conducted through interviews with shire, CALM and Main Roads officers with road building responsibilities. The purpose was to determine first hand the major issues of concern to road builders.

The LGs approached were: Augusta-Margaret River, Broome, Busselton, Carnamah, Chapman Valley, Cranbrook, Cunderdin, Dandaragan, Esperance, Gingin, Kellerberrin, Mingenew, Moora, Roebourne, and Wyndham-East Kimberley.

They were selected because of identified problems with gravel supplies, because alternative materials were being used for road building, or because of the access and rehabilitation policies developed by the LG.

The 15 case studies are detailed in Appendix 4. They provide a background or reference points for subjects raised in the Issues and Actions section (Section 6).

The main issues arising from the case studies are summarised below.

5.2 PLANNING

LGs vary in their approach to planning road works and road maintenance. Some have detailed plans which cover a five-year time horizon, while others plan only within the confines of the financial year.

Successful long-term planning requires a detailed knowledge of the distribution and quality of potential road-making resources, and this is not encouraged by the current paucity of data on resource size and distribution.

Although supplies of the resource are not an issue for more favourably situated LGs, this should not make planning a less important function than other activities. LGs with access problems to known resources are constrained in their attempts to plan by a lack of knowledge of the location of other potential gravel supplies.

Equally, the inability of LGs to sequester areas of potentially useful supplies except through the Mining Act is a constraint on long-term planning. It is difficult for the provisions of the Mining Act to be exploited because gravel is not deemed a mineral when found on private land. However, two of the 15 LGs considered in the case studies have used Mining Act tenements to secure resources on leasehold and other non-freehold land.

5.3 USAGE

There was wide variation among the LGs in the quantity of gravel used and the length of road treated each year. Quantity ranged from 5,000 to 200,000 cubic metres and appears to be a function of the size of the LG, the size and status of its road network, and the type of natural sub-grade traversed by the roads.

5.4 HAULAGE DISTANCE

The maximum distance over which LGs haul gravel to road works averages 15 kilometres and ranges from five to 50 kilometres. In most instances, the material carted is ideally suited for road making.

There does not appear to have been any assessment of the cost/benefit of using stabilisers or amendments to improve poorer quality materials as an alternative to long haulage of better quality material.

Most LGs lack the expertise to evaluate stabilisers or alternatives to lateritic gravel. If they were better advised, they might use RBMs of lesser quality obtained closer to the site of a road project.

5.5 SUPPLIES OF LATERITIC GRAVELS AND LIMESTONE/MARLS

Eleven of the 15 LGs have adequate potential supplies of laterite gravels and limestone/marls,

though distribution may be adverse to operations. Information on the location and quality of the materials is poor and affects the LGs' perspective on the availability of resources.

Access to potential resources is restricted in some instances by constraints imposed by CALM, and in other cases by the LGs' unwillingness to obtain material from freehold land.

5.6 LOCATING SUPPLIES OF LATERITIC GRAVEL AND LIMESTONE

Most LGs use local knowledge to locate resources of lateritic gravel. In general, they are not given information on resources by owners of freehold land and are therefore hampered in extending their knowledge of potential resources.

LGs and other bodies interested in gravel suffer from a lack of information on the nature, extent and distribution of the material.

5.7 OBTAINING GRAVEL

In pastoral areas, contractors are used to cart gravel supplies coming from remote pits because, unlike LGs, they have large haulage equipment which enables them to take advantage of economies of scale.

In the South West Land Division, Crown land and gravel reserves are a diminishing source of gravel supply. However, gravel is still being obtained from some areas of CALM-managed land. This includes State forests where there are established pits, and/or there is a demonstrable scarcity outside the State forests.

Gravel is sometimes being obtained from nature reserves, but in most cases only for use on roads serving those reserves.

Finally, it is being obtained from areas excised from nature reserves, where reasons of scarcity or prior use have been balanced against conservation considerations.

Several LGs have expressed frustration at the decline in access to traditional sources on Vacant Crown Land, or on Crown reserves which have been incorporated into the conservation estate. In some cases, this has led to political intervention to seek a compromise.

These LG frustrations are set against the changing expectations of a society which wants increasing emphasis on conservation of native flora and fauna. Against this background, it is inevitable that RBMs will be less accessible from the conservation estate, and that LGs must increasingly obtain materials from other sources, often with increased haul distances and costs.

The frustration might be tempered if there was improved consultation between CALM and LGs before reserves were established or expanded. In these circumstances, if resource scarcity is a problem, CALM might also support the determination of the presence or otherwise of significant deposits of RBMs within the proposed reserve boundaries.

As a general observation, the increasing difficulty of access to material sources which are now within CALM-managed land is resulting in increased recourse to gravel on private land.

5.8 COMPENSATION

There is a wide variation in LG gravel payments to holders of freehold land. Payments in cash or in kind are usually at a rate between 10c and 50c a cubic metre, but can rise to $4.50 a cubic metre in areas where the resource is scarce and/or is used in urban subdivisions.

For individual farmers, the total amount received is generally a few hundred dollars a year, and rarely more than $1,000; while some LGs pay no compensation.

5.9 ALTERNATIVE ROAD BUILDING MATERIALS

Alternatives to lateritic gravels and limestone - such as crushed rock, marl and manufactured materials - are used only when scarcity of the resource or access problems make it necessary.

However, there is scope for a wider economic appraisal of the use of alternative materials.

In areas where massive duricrust or caprock is available, and where more easily winnable materials are exhausted or are scarce, LGs have resorted to the use of in situ crushing to access these materials.

5.10 MODIFICATIONS AND STABILISATION

Soil stabilisers and modifiers are not commonly used by LGs, usually because of a lack of information on their use. There is therefore scope for an investigation of the costs and benefits of using stabilisers and modifiers in a range of situations.

5.11 PIT REHABILITATION

The history of rehabilitation of gravel pits by LGs suggests their performance in the past has been poor. Increasingly, LGs are adopting guidelines for rehabilitation published by CALM, Main Roads and DME, but there is still variation in techniques, in the use of available information, and in the quality of work. Many LGs need assistance in this respect; rehabilitation techniques often are poorly applied and token efforts are sometimes evident.

The legacy of opposition to LGs entry to freehold land because of poor rehabilitation in the past is being overcome by LGs which allocate funds each year to repair abandoned pits and effectively rehabilitate current pits. Some LGs have also demonstrated that progressive rehabilitation during the life of a pit is more cost-effective than rehabilitation after its closure.

5.12 OTHER ENVIRONMENTAL ISSUES

In some LGs, gravel is still obtained from road reserves. Remnant vegetation within these reserves is inevitably affected - either through direct clearing or, in some areas, through the introduction of dieback.

Lack of attention to dieback hygiene is an evident problem, with strict attention generally applying only on CALM-managed land. In consequence, areas of remnant vegetation exploited for their gravel content - in road reserves or elsewhere - can be placed at risk of infection.

Some of the more responsible LGs are reluctant to use gravel from areas of remnant vegetation and road reserves because of the adverse environmental and aesthetic impacts. Owners of freehold land are also increasingly opposed to the clearing of remnant vegetation on their properties, so exacerbating a notional shortage of RBMs, particularly if there is a reluctance to allow access to material on arable land.

5.13 TECHNICAL SUPPORT

While some LGs employ qualified engineers on a full-time or part-time basis, many rely on the combined experience of the shire clerk and the works supervisor to design and superintend road building operations. This can affect the efficiency and competence of road design in matters such as materials used, access to materials, evaluation of materials' quality, and assessment and use of modifications to improve material performance.

Consequently, there are aspects of current road making operations which are rooted in the techniques of the past.

There are two complementary avenues for increased technical support:

- employment of engineering and environmental professionals by each LG, or by groups of LGs, and
- increasing use of network processes, such as workshops run by Main Roads to disseminate information to LGs.

5.14 CONCLUSIONS

The LG case studies have indicated a variety of approaches, problems and potential strategies.

In the planning arena, a lack of information on the distribution of RBMs is a clear constraint for many LGs. This has come about in some cases, and has been compounded in others, by loss of access to resources on Vacant Crown Land, or Crown reserves, which were once freely available.

Restriction of access to these areas is a comparatively recent phenomenon brought about by a shift in community attitudes and Government policy. This has resulted in areas of remnant vegetation that were once freely accessible being protected from exploitation by incorporation into national parks and nature reserves.

The restraints on access to these areas have led to a need for increased access to freehold land, but here too difficulties arise. A legacy of poor rehabilitation of extraction sites has made many landholders loathe to permit access to cropping and pasture paddocks. They often believe that productivity will suffer and that unsightly extraction scars will remain.

The difficulty is compounded by the varying approaches of different LGs to compensation offered for disturbing private land. Some with a critical materials shortage offer overly generous recompense, while others depend on pressure or persuasion and offer little recompense.

Where RBMs are scarce, alternatives are often available. This may be in the form of good quality but more expensive materials, such as the caprock found in the bottom of some gravel pits; or it may involve the use of additives to upgrade poorer quality materials. Here too the approach varies widely, with some LGs having greater experience and knowledge of the opportunities and techniques available.

Against this background, there are positive signs and lessons to be learnt from LGs which have come to terms with the problems of obtaining RBMs and developed satisfactory approaches to resolution of the problems.

For example, some are working cooperatively with CALM to secure access to resources within the CALM-managed estate where it can be demonstrated that access is justified. Others have a sound working relationship with local landowners that sees both parties benefiting from acquisition of gravel from private land.

The latter is being helped by an improved approach to rehabilitation, which is evident in many areas. A variety of published rehabilitation guidelines are available and being used by LGs. However, this improvement is measured against a background of historic neglect, and scope remains for further advances in this area.

Overriding the above considerations is the evident importance of each LG having access to competent engineering and environmental expertise. Such expertise is essential for sound forward planning to identify and secure RBMs, and for subsequent use of the materials in the most cost-effective manner. It is also needed to plan and guide a satisfactory standard of post-extraction rehabilitation.

It is against this background of issues and opportunities identified by the case studies, combined with the experience of Main Roads and the advice proffered by various government agencies, that the following section identifies five key issues and suggests appropriate actions to address them.

6.0 Issues and Actions

6.1 ISSUE 1

The lack of a comprehensive database on potential resources of gravel and other suitable RBMs, and current and ongoing demand.

Historically, gravel and other RBMs have been considered freely available. Recently, in rural areas of the State, difficulties have been experienced in finding adequate supplies of suitable material. This can be because of the absence of the resource itself, insufficient knowledge of its location, haul distance and cost, or difficulties of access.

To increase the potential resource in areas of shortage, new approaches and improved techniques are needed in:

- identifying resources,
- determining quality of resources,
- evaluating alternative materials, and
- improving operational efficiency.

The first is discussed in this section, while the other three are discussed in Section 6.5.

6.1.1 The changing nature of demand

The demand for RBMs over time is likely to be increasingly related to upgrading existing roads, with a relative decline in the demand for new roads. This has important implications for RBM requirements.

- Often, roads to be upgraded have already drawn on the most readily available RBMs in the locations through which they pass. Finding new sources for upgrading requirements in those locations can therefore be increasingly difficult or costly.
- Upgrading may demand higher quality materials than those used to construct the original road because traffic volumes, speeds and loads have increased.
- Changing characteristics of the environment through which roads pass (such as rising watertables and consequent moister foundation conditions in low-lying terrain) can lead to changes in the quality, quantity and/or type of materials required for roads.

6.1.2 Location of road building materials

The most common method used by LGs to identify RBMs is the local knowledge of the engineer, works supervisor or foreman. The LG approach is generally sufficient to identify new sources when the resource is plentiful, but is deficient where the resource is scarce. Obtaining additional soil, geological and vegetation information, where it is available, and exploiting the potential of remote sensing and airphoto interpretation, can remedy the deficiency, and provide the following advantages:

- more efficient identification of RBMs in areas where there is not a scarcity, and
- location of additional resources where there is a scarcity.

Main Roads already complements the knowledge of its officers with published soils and geological data, and by using specialist personnel. Problems can, however, still arise when work is tendered to private contractors who face difficulties if they have to locate and price economic sources of RBMs within the tender period. In some cases this leads to a premium on the supply price.

6.1.3 Quality of road building materials

LGs adopt a similar approach using local knowledge to determine the quality of RBMs on-site. Main Roads makes wider use of laboratory appraisal to determine the characteristics of the resource.

LGs usually depend on the ability of an experienced field operator to determine the suitability of different materials for use on roads.

However, there are many situations where laboratory testing would be justified to obtain a better understanding of a material's characteristics. This would permit more effective use of materials through blending, modification or strategic placement in a road formation.

6.2 POSSIBLE ACTIONS TO ADDRESS ISSUE 1

6.2.1 Compile and maintain a database of regional and local needs for RBMs for the short, medium and long terms.

A database should be compiled on the projected requirements for RBMs by LGs, Main Roads and, where they are major users, organisations such as the Water Corporation, Westrail, Co-operative Bulk Handling and private industry. Competing requirements for non-road uses, such as airstrips, dams and industrial construction also need to be recognised, seeking input from agencies such as the Department of Commerce and Trade.

The database should be compiled on a regional basis, and should be updated annually using statistics provided by users.

Where local or regional plans are being prepared, future demand for RBMs related to proposed developments also should be quantified by MfP and/or by relevant LGs.

The database on resource availability would provide a warning of regions where shortfalls are likely to occur. Efforts could then be focused on those areas to upgrade knowledge of gravel or alternative resources, and/or to evaluate modifications which would make recycling of existing materials, or the use of lower quality materials, an attractive option.

The database could be further refined by adding to it information on proven extraction sites, past or present. This would include:

- locations where gravel or other RBMs have been obtained in the past, when the information is available from sources such as Main Roads, DME, DOLA or LG records,
- the location of each new extraction site as it is opened, and
- the location of dormant and rehabilitated pits.

6.2.2 Compile and maintain a database of gravel and other road building materials.

To improve efficiencies, particularly in locations where the resource is scarce, the identification of RBMs needs to be more systematic and coordinated.

The study undertaken as part of this strategy demonstrated that geology and soils maps can be used as a first basis for desk-top identification of likely locations of RBMs or alternatives. The task can be simplified by use of a Land Information System (LIS) to identify areas with the soils or rock types with which gravel or other RBMs are commonly associated. Map prints showing only this rock or soil type are then requested from the land information system.

The cooperation of Main Roads and LG personnel would be required in compiling maps showing current pits and quarries, and those operated in the past where data is available.

Maps of likely locations of gravel or other RBMs developed in this way could be referred to the relevant regional office of Main Roads and LGs for critical appraisal. Their comments would permit refinement of the map data before it was registered on a computer file.

While such a database ideally could be developed for all regions of the State, initial focus should be on localities where scarcity of gravel and alternative RBMs is most serious, or where local or regional plans are being prepared.

In the latter case, LGs and MfP should seek information on distribution of RBMs as part of the planning process, paying particular attention to

areas proposed for hobby farms. Whether these areas are then secured through zoning, or are sterilised by competing land use demands, would be a matter for determination within the planning process. The approach would also reduce the incidence of unintentional sterilisation.

The foregoing approach would not replace the role of knowledgeable LG officers and farmers in identifying the most likely sites for gravel or other RBMs. However, it could assist significantly in initial selection of target areas for subsequent field appraisal.

Information from the RBM database should be made available not only to Main Roads and LGs but also to contractors tendering on their projects, if they have to locate and price sources of materials as part of the tender process. It is important, too, that they be allowed sufficient time in the tender period to identify source areas which meet access guidelines developed under this Strategy.

6.2.3 Investigate improved techniques for identifying the location of gravel and alternative road building materials.

Investigation of techniques for identifying and assessing resources would be most effective if targeted on localities or regions where demand for gravel or other RBMs exceeds supply, or is likely to do so in the short to medium term.

Based on previous work of which the consultancy team is aware, there appears to be scope for using:

- Geographic Information Systems or Land Information Systems to present combinations of data - such as remnant vegetation, soils and geology - that indicate potential areas of gravel or other RBMs, as well as data that identify constraints to obtaining the material, such as land ownership and usage,

- remote sensing which offers opportunities for initial identification of prospective areas warranting closer appraisal, and

- Global Positioning System equipment for precise location of resources in remote areas.

6.3 ISSUE 2

Reduced access to, and security of, road building materials because of competing land uses.

The presumption that gravel and other RBMs are freely available can no longer be sustained. The expanding population and development have increased demand for RBMs, but, at the same time, have sterilised the very resources needed for road construction.

In the South West, urban expansion and a proliferation of hobby farms are the primary competing land uses. In the Wheatbelt, farming activities limit extraction opportunities. Further east and in the north of the State, pastoral, mining and Aboriginal interests must be considered.

The rights to gravel and other RBMs on freehold land have been reserved to the Crown in most Crown grants. Under the Public Works Act, state instrumentalities can remove gravel for public purposes without paying compensation for that material.

Under the provisions of the Local Government Act 1995, LGs also have access to freehold land. They are, however, excluded from areas that are developed or cultivated. If requested by the landowner, they are obliged to pay for the material taken, and to pay compensation for damage. Some LGs are reluctant to press for access where they meet opposition from farmers, even though the resource may be evident on the land.

Private operators have no rights of access and must negotiate with the landowners; while landowners can secure extraction rights and use the resource for their own requirements, or sell it to others.

These scenarios are inconsistent in their treatment of landowners. Also, State and LG rights to access are incorrectly perceived by some

landowners as a violation of their "common law" rights acquired through continuous use and enjoyment of the land.

Against this background, landowner reluctance to cooperate with road builders by permitting access can stem from one or all of the following:

- protection of the productive or conservation value of the land involved,
- concern that rehabilitation will be inadequate,
- a perception that compensation is inadequate, and
- resistance to perceived bureaucratic interference.

6.3.1 Urban expansion

RBMs for the most populous areas of the State are either limestone from coastal sources, rock or gravel from the Darling Range, or manufactured materials.

There are potentially eight rock quarries servicing the Perth Metropolitan Region - six existing quarries and two approved but not operating. Approved limestone quarries are primarily in the Kwinana-Cockburn area in the south and the Wanneroo area to the north.

Gravel for road building is taken from CALM leases in State forest and supplied primarily to hills shires. Commercial developments, on the other hand, generally use limestone or hard rock procured under extractive industry licences. These are economic alternatives to gravel when the scale of development is sufficient to make them cost-effective.

Elsewhere within the south-west coastal strip between Geraldton and Albany, regional plans outline future urban growth. Road building requirements to meet this growth should be determined so that appropriate material sources can be protected from competing land uses.

The same consideration will apply to urban, industrial and intensive agricultural growth centres such as Karratha, Broome and Kununurra, where future subdivision may demand substantial resources of RBMs.

6.3.2 Hobby farms and other small holdings

The proliferation of hobby farms and the associated subdivision of land effectively precludes these areas from extraction operations. The area to be disturbed by quarrying is generally too large in relation to the limited size of holdings, the local landscape may suffer excessive impact, and land values may decline.

There is evidence of the problem being aggravated when a hobby farm is owned by an absentee landholder who may not have the community affiliation which leads other residents to be more sympathetic to local road maintenance and improvement needs.

6.3.3 Agricultural land

The issue of RBM extraction competing with farming activities is a common problem in the Wheatbelt for rural LGs trying to maintain supplies.

6.3.4 Pastoral land

Main Roads has access to pastoral land, but can encounter leaseholder opposition, particularly if a gravel reserve is to be created and excised from the lease. This opposition is a contributing factor to the extraordinarily lengthy and cumbersome process of reserve creation and vesting.

Other factors affecting the length of this process can be the need to secure Aboriginal sites or native title clearance, requirements for environmental clearance which sometimes apply, and the prior existence of Mining Act tenements or their establishment while reserve vesting is in train.

6.3.5 CALM-managed land

Conservation reserves and State forests often contain deposits of gravel or other RBMs which

make them an attractive source for road building agencies, particularly for roads which traverse or abut these areas. Obtaining gravel or other RBMs from conservation reserves, in particular, conflicts with their primary purpose of ensuring that representative areas of the State's natural heritage are set aside and managed in a sustainable manner.

CALM and NPNCA have therefore formulated policies for the extraction of gravel and other basic raw materials from CALM-managed land.

The policies place severe constraints on securing gravel, which in turn adds significantly to its cost. However CALM perceives a risk that the policies can be bypassed because section 112 of the Public Works Act allows the Minister for Works to provide access to RBM's on CALM land without reference to the Minister responsible for CALM or the vested authority. However, under Section 38 of the EPA Act may require referral to the EPA.

The extra costs these policies impose on securing resources from CALM-managed land are not always recognised by road building authorities. On the other hand, the authorities are generally aware of added costs (such as those associated with increased haul distance, or with compensation to private landowners) attached to obtaining gravel from alternative locations when access to CALM-managed land is denied.

It should be noted that in several LGs where access to CALM-managed land was seen as a major constraint, geology and soils maps showed an abundance of RBMs on freehold land.

It also should be appreciated that in the Wheatbelt, national parks, nature reserves and other conservation areas comprise only a small proportion of the total land area. Most are vested in NPNCA and are managed by CALM.

An analysis of these reserves by NPNCA involving 41 local government districts from Morawa to Gnowangerup, which form the core of the Wheatbelt, revealed the following:

- on average, NPNCA-vested conservation reserves comprise only 4.5 per cent of the region's area,
- in the region's western zone, conservation reserves cover only 1.25 per cent, suggesting little scope for these reserves to satisfy gravel demands for roadworks,
- while the eastern zone of the region is better endowed with conservation reserves, this is only marginally so in the northern sector of the zone (Mukinbudin to Narembeen) where they represent just 3 per cent of the total area, with the larger reserves mostly situated close to the eastern border of the Wheatbelt and beyond the principal road system, and
- in the southern sector of the eastern zone (Kondinin to Gnowangerup), conservation reserves increase to 10 per cent of the total area, but many reserves are focused on salt lake systems and other country which is not prospective for good quality RBMs.

Because CALM-managed land is a minor portion of the Wheatbelt compared with freehold farmland, it accounts for only a minor component of the road building resources within the region. On the other hand, because it is such a small segment of a largely cleared landscape, the impact of its clearing for RBMs is of increased significance.

6.3.6 Reluctance of some LGs to seek access to private land

There is an evident reluctance on the part of some LGs to seek access to gravel or other RBMs on private land. This may stem from the attitudes of councillors, council staff, or both. It can also arise from a perception of inequity between LGs with gravel, who suffer disturbance of their land, and those without, who are unaffected.

Reluctance may also arise where gravel was obtained with relative ease in the past from pits on Vacant Crown Land or on Crown reserves, with no necessity to disturb private landholders. This has sometimes lead to a perception that Crown land as

a source of gravel is more expendable than freehold land.

If former sources on Crown land and Crown reserves have been incorporated into the conservation estate, LGs have generally lost their ease of access. They do not readily accept the greater difficulty of obtaining gravel from private land. They also may fail to recognise the costs of assessment, operational management and rehabilitation involved in obtaining material from Crown land once it is within the conservation estate (see Section 6.6.1).

6.3.7 Inequities in compensation offered to landowners

Main Roads compensates landowners for loss of production and effects on improvements caused by gravel extraction. There is however, inconsistency between regions. Some assume production is affected for only one year after rehabilitation. Others adopt a sliding scale for effects on production up to five years after rehabilitation. Beyond this, there is, however, no obligation on Main Roads to compensate for the value of material taken.

LGs, on the other hand, are required under section 3.22 of the Local Government Act 1995, to recompense landowners for damage, including compensation for the value of material removed, where such recompense is sought. This inequity is resented by some farmers and LGs and, according to the WA Farmers Federation, is a source of some bitterness.

On the other hand, relations between Main Roads and landholders are enhanced where Main Roads staff adopt a flexible approach to compensation, offering reasonable recompense for damage and production foregone, even though there can be no recognition of the value of material removed.

It should be added that, as well as compensation for losses, the standard of rehabilitation and the approach adopted by Main Roads' field officers has an influence on the positive attitude of farmers.

Notwithstanding the compensation requirements of the Local Government Act, the approach of LGs to compensation varies widely. Compensation rates quoted by LGs ranged from no payment whatsoever to $4.50 a cubic metre of material removed. The higher levels of payment generally apply to areas where the resource is scarce and is needed for use on town roads in new subdivisions. Low rates more commonly apply where the gravel is being used primarily on rural roads. In these situations, the compensation rate is generally between 10 and 50 cents a cubic metre .

Where LGs offer no recompense, factors influencing the situation include:

- ignorance on the part of farmers of their rights,
- in small communities, farmers - sometimes with encouragement from the LG - perceiving access to gravel as being in the interests of the wider community, or in their specific interest if the gravel is to be used on a road serving their farm, and
- a combination of coercion and persuasion on the part of the LG for landowners to permit access to their property for gravel.

Main Roads and many LGs offer landholders the option of a compensation payment in cash, in kind, or a combination of the two. In kind payment can include works such as construction of farm roads and dams, or leaving gravel stockpiles for the farmer's use. It is a cost-effective approach because it often uses machinery already mobilised to remove gravel.

6.3.8 Variations in approach to landowners

The approach to landowners adopted by regional offices of Main Roads and LGs seeking gravel or other RBMs varies considerably. Cases were cited of coercive approaches by aggressive councillors or council staff; while, in other instances, LG personnel adopted a constructive and persuasive approach.

In the case of Main Roads, concerns raised in some quarters included:

- The legalistic tone of the Notice of Entry (NOE) which Main Roads personnel must issue before entering private property to obtain gravel.
- Insufficient warning of entry, with consequent loss of recently sown crops or pastures.
- Land alienation too far ahead of the requirement for RBMs on that land.
- Little account being taken of foreseeable seasonal conditions when programming site assessment or development, with consequent damage to affected land in wet conditions.
- Difficulty in identifying a single officer operating for each region with ultimate responsibility for an extraction operation should problems arise.
- Lack of recourse to Main Roads itself when contractors are operating on its behalf.

Against this background, effective communication skills of individual officers and a good rapport with landowners have proved significant in achieving a positive response. This is reinforced where the legalistic NOE is modified to a conciliatory tone suited to individual circumstances.

6.3.9 Constraints imposed by mining act tenements

Mining Act tenements are sometimes a constraint to Main Roads and LGs seeking access to gravel or other RBMs. The problem is more common in pastoral than in farming areas, and arises when there are pre-existing tenements.

Companies holding Mining Act tenements have the right to explore for and develop all minerals, including gravel. Their agreement is therefore required for the extraction of surface gravels from a tenement. Where the surface materials are expected - or alleged - to contain significant grades of valuable minerals or ores (usually gold), the tenement holder may refuse to enter into an agreement, or may demand compensation for removal and use of the gravel.

On Crown land, if there is no existing Mining Act tenement, Main Roads can secure protection under Section 19 of the Mining Act, which allows the Minister for Mines to exempt an area from exploration or mining. In the past, DME has agreed to use this Section to secure, for a 12-month period, areas identified by Main Roads. The deferral gives Main Roads time to assess gravel resources so that DME can proceed with creation of a gravel reserve.

However, the mechanism is unsatisfactory in practice. It leaves the gravel resource unprotected between the time of application and ministerial approval to use Section 19 of the Mining Act. The subsequent process for creation of a gravel reserve is time-consuming and laborious.

Difficulties sometimes arise where "entrepreneurs" seek a Mining Lease over land with gravel potential because they know it is of interest to Main Roads or to a LG. In such cases, unless Main Roads or the LG is aware that a Mining Act tenement is being sought and lodge an objection, the tenement may be granted. Without advice from Main Roads or the LG, DME does not realise that the applicant intends securing the gravel resource with a view to selling it to Main Roads or the LG.

6.4 POSSIBLE ACTIONS TO ADDRESS ISSUE 2

6.4.1 Protect areas containing important deposits of RBMs from competing land uses to avoid sterilisation of the resource, and make allowance for planned end uses following its extraction.

The planning processes administered by LGs and MfP should provide zoning or other mechanisms for protecting significant deposits of RBMs (both undeveloped resources and operating

pits or quarries) where their extraction is preferred over competing land uses. In the process, particular recognition might be given to potential regional resource sites that could be accessed by neighbouring LGs and Main Roads.

The quantity of RBMs protected in the above manner should be sufficient to meet foreshadowed demands.

Agencies in which affected areas are vested should be involved in the process and, if remnant vegetation is involved, referral to the EPA may be required. Environmental issues will still require attention at the project proposal stage.

The planning processes should also consider the final use of resource areas which are protected, providing a basis for rehabilitation objectives following extraction of the resource. For example, planning could provide for:

- reintroduction of native vegetation where the landscape has been substantially cleared and remnant native vegetation is scarce,
- recreation, industry or housing development where the resource is within or adjoining an urban area, or
- intensive farming or silviculture where removal of the resource will leave a soil profile more suited to such uses.

6.4.2 Areas being considered for inclusion in CALM-managed land should be assessed for road building resource potential so that boundaries can be modified to permit access where justified to meet resource needs while protecting conservation values.

Assessment of road building resource potential could be assumed by regional offices of Agriculture WA and/or Geological Survey under its catchment mapping program, working in conjunction with CALM. Best available data and resource identification techniques would be used to indicate the presence of significant resources within proposed additions to the CALM-managed land.

Desk-top assessment would be undertaken initially. The intensity of follow-up field appraisal would depend on the extent and significance of resources as indicated by the desk-top appraisal.

Once the necessary data is available, the likely economic and strategic significance of deposits would be balanced against conservation values affected if the deposits were to be excised from CALM-managed land.

This approach is unlikely to result in a multitude of excisions from CALM-managed land because vegetation types which grow only on good gravel resources are likely to be poorly conserved. However, it would provide an opportunity for balancing resource needs against conservation values before decisions on additions to CALM-managed land are taken.

6.4.3 For areas already within CALM-managed land, consider boundary modifications, land exchange or access to permit use of important deposits if resource scarcity is critical and this does not compromise the values and objectives of the estate.

Access to the established conservation estate is covered by the NPNCA Basic Raw Materials Policy. This defines the circumstances under which access will be considered and outlines the conditions applying to access. It is a stringent, but appropriate, approach to protecting the important values of the conservation estate. Where justified, provision is made in the policy for excisions or boundary modifications.

Access to State forest and timber reserves is covered by CALM Policy Statement No 2. The policy was developed in response to difficulties South West councils were experiencing in securing access to gravel. It is working effectively in that region, demonstrating its practical value.

The policy clearly states the circumstances under which access will be considered and the conditions which apply to access. In some cases, excisions might be considered, or a sympathetic attitude on access might be adopted in appropriate circumstances. For example, access might be allowed in areas which are degraded by dieback, prior extraction operations or by some other prior land use.

It also could apply to pockets of forest surrounded by cleared private land where the value and/or integrity of the pockets is doubtful, to fire protection buffers on the fringes of forest areas, or to cleared powerline easements.

Access should be provided for private contractors as well as LGs and Main Roads if the material is required for public works. In such cases, the preferred approach is for the contractor to be given access to a LG or Main Roads lease by agreement with the lessor.

Use of gravel resources in areas disturbed by prior gravel extraction, logging or other activity may ultimately enhance overall value of a reserve by permitting proper rehabilitation. On the other hand, there is some danger that flora or fauna restricted to areas which have good gravel resources may be displaced by the extraction of the resource.

The scope for the Ministers for Lands and Works to consent to extraction of basic raw materials from CALM-managed land without reference to the vested authority or the Minister for the Environment still requires attention through legislative changes. The changes should be designed to ensure that consent is available only after reference to, and agreement from, the Minister for the Environment and the vested authority.

6.4.3 a Develop a regulation to amend section 3.27(3) of the Local Government Act 1995 to permit extraction of RBMs from certain cultivated and developed land, with appropriate safeguards.

The restriction on RBM extraction from developed or cultivated land is a new constraint, introduced by the 1995 Local Government Act, with far-reaching consequences. It has the potential to lock up large quantities of RBMs generally, and of gravel in particular, on private land. As a result, this could lead to the targetting of remnant vegetation rather than cleared landscapes by road builders.

Of particular concern is the additional pressure which will be placed by road builders on access to RBM's within pockets of remnant vegetation in landscapes prone to salinity, as well as on Nature Reserves within the wheatbelt. The protection of native vegetation in these areas is a high priority for Government as confirmed in the recently released Salinity Action Plan.

Section 3.27(4) of the Act allows for regulations to exclude the application of Subsection (3) in respect of a particular matter. Development of such a regulation should be pursued to maintain access to RBMs on land that falls under the board category of being cultivated or developed. Specific exclusions will need to be nominated, similar to those obtaining under the old Act, to protect uses or developments which warrant precedence over RBM extraction.

6.4.4 Establish guidelines for compensation as an incentive for landowners to cooperate in making RBMs available, with a minimum level of compensation and the opportunity to negotiate a higher figure.

Just as improvement in the approach to rehabilitation of gravel pits can foster greater landowner cooperation, fair and adequate compensation for loss of production - plus some recognition of the value of material removed - can provide an incentive to cooperation.

The present widely varying approach to compensation on freehold land should be rationalised to ensure equity. This would be assisted by Main Roads and all LGs adopting a specified minimum level of compensation which incorporates both restitution for lost production and damage, and payment for material removed.

The first component would be determined as at present, based on the assessed value of production foregone and the actual cost of repairs to infrastructure damaged or altered. A standardised approach to this determination should be adopted by regional offices of Main Roads and by LGs, seeking guidance from Agriculture WA on a sound basis for assessing production foregone. For the second component, it is proposed that the level of payment per cubic metre of material removed be assessed on one of two options:

- a proportion of the market value of the land disturbed, or
- ten times the gross margin of existing production from that land.

An example of the method of calculation for the former is illustrated in Figure 7.

This approach involves a significant change from the present situation in that Main Roads would pay for material removed. This should not be seen as diminishing the fundamental right of the Crown to free access to gravel and other basic raw materials on freehold land, as recognised in legislation and Deeds of Title. Rather, it is proposed as a matter of policy to ensure equity in the methods the State and LGs obtain gravel or other RBMs from private land.

If Main Roads and LGs do not operate on the same basis, there will be increasing dissatisfaction among landowners at the different requirements imposed by the two authorities. If Main Roads continues to operate under its existing system, which makes no allowance for the value of material removed, while LGs uniformly adopt a system that incorporates an allowance, Main Roads may experience increased opposition to access. This will lead to increased staff time and costs in negotiations to secure access.

As a further step towards securing consistency, contractors operating as agents of Main Roads or LGs should be required, as a condition of tender, to compensate landowners within the same guidelines that apply to these agencies where the supply of road building materials is part of the contract.

6.4.5 Foster a more constructive and persuasive approach to landowners when seeking access for extraction of RBMs.

The provision of adequate technical expertise to LGs proposed at 6.6.8 below might offer one avenue for LGs experiencing access problems to develop a constructive and informative approach to landholders.

The engineering professional engaged by a LG might assume responsibility for approaching landowners, or might provide guidance to subordinate staff given that responsibility. At the same time, the proposed management group could guide LGs on a common approach.

With these initiatives in place, negotiations with landholders would be handled more skilfully, and conflict situations would arise less frequently.

With regard to Main Roads, personnel with particular communication skills should be used for the initial approach to landholders. This strategy is already working successful in a number of Main Roads regions. For subsequent dealings, a single officer at the regional level should be identified as having the responsibility for each extraction and rehabilitation operation, and that officer should be conscious of the need for a courteous and constructive approach at all times.

While Main Roads is required by law to issue NOEs, these documents should be modified to a more constructive and conciliatory tone and tailored to meet individual circumstances. This too is already happening in some areas, with evident benefits.

In issuing the NOEs, Main Roads should endeavour to give sufficient forward notice, so that crops or pastures are not needlessly destroyed. They should also, where practical, schedule assessment and development operations to avoid unfavourable seasonal conditions, when damage to affected land may be increased.

LAND VALUE $/Hectare	COST/m3 (cents) DEPTH OF GRAVEL REMOVED			
	0.4m	0.6m	0.8m	1.0m
400	10	6.7	5	4
600	15	10	7.5	6
800	20	13.3	10	8
1000	25	16.7	12.5	10
1200	30	20	15	12
1400	35	23.3	17.5	14
1600	40	26.7	20	16
1800	45	30	22.5	18
2000	50	33.3	25	20
2200	55	36.7	27.5	22
2400	60	40	30	24

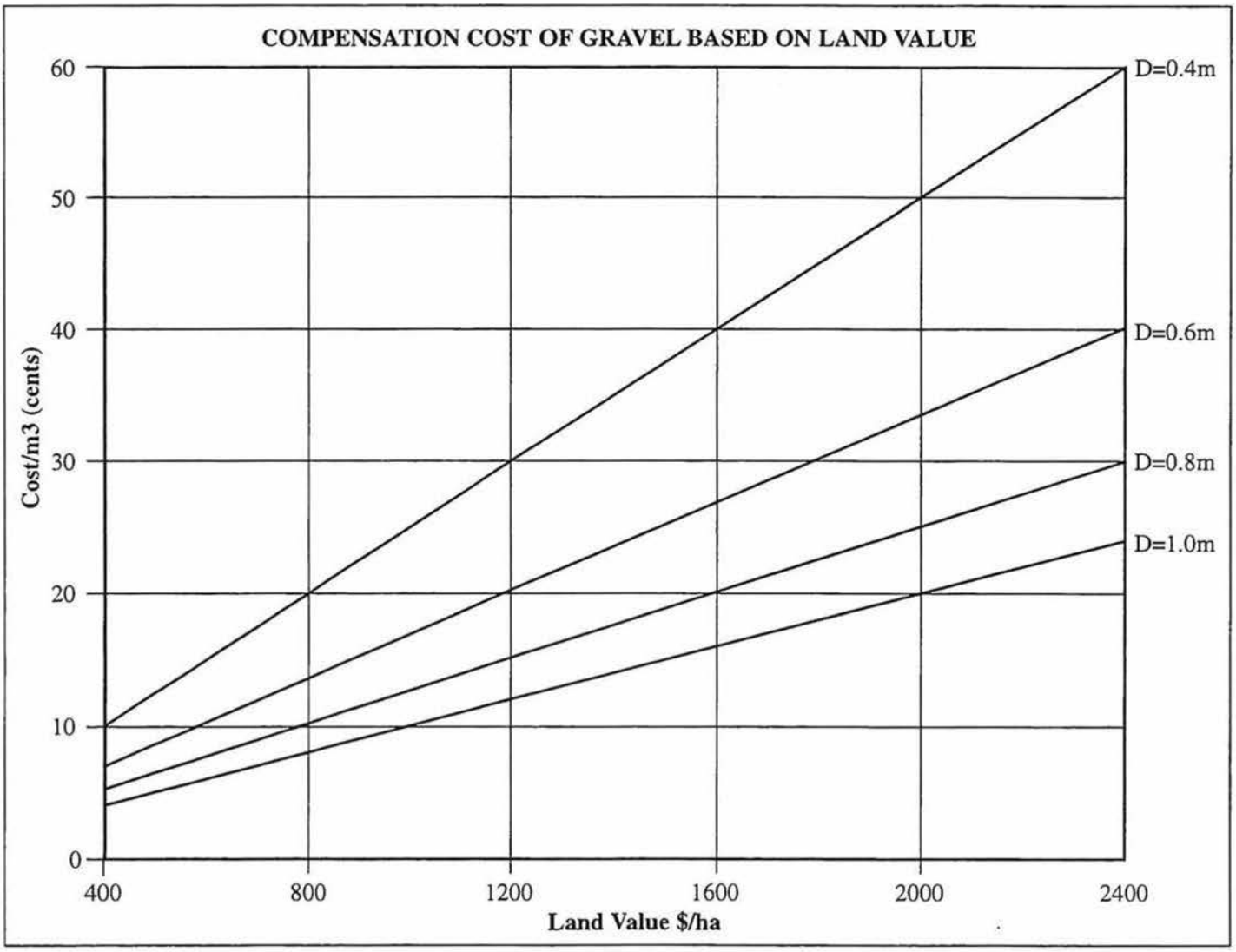


Figure 7 - Compensation based on land value for agricultural areas

Where a contractor extracts gravel on behalf of Main Roads or LGs, an officer might be identified within the respective agencies as a contact point in the event of landowner dissatisfaction with the contractor's activities. LGs might also consider adopting Main Roads' policy of retaining a withholding fee to secure responsible contractor performance in extraction and rehabilitation operations.

Finally, relations with landowners might be further enhanced if they are permitted to use reasonable quantities of gravel from pits developed on their properties. Such use would be subject to an offsetting reduction in compensation paid, if a landowner is using this gravel for commercial purposes.

6.4.6 Protect resources of interest to road builders during the exploration and assessment phase.

Mining Act

A mining company can secure an Exploration Licence for five years over an area in which it has an interest. This gives the company security while it assesses the mineral resource and identifies smaller areas which are to be secured for 21 years and mined under a Mining Lease.

While RBMs on Crown land remain under the ambit of the Mining Act, protection can be provided to Main Roads or LGs with an interest in the materials if their forward planning indicates areas of interest, which can be recorded as file notations on DME's public plans. Through this avenue, DME would be informed of the prior interests of road building authorities and could take this into account in the event of a subsequent tenement application.

Alternatively, the road building authority might request DME to use Section 19 of the Mining Act under which the Minister for Mines can exclude from lease applications areas containing road making resources if they occur on Crown land.

It should be noted that Prospecting and Exploration Licences do not present the same conflict potential as mining leases because gravel and other basic raw materials are reserved to the Crown under these licences. The materials are still available to Crown agencies, such as Main Roads, although this right does not extend to LGs.

Where there are pre-existing Mining Act tenements, areas containing significant RBMs might be progressively assessed by the tenement holder under an arrangement with State agencies. Areas of non-mineralised ground could then be released to allow access to RBMs.

This arrangement may not be possible where there is a need for the tenement operator to use topsoil or overburden containing gravel for ultimate rehabilitation of areas to be disturbed by exploration or mining. Once again, however, advance planning by State agencies and agreement with the tenement holder can achieve an appropriate compromise.

Land Act

The present cumbersome and time-consuming process for establishing gravel reserves under the Land Act has discouraged use of this procedure to access resources. Yet the reserve is a mechanism for securing strategic or substantial quantities of RBMs on Crown land.

The main time-consumer is the consultation process, which cannot be avoided. However, a reserve for Government requirement could possibly be initiated for a limited period, giving a designated agency rights to gravel or other RBMs for that period. The question is one which warrants further examination with DOLA.

Extractive Industry Local Laws under Local Government Act

Where RBMs do not come under the ambit of the Mining Act (ie. outside Crown land), an extractive industry licence can be issued under the Local Government Act. However, as this is for

operating a quarry and not designed for exploration, provision for the equivalent of an exploration licence under the Land Act or the expansion of the extractive industries licence under the Local Government Act, should be considered. The issuing of such a licence should give the applicant prior claim to RBMs within the area covered. Samples can then be collected and, if results prove positive, the LG would issue an extractive industry operation licence. The exploration licence would be issued for a limited time only and would lapse at the completion of that time.

Using the provisions of the Local Government Act, this approach could entail a LG applying to itself for a licence when seeking RBMs within its own boundaries. While this presents a potential conflict of interest, it appears to be the only practical avenue under current legislation for an LG to secure prospective areas on private land.

6.5 ISSUE 3

The increasing cost of securing, excavating and using RBMs.

As competition for land increases and community expectations relating to environmental standards rise, freely-available, high-quality deposits of RBMs close to road building projects are becoming increasingly scarce. This is resulting in increased road building costs through:

- greater haul distances,
- the need to modify poor quality materials, and
- the need for greater technical expertise to find, evaluate and effectively utilise diminishing resources.

The value of RBMs as an important resource to Main Roads and LGs must therefore be emphasised in the context of:

- the progressive depletion of the resource and an associated need in some areas to accept lower quality materials (with or without modification), or more costly alternatives,
- increasing demand for the resource in areas where urban and rural subdivision is occurring, and
- increasing sterilisation of the resource by the demands of competing land uses, including land reservation in the conservation estate and the emphasis now on protecting of remnant vegetation.

6.5.1 Cost of access to CALM-managed land

Obtaining RBMs from CALM-managed land offers a seemingly easy solution to the problem of rising costs. However, there are financial costs associated with obtaining material from this estate which often are not recognised by LGs. Rather, they see the material as a resource that was free when the areas from which they were obtained was Vacant Crown Land or Crown reserves before incorporation into the conservation estate.

6.5.2 Cost of access to private land

The cost of access to private land is a disincentive to some LGs wanting to obtain gravel from that source. This is particularly so where LGs have historically obtained their requirements at no charge from Crown land. It can also apply where excessive compensation payments are demanded by landholders because of resource scarcity and/or the material is required for the road building needs of urban expansion.

There is also opposition among LGs to locating gravel pits in farm paddocks several kilometres from the nearest road if a portion of the gravel resource will be consumed in construction of an access track.

6.5.3 Efficiency of extraction operations

In some LGs, machinery used to extract gravel is not of sufficient weight or horsepower to recover the full depth of material available in a pit. Optimal use of the available resource is not occurring because of a lack of suitable equipment.

Larger equipment also can reduce significantly the unit cost of excavation. It has been indicated

that a 300hp machine extracts gravel at one-third to half the cost of a 150hp machine.

Equipment limitations may also inhibit the efficiency and quality of rehabilitation, if deep ripping is required to facilitate revegetation with tree or shrub cover.

6.5.4 Haul distance

Most LGs in farming areas are averse to hauling gravel more than 10 to 15 kilometre because the cost and inconvenience are too great.

Exceptions arise for rural towns where haul distances of up to 25 kilometres have been reported.

Sometimes opposition to long haul distances derives from a history of ready access to gravel from VCL, Crown reserves or road reserves. It may also relate to the shorter hauls of the past, when gravel was more widespread and before the increasing demands of road construction diminished the resource.

6.5.5 Alternative materials and modifications and their cost

The focus of users generally is on lateritic gravels. However, in certain areas where these gravels are scarce, alternatives and modifications are being developed and exploited. The cost of alternatives and modifications is usually greater than the cost of natural gravel excavated from surface deposits, but resource scarcity may dictate their use.

Alternatives and modifications being used in different locations include:

- Duricrust or caprock in the floor of, and adjacent to, some old gravel pits is a significant source of rock for crushing. The cost of crushing is up to $6 a cubic metre, depending on crusher mobilisation charges. Benefits include:
  - a high quality product which requires little screening because it is free of roots and other vegetable matter,
  - savings on the cost of clearing and topsoil stripping to open a pit, and
  - provision of a more suitable substrate in the pit floor - clay rather than rock - for subsequent rehabilitation,
  - greater potential for securing dieback-free material.
- Limestone is commonly used in coastal areas where laterite gravel is not available. It may not be appropriate on clay soils where water can rise and dissolve the limestone.
- Stabilised sand has been used with some success where conventional road-making methods are not available and traffic is not heavy.
- Materials from scree and talus slopes have been used in the Kimberley. They are low in clay binders and erode when exposed on road shoulders.
- Processed igneous and sedimentary rocks, such as blue metal, are used throughout the State.
- Colluvial materials have proved to be a satisfactory alternative to laterite gravel.
- Modifications involving use of additives such as lime, cement, bitumen emulsion and enzymes can improve performance, stability and useability of inferior gravels. Their use extends the available gravel resource.
- Recycling of gravel already in place on a road often can be assisted by additives to improve life, durability and performance if its quality has deteriorated.

- Crushed and sorted building wastes are used widely in NSW and Victoria for sub-base and low-grade backfill. About 265,000 tonnes of this waste is available each year within a 25 kilometre radius of the Perth CBD. A "State Construction and Demolition Waste Strategy" currently in preparation will incorporate specifications for use of this material as road base.

- Industrial wastes, such as titanium pigment plant residues and smelter slag, have potential for use in road making, either directly or in mixes with other materials.

Awareness by LGs of the various alternatives and modifications is limited by:

- a lack of available information, and/or

- a lack of the expertise to appreciate needs and opportunities, and to secure and evaluate the information available, and apply the knowledge gained.

At the same time, LGs which have had ready access to a cheap natural resource in the past may have difficulty adjusting their attitudes - and their budgets - to accept higher cost alternatives, or to accommodate the cost of modifying lower quality materials. In some cases, they will use lower quality materials without modification to the detriment of pavement quality, thereby deferring problems - and expenditure to remedy them - to the future.

6.5.6 Technical expertise for planning and design

A lack of engineering expertise can restrict the adequacy of road planning and design, and the associated securing of gravel resources to meet requirements. Understanding and adequate assessment of alternative materials, and of modifications to existing materials can be restricted for similar reasons.

In this respect, 54 per cent of LGs outside the Perth metropolitan area do not have their own engineer or use the services of a consultant engineer. Of the rest, only 31 per cent have a full-time engineer, eight per cent share an engineer, and seven per cent use an engineering consultant.

There are even fewer LGs with staff who have environmental qualifications or expertise.

6.6 POSSIBLE ACTIONS TO ADDRESS ISSUE 3

6.6.1 Prepare cost assessment guidelines to indicate the comparative costs and benefits associated with obtaining RBMs from CALM-managed land, freehold land and pastoral leasehold land.

If the true financial costs of obtaining RBMs from CALM-managed land were recognised and passed on to organisations seeking access, this land will not be perceived as a cheap source of material. Alternative sites outside the CALM-managed estate would frequently emerge as more attractive options.

CALM has recently prepared an analysis of the approximate financial costs to proponents from obtaining gravel from conservation reserves. For a hypothetical pit in a nature reserve in the Northern Wheatbelt, CALM estimated the costs as follows:

	$/ha
Prior biological assessment	2,500
Prior dieback assessment	600
Pit planning	250
Revegetation	2,500
TOTAL	5,850

In addition, CALM indicates a further $4,000 a hectare is needed for replacement costs and management overheads.

It should be noted that the above figures place no cost on the intrinsic value of the site as a reserve; that is, the floral and faunal communities which may be damaged or individual species which may be lost.

A similar analysis might be prepared by CALM for obtaining gravel from State forest and areas of remnant vegetation which have significant conservation value. At the same time, the financial figures should not stand alone; they must be complemented by recognition of the significant environmental costs that frequently attach to securing RBMs from CALM-managed land. These economic and environmental costs can then be weighed against the importance of the resource for meeting local community needs.

Main Roads figures and information from LGs which presently rehabilitate gravel pits - and possibly also from Agriculture WA - could be used to develop indicative costings for opening, operating and rehabilitating gravel pits on cleared farmland with various intensities of use, pastoral land, and areas of special rural use, such as hobby farms.

The adoption of a standardised approach to determining compensation levels on private land, as proposed at 6.4.4, will assist in developing these costings and reducing the current inconsistency in this component of materials acquisition costs.

The above information should be collated into a "costs" manual and distributed to all LGs and regional offices of Main Roads. The manual would assist them to determine in various situations the merits of seeking access to resources affected by different land uses, tenures and environmental values.

6.6.2 Encourage shared regional exploration by LGs on a common interest basis.

Where resource scarcity is emerging in particular regions, a shared approach by LGs, in conjunction with Main Roads, would offer efficiencies and associated cost savings in identifying resources.

For example, several LGs might jointly fund a regional investigation, obtaining available data from Geological Survey and Agriculture WA. LGs might also lobby to have such data compiled where it is inadequate.

This regional approach also would permit more cost-effective use of government agencies responsible for collecting the requisite data.

6.6.3 Promote common pits, equipment sharing, or use of contractors for more effective access to limited RBMs.

Some small rural shires cannot afford the larger earthmoving equipment which may be required to extract gravel from deeper layers in the soil profile. In such cases, equipment sharing by adjoining shires or the shared use of contractors with the larger equipment needed for the purpose may be a feasible alternative.

Similarly, equipment sharing or employment of contractors may permit use of larger vehicles for cheaper haulage of materials over long distances from extraction sites to roadworks locations.

Issues of convenience, haul distance, equity in sharing the resource and in assuming responsibility for pit management and rehabilitation could mitigate against shared gravel pits. However, shared or regional pits should not be ruled out as an efficient and cost-effective approach to obtaining gravel in certain circumstances.

For example, a pit may be on the outskirts of a major regional centre where neighbouring LGs require large quantities of RBMs for urban and special rural subdivision. A single authority could assume responsibility for the pit, with others seeking access by negotiation.

Where there is a major resource that could serve the needs of two or more adjoining LGs, there would be economies of scale advantages in sharing overheads associated with pit opening and subsequent rehabilitation, and possibly in using common machinery.

A competent inventory of gravel resources, as proposed at 6.2.1, could identify locations where shared or regional pits might be considered for more efficient use of the resource. Such locations might then be recorded on local and regional plans.

6.6.4 Where practical, use old gravel pits in preference to opening new ones.

The costs and benefits of using old gravel pits rather than opening new ones needs to be appreciated. For example, costs for clearing and topsoil or overburden removal do not apply to an old pit which has not been rehabilitated. Also, if a policy of rehabilitating old pits applies, overall rehabilitation costs will be reduced by reactivating the pits because they will eventually require rehabilitation, regardless of whether they are reactivated.

There also is an environmental benefit in facilitating the rehabilitation of old pits, and an economic return if rehabilitation results in a productive land use.

These benefits can be weighed against the costs involved, including rock crushing costs if the pit is to be reactivated for access to duricrust exposed by earlier gravel extraction. In this case, a benefit can be more effective rehabilitation, as has happened with a number of old pits in State forest in the South West.

6.6.5 Research of alternatives and modifications to extend the available road building resource.

Considerable work has been undertaken by commercial enterprises to develop substances that can be used to modify and improve RBMs. Main Roads and certain LGs have, in turn, carried out field trials using these substances.

With diminishing resources in some areas, and the need to use alternatives and lower quality materials, development and trial of appropriate modifications should be encouraged for different situations and applications. Attention should also be paid to the potential for recycling RBMs from old formations.

Information gained should be shared between Main Roads and LGs, allowing all parties to learn from the experience of others. This also would encourage LGs which cannot afford to conduct their own trials to adopt modifications and alternatives where experience elsewhere has demonstrated that they can be appropriate and cost-effective.

6.6.6 Encourage information sharing on techniques of access and extraction.

Information sharing between parties involved in quarry and gravel pit rehabilitation should be encouraged to ensure that knowledge on techniques and approaches is distributed as widely as possible for the benefit of all. Apart from personal contact, sharing would best be achieved through manuals issued by DME, Main Roads, CALM and the Roadside Conservation Committee (RCC), and through regional seminars and workshops for information exchange.

6.6.7 Provide a financial incentive to encourage LGs to improve their technical expertise and therefore their efficiency in road planning, design and construction, and in associated materials procurement and usage.

If each LG had access to increased engineering expertise, there would be a better understanding of the location and quality of gravel resources and how to use them effectively. This would stem from:

- Available staff time and knowledge to permit:
  - forward planning of road development, maintenance and upgrading,
  - appropriate and timely design and construction, and
  - associated advance detailing of materials requirements.
- A better appreciation of sources of information - such as trade magazines, professional associations, seminars,

workshops, and contact among peers - on all aspects of road planning, design, construction and materials usage; and the ability to discern and use the information.

- A better understanding of appropriate materials quality criteria for different site characteristics and road requirements, and associated use of materials testing services offered by Main Roads or private firms.

- Appreciation of alternative materials, and of the potential of additives to improve lower quality materials.

- The technical capability to convince councillors about road planning, design and construction initiatives, while identifying the benefits that will offset any costs be involved.

It is clearly beyond the resources of many small LGs to employ a full-time engineer. This problem has been overcome by some LGs which share an engineer, or through use of an engineering consultant on a retainer or an hourly rate. Experience suggests that for rural LGs which do not have a major urban road network, employing engineering services for a minimum two days a week provides adequate attention to road planning, design and construction, including sourcing gravel or other RBMs.

An incentive could be provided for LGs to engage engineers by reintroducing an earlier Main Roads policy of adding six per cent, or more, to General Purpose Road Grants for LGs using a suitably experienced engineer to administer the use of road grants. While more difficult to achieve, it also would help if Federal grants were tied to a similar incentive policy.

A condition of the incentives could be a requirement for the LG to compile an annual report detailing supply and demand figures for road materials, and identifying initiatives undertaken, or products or machinery tried. This would contribute to the databases mentioned earlier, and to information sharing on materials and techniques.

Finding an experienced engineer willing to live locally could be difficult for the more isolated LGs. Additional incentives would therefore be needed to provide sufficient inducement to attract an experienced professional.

6.7 ISSUE 4

The need to recognise environmental values when obtaining and using RBMs.

While the extraction of RBMs does not have the same impact as more extensive land use disturbances such as urban development, farming and large scale mining, it can be a significant nuisance to those whose land is directly affected, and occasionally to a wider area. The nuisance can relate to factors such as visual impact, dust generation, traffic, noise, paddock access, weed introduction, and sometimes downslope erosion or salinity potential.

Extraction activities also have the potential to make a significant impact on the State's biological resources through selective clearing of remnant vegetation located over gravel resources in the Wheatbelt, or through dieback distribution from injudicious access to areas where dieback is a present.

Flora may be declared as rare under the Wildlife Conservation Act which gives it special protection. CALM maintains a data base of rare flora populations which can be accessed to determine rare flora occurrences near gravel extraction sites.

Much of the historic antipathy among landowners to gravel extraction stems from inadequate rehabilitation, or, more commonly, no rehabilitation of the scars left by past extraction activities.

Against this background, road builders have improved their environmental management and rehabilitation performance recently in the face of increasing public awareness of environmental values. However, there is still much room for improvement in both the location and operational management of extraction sites, and in their subsequent rehabilitation.

6.7.1 Remnant vegetation

While the importance of protecting remnant vegetation for both its ecological value and amenity is widely recognised, it is an unfortunate fact that the most significant remnant vegetation in the Wheatbelt often coincides with rocky and gravelly outcrops. In these circumstances, the vegetation itself is an indicator of the gravel's location. Such gravel will sometimes be the best remaining RBM in an area of otherwise cleared farmland and may already be covered by a gravel reserve. Because of its environmental value, access to the gravel resource may not always be in the community interest.

In other cases, the most readily available gravel for some LGs is within their road reserves. The advantage of using this source is accentuated where scrapers - which operate most effectively on short hauls - are being used to obtain the material.

These circumstances have resulted in a proliferation of gravel pits in road reserves, with associated clearing of remnant vegetation and risk of dieback spread. The practice is still occurring in some localities where a reluctance to seek alternative gravel sources on private land or in CALM-managed land, combined sometimes with the financial advantage of the short haul which a road reserve source permits, prevails over the wish to protect remnant vegetation.

This represents a direct conflict with the purpose for which wide road reserves are often created - to preserve ribbons of vegetation along each side of public roadways.

6.7.2 Clearing approvals

Some LGs regard the requirement of approval from the Soil Conservation Commissioner to clear areas greater than one hectare to obtain gravel as an unnecessary administrative hurdle.

6.7.3 Dieback

Dieback incidence can have a critical bearing on obtaining and using gravel. It is clearly desirable that gravel spread on roads through forests, reserves and areas of remnant vegetation be free of dieback if the disease is not already present. The issue is particularly important along the south coast, in south-west forests, and on the Northern Sandplain. In these areas, even CALM experiences difficulties finding dieback-free gravel within its own estate.

On CALM-managed land where hygiene procedures are required when extracting gravel and/or constructing roads, CALM prescribes the protective measures and ensures their adoption.

However, there are areas of remnant vegetation not managed by CALM, but where dieback hygiene is warranted if the risk of infection is to be minimised. The Roadside Conservation Committee (RCC) has provided guidelines for these situations, but there is no check on their adoption.

There is no assurance that the need for dieback hygiene is always recognised by road builders. If it is recognised, there is still no assurance that dieback procedures are applied with sufficient rigour, particularly where works crews are not accustomed to the procedures.

6.7.4 Standard of rehabilitation

Some farmers are reluctant to permit LGs or Main Roads on to their land to obtain gravel because of unrepaired scars left by previous gravel removal. Their reluctance is reinforced where there is a continuing failure of LGs to rehabilitate gravel pits satisfactorily.

While Main Roads now has strict rehabilitation procedures, no similar standards have been adopted by LGs as a whole. This situation persists despite the issuing in recent years of various rehabilitation guidelines by Main Roads, DME, CALM and RCC, and despite a series of regional workshops on rehabilitation benefits and procedures run by Main Roads in the late 1980s.

Some LGs are doing rehabilitation on private land to the satisfaction of landowners, or are

rehabilitating CALM-managed land within criteria established by CALM. Others are doing minimal rehabilitation, or are leaving pits open over several years while extraction continues, rather than rehabilitating progressively.

6.8 POSSIBLE ACTIONS TO ADDRESS ISSUE 4

6.8.1 Facilitate identification of gravel resources without reliance on remnant vegetation as a primary indicator, and foster access to cleared areas.

Protection of remnant vegetation is particularly important in the Wheatbelt and the Swan Coastal Plain. It is generally less critical in areas where large scale clearing has not occurred, although each situation should still be assessed on its merits. Protection of remnant vegetation where it is used as an indicator of the presence of gravel will be assisted by adoption of alternative approaches to identify the resource.

Improving access to resources on freehold land also will assist the protection of remnant vegetation by reducing the need to obtain gravel from road reserves and other areas where vegetation remains uncleared.

On farms where areas of remnant vegetation have been protected with the assistance of grants from Agriculture WA, a memorandum of understanding is included on their title which assures the continued protection of those areas against clearing for a minimum of 30 years. Road builders seeking gravel should check that farmland areas from which they wish to secure material are not subject to such memoranda.

6.8.2 Maintain the requirement for clearing approvals under the Soil and Land Conservation Act.

The present requirements of the Soil and Land Conservation Act were introduced to ensure that land degradation problems are not created unnecessarily. These requirements should continue to apply to all clearing, including for gravel pits.

LGs should also be encouraged to adopt Main Roads or DME guidelines on design, operation and rehabilitation of gravel pits, so that erosion control practices are understood and employed.

6.8.3 Maintain and, where necessary, improve standards of dieback management when obtaining RBMs.

On CALM-managed land, it will remain incumbent on CALM to ensure adoption of dieback hygiene procedures, and to provide the necessary education, monitoring and audit back-up to assist this purpose.

Outside CALM-managed land, there is scope for increased emphasis on dieback surveys in areas of remnant vegetation to identify the need or otherwise for dieback hygiene, and for more rigorous application of hygiene procedures where appropriate.

Guidelines published by DME for management of dieback in mineral exploration offer a suitable model. They identify an "area of dieback risk" extending from Kalbarri south through Moora to Wagin, then east through Ravensthorpe to Israelite Bay. Explorers operating in native vegetation within this dieback risk area are required to:

- identify locations where unmanaged activities could spread dieback (in the absence of survey information on dieback occurrence, it is presumed that all native vegetation is at risk),
- prepare a dieback disease management program, and
- demonstrate a commitment to avoid spreading the disease.

Remnant vegetation on private land may be exempted from the policy if existing use of the land already puts the vegetation at risk of infection. This would apply, for example, where livestock is grazing among the vegetation, because animals are a potential vehicle for introduction of the disease.

The above approach could be adopted in the search for, and access to, gravel in areas of native vegetation outside CALM-managed land. The requisite dieback management program could be based on a format previously provided to the WA Municipal Association (WAMA) by CALM.

In principle, such an approach would have universal application; but, in practice, it would be most applicable to LGs because Main Roads has already adopted specific dieback management guidelines.

Also, CALM could offer educational support to LGs which are obliged to adopt hygiene procedures to ensure that the procedures are understood and are correctly implemented by works crews in the field.

Another useful CALM initiative would be identification of strategically located sources of dieback-free gravel for use on roads through sensitive areas. Use of such sources must, of course, conform to CALM and NPNCA policies on access. For its part, Main Roads should continue its practice of ensuring field staff are adequately informed through internal training programs. It should also continue current investigations with CALM on soil testing methods for proving dieback free gravel in cleared or otherwise uninterpretable areas. Any outcomes from this work should be passed on to LGs.

6.8.3a Maintain and, where necessary, improve consideration, monitoring and treatment of Declared Plants and other weeds where they have potential to be spread through RBM sourcing activities.

There is a legislative requirement under the Agriculture and Related Resources Act (1976) to prevent or control the spread of declared Plants in certain areas. All areas of the State are affected by this legislation, as are all land users and managers.

Previous reported instances of spread of weeds by Main Roads have been as a result of spoil dumping in pit sites. Education, monitoring and prompt treatment of outbreaks should minimise the risk of weed spread by RBM extraction activities.

6.8.4 Improve the management and rehabilitation of existing and new pits, and progressively rehabilitate abandoned pits, thereby fostering wider public acceptance of gravel extraction.

Experience indicates that landholder acceptance of gravel pits is improved if prior land use has been reinstated through sound rehabilitation. The response is even more positive when pit operators rehabilitate the scars left by historic extraction activities.

In this respect, there is scope in many areas for greater application of published rehabilitation guidelines and for development of improved local techniques. LGs could also be encouraged to draw more frequently on rehabilitation advice from Main Roads, CALM, Agriculture WA and DME. They might also be urged to set aside budgets for borrow pit rehabilitation, possibly in a reserve account, as provided for under Section 6.11 of the Local Government Act 1995, and to carry out that rehabilitation within a reasonable timeframe following extraction operations.

Where extraction operations are being carried out by contractors on behalf of Main Roads or LGs, those agencies should check to ensure that rehabilitation is carried out satisfactorily. In this respect, the withholding fee which Main Roads applies to contract operations is a prudent safeguard to secure satisfactory rehabilitation. Such a fee might be considered by LGs in similar situations.

As well as rehabilitating current pits, LGs and Main Roads should be encouraged to adopt a policy of repairing old extraction scars, if natural regeneration has not already occurred, to foster greater landholder acceptance of the need for new gravel pits. This could be undertaken in

conjunction with the rehabilitation of current pits where the two are in proximity.

There will be circumstances where funding assistance is required to deal with larger pits which may have had several users and which are beyond the resources of a LG to repair. On the other hand, there will be cases where old pits can be reworked with larger equipment to win material left by earlier operations, providing the opportunity to rehabilitate the pits when the new extraction operation is completed.

There also are opportunities to draw on assistance from environmental and community groups to rehabilitate old pits. The Wildflower Society, for example, is already involved in such projects.

While rehabilitation standards can undoubtedly be lifted, it must be appreciated that in bushland situations it cannot equate to restoration; in other words, it cannot reinstate the original plant community. Rehabilitation should seek to reinstate as nearly as practical the pre-existing values and maximise the return of original taxa. However, it must be accepted that only partial success can be achieved.

6.8.5 Develop rehabilitation guidelines to meet varying environments and requirements throughout the State.

Existing rehabilitation guidelines are a useful basis for planning the development, management and subsequent rehabilitation of quarries and gravel pits. However, they require additions and/or modifications to meet the specific end-use requirements and environments of different regions of the State.

Pooling of knowledge and experience among LGs and Main Roads will allow progressive adaptation of established guidelines to suit the environment and the needs of different regions of the State.

6.8.6 Continue to pursue the recommendations of the Working Party on Conservation and Rehabilitation in the WA Quarrying Industry.

In May 1990, after a two-year study, the Working Party on Conservation and Rehabilitation in the WA Quarrying Industry produced comprehensive recommendations on environmental standards for the quarry industry. They embraced the wide range of quarries extracting basic raw materials, including gravel pits. The recommendations included:

- quarry rehabilitation continue to be managed by relevant state agencies and LGs,
- rehabilitation guidelines prepared by the working party be adopted as a basis for quarry rehabilitation throughout the State, with the formulation of model by-laws to assist this process,
- implementation of the rehabilitation guidelines should take account of local characteristics and land uses and be supported by training of State and LG personnel,
- a Quarry Rehabilitation Steering Committee (QRSC) be established to operate for a maximum of three years, monitoring and assisting performance in quarry rehabilitation,
- LGs share the skills of a panel of experienced environmental scientists and engineers to extend training provided by the QRSC,
- an audit of abandoned quarries be carried out by the QRSC, which would then report on remedial measures, costs and required technical resources, and
- if poor rehabilitation practice continued, DME should assume responsibility for ensuring adequate rehabilitation of all quarries.

The State Government accepted the working party's recommendations but did not provide funding to facilitate their implementation. However, the QRSC was convened under the chairmanship of DME in August 1991.

The committee has since pursued the above recommendations as far as available resources have permitted. In particular, it has:

- circulated 2,300 copies of the rehabilitation guidelines, including one to every LG in the State,
- prepared a plan and funding proposal for a training course on quarry and gravel pit management and rehabilitation to be offered to LGs on a regional basis,
- assisted the development of model Extractive Industry By-laws which are to be recommended to LGs for adoption, and
- continued to advocate provision of necessary staff and funding to permit compilation of the proposed inventory of abandoned quarries.

Despite the wide circulation of the above-mentioned guidelines, the standard of rehabilitation adopted by LGs still varies widely and is unsatisfactory in many cases. This situation should be remedied - an objective which could be achieved through continued pursuit of the recommendations of the Quarry Rehabilitation Working Party.

Pursuit of the recommendations for quarries extracting gravel and other RBMs could continue to reside with the QRSC, or it could be transferred to the management group recommended at 6.10.3 below; the group would take over the role of the QRSC in relation to gravel pits and other sources of RBMs while it pursues the other objectives of this strategy. However, the QRSC would retain responsibility for hard rock quarries, and for sand and clay pits.

Whichever administrative course is adopted, the following require early attention:

- funding the development and implementation on a regional basis of the training package proposed by the QRSC,
- encouraging LGs to engage the necessary engineering and environmental expertise (shared or otherwise) to assist in the application of rehabilitation guidelines, for both current and historic gravel pits,
- promoting adoption by LGs of the model Extractive Industry By-laws with their requirement for rehabilitation and bonds to ensure that requirement; the by-laws would apply to all road builders - private contractors, Main Roads and the LGs themselves, and
- obtaining the necessary funding to:
  - allow compilation of an inventory of disused gravel pits and quarries,
  - develop associated recommendations and costings on remedial measures, and
  - undertake a follow-up survey in three years to check on the standard of rehabilitation as a basis for determining whether intervention by DME or some other agency is warranted.

With respect to the last point, it would be more realistic to allow a gradual evolution of improved practices than expect a dramatic change in a short timespan. In this context, the proposed authority should take account of two considerations:

- LGs, while not operating strictly by all aspects of the rehabilitation guidelines, are achieving a reasonable standard of performance to meet landholder expectations, and
- LGs which are doing little or no rehabilitation may require considerable encouragement to alter their approach, which has been accepted for generations and which will require education and ongoing technical support to change.

While rehabilitation by LGs is less than ideal, Main Roads has its own rehabilitation guidelines which are of a high standard and which are applied to all gravel pits and quarries. CALM has also prepared a set of stringent guidelines which it applies, or requires other operators to apply, on CALM-managed land.

6.8.7 Encourage information sharing on techniques of rehabilitation.

Information sharing should be encouraged between those involved in quarry and gravel pit rehabilitation to ensure that knowledge on techniques and approaches is shared as widely as possible for the benefit of all. Apart from personal contact, sharing can be achieved through several avenues:

- manuals previously issued by DME, Main Roads, CALM and the RCC,
- modified versions of the manuals to suit different regions of the State,
- regional seminars and workshops for information exchange, and
- practical extension advice from Main Roads, CALM, Agriculture WA and possibly rehabilitation officers employed by local mining companies.

6.9 ISSUE 5

The lack of an appropriate legislative and administrative framework to ensure efficient procurement and use of RBMs.

The preceding sections have identified a range of problems and have proposed solutions aimed at:

- improving the availability of RBMs,
- ensuring their more efficient use, and
- fostering a higher and more consistent standard of rehabilitation of areas disturbed by their extraction.

Appropriate legislative and administrative mechanisms are essential if these proposed actions are to be recognised and adopted.

6.9.1 Legislation

Support is required either through existing or new legislation to achieve three objectives:

- ensure that resources are not unnecessarily sterilised,
- ensure greater security of tenure over RBMs to be used for a public purpose, and
- ensure an adequate standard of rehabilitation is achieved on extraction sites.

6.9.2 Administration

Administrative support is required to promote the adoption of initiatives and proposed actions, including:

- development of a comprehensive database of needs and resources,
- development of improved exploration techniques;
- LGs and Main Roads pooling their efforts to identify resources on a regional basis,
- assessment in regional plans of projected needs for RBMs,
- improved environmental performance in the opening and operation of pits and quarries, particularly with respect to drainage, erosion control and dieback management,
- improved rehabilitation of both current and old pits,
- procurement by LGs of the necessary engineering and environmental expertise to assist in obtaining and using RBMs efficiently, and rehabilitating quarries and pits satisfactorily,

- information sharing on techniques for extracting and using RBMs, alternatives and modifications, and rehabilitation of pits and quarries,

- preparation of guidelines on the cost of obtaining gravel under a variety of land use constraints,

- adoption of a standard basis for compensation to landowners affected by extraction operations,

- adoption by LGs of by-laws to improve the management of quarries and gravel pits, and

- compilation of an inventory of abandoned quarries and gravel pits proposed by the Quarry Rehabilitation Working Party, including research of databases and files, airphoto assessment and field survey, with follow-up monitoring of their rehabilitation.

6.10 POSSIBLE ACTIONS TO ADDRESS ISSUE 5

6.10.1 Use the powers of existing legislation more effectively to protect RBMs.

On Crown land, RBMs fall under the jurisdiction of the Land Act and the Mining Act. Under the latter, Exploration Licences, Mineral Leases and Section 19 exemptions can be used to access RBMs. These legislative instruments should continue to be available for protection of RBMs on Crown land as long as the resources remain under the ambit of the Mining Act.

Creating and vesting reserves under Section 33 of the Land Act is another way of obtaining RBMs on Crown land. However, the procedure is extremely cumbersome and time-consuming. The possibility of streamlining the procedure merits investigation to see whether this avenue can be used more efficiently to protect RBMs, or whether alternative protection mechanisms should be investigated.

In the event that gravel is removed from the definition of a mineral under the Mining Act, extractive industry licences issued under Extractive Industry Local Laws under the Local Government Act 1995 may be an option to secure RBMs during the exploration phase. A reserve for government requirements for a limited period under the Land Act may be an appropriate alternative.

An Extractive Industries Licence under the Local Government Act, or a gravel reserve under the Land Act, offers security subsequently when the resource has been located and is to be excavated. Modification of the Extractive Industries Licence to extend its term, as recommended by the Quarry Rehabilitation Working Party, is still required.

6.10.2 Use the powers of existing legislation more effectively to improve rehabilitation performance.

Two of the legislative mechanisms discussed above - the Mining Act and Extractive Industry By-Laws - contain the necessary powers to achieve a satisfactory standard of rehabilitation at gravel pits and quarries.

The Environmental Protection Act can also be used where extraction operations are large enough, the environment is sufficiently sensitive, or the level of public concern is so great that environmental assessment and associated EPA conditions are warranted. On CALM-managed land, leases administered by CALM can also contain requirements to ensure satisfactory rehabilitation.

The first two legislative mechanisms are most widely applicable to extraction operations for RBMs. DME presently uses the powers of the Mining Act, applying bonds and conducting follow-up monitoring to ensure rehabilitation is undertaken and meets required standards.

Similar powers allowed by Extractive Industry By-laws are not being widely used by LGs. LGs should be urged to adopt the by-laws where they have not already done so, and use the powers conferred to require rehabilitation, imposing bonds to ensure the adequacy of rehabilitation.

The latter legislative provision will not provide any guarantees over the adequacy of rehabilitation by LGs themselves. To ensure comprehensive adherence to the by-laws, they should be made applicable to all operations, regardless of the nature of the licence, lease or other arrangement.

That would require an independent monitoring agency. Should this not happen, recourse to control by DME - recommended as an option of last resort by the Quarry Rehabilitation Working Party - would have to be considered.

A deficiency identified in Section 4.3, which allows the Minister for Works to authorise state agencies or LGs to access RBMs on Crown land and reserves without reference to the EPA and without rehabilitation requirements, needs attention to close the loophole. Amendment of the Public Works Act may be justified, possibly drawing on the model provided by Section 84 of the Mining Act.

6.10.3 Establish a Management Group with executive support to oversee and facilitate adoption of the recommendations of the State Gravel Supply Strategy.

The study has brought to light a wide range of issues relating to securing and use of RBMs and has identified practical actions to address those issues. While there will be certain difficulties and some costs in implementing these actions, the resulting efficiencies and cost savings will more than compensate for the costs and difficulties.

Furthermore, a change of direction is needed if the issues identified above are to be addressed effectively. A recommended strategy with proposed actions to achieve strategic objectives is outlined in Section 7.

To achieve the strategy's effective implementation and ensure that the maximum benefits are derived, it is essential that a management group with executive support be established. The group would ensure the progressive adoption of proposals within the strategy and provide technical and administrative support to foster and facilitate that process.

Accordingly, it is recommended that a group be established comprising members of the corporate executives of Main Roads, DME, WAMA and WAFF.

The group is to have three primary roles:

1. Planning

Developing a database on supply and demand, and ensuring that land use planning and the mining process recognise valuable RBMs.

2. Technical advice

Providing advice and assisting information sharing and education on a range of technical issues to improve the efficiency of RBM exploration, extraction and use, and to reduce costs where possible through economies of scale.

In this respect, one of the management group's first steps might be to summarise the Gravel Supply Strategy in a code of practice which details steps for procuring, managing and rehabilitating RBM resources. Such a code would be beneficial in clarifying the present confused situation and in laying a basis for bringing consistency into extraction operations.

3. Monitoring standards

Setting and monitoring environmental standards on all extraction sites, including those operated by Main Roads and LGs.

Main Roads should chair the group because of its role as the major road builder in the State. It has the greatest depth and range of expertise in RBMs and techniques, as well as significant expertise in rehabilitating areas disturbed by road construction. It is also the agency providing state funding to LGs for road construction.

DME's membership is a reflection of its pre-eminent role in overseeing the rehabilitation of areas disturbed by mining and quarrying. It also

recognises DME's current chairmanship of the QRSC, a committee whose remaining commitments might be assumed by the group.

WAMA should be a member of the group to represent the 142 LGs in WA, which - together with Main Roads - are the client base for, and the major beneficiaries of, the State Gravel Supply Strategy.

WAFF's membership is a response to the fact that farms are a major source of gravel and are likely to become increasingly significant in this respect. WAFF is the umbrella body best positioned to represent the interests of affected farmers in application of the State Gravel Supply Strategy.

To achieve its functions, the group will require executive support. This should comprise four professional officers who might be appointed on contract or be seconded from Government departments. Alternatively, the functions of up to three of the positions might be fulfilled by engaging consultants, as long as there is at least one full-time officer as senior administrator, with the support of a secretary.

The suggested positions, whether they are secondees, contract staff or consultants, would be:

- a senior administrator with good communications and public relations skill who would direct the work of the secretariat and play a major role in developing its promotional and educational responsibilities.
- a civil engineer with primary responsibility for access to, and use of, RBMs,
- an environmental or engineering geologist with primary responsibility for identifying and assessing resources for road building, and
- an environmental scientist with responsibility for environmental management during the extraction and use of RBMs, and subsequent rehabilitation of areas disturbed during investigations and extraction.

It is proposed that the secretariat be located within the head office of Main Roads, using its facilities and support services, rather than incur the costs of renting and equipping new offices and securing vehicles and other support items.

Annual cost for this group and its executive support is estimated at $500,000. This represents less than 10 cents for each cubic metre of gravel presently extracted each year for use on roads throughout the State, and is less than one per cent of the present cost of obtaining gravel.

The $500,000 might be provided through a modest levy on current State road grants. Such a levy would have only a minor impact on the total grants distributed to LGs - a cost impact totally overshadowed by the efficiencies and economic benefits which the group can bring to LGs through implementing the strategy,.

As well as the financial benefits, significant environmental and social benefits will flow from sounder policies and practices on access to RBMs, and from improvements over time in the rehabilitation of areas disturbed by extraction operations.

The group would be responsible to the Minister for Transport and would operate for an initial period of three to five years, with its functions, effectiveness and the need or otherwise for its continued existence to be reviewed at the end of that period.

7.0 The Recommended Strategy

7.1 A STATE GRAVEL SUPPLY MANAGEMENT GROUP

The present study has not identified any agency which could with it present resources adequately oversee and facilitate the wide ranging actions required by this strategy. It is therefore recommended that the Government establish a management group dedicated to overseeing and facilitating the objectives and actions listed below.

The management group would comprise members of the corporate executives of:

Main Roads Western Australia
Department of Minerals and Energy
Western Australian Farmers Federation
Western Australian Municipal Association.

The group would work closely with LGs and Government agencies involved in road building. It also would develop a cooperative working relationship with Regional Development Commissions, drawing on the assistance they can offer in its dealings with LGs in each of the regions.

It is recommended that the group be provided with executive support from Main Roads and that it report to the Minister for Transport.

The first task of the management group is to review the individual strategies identified at 7.2 to 7.4 to identify:

- Detailed actions
- Fully cost each action
- Clearly defined deliverable and estimated time lines
- Prioritise each action
- Identify benefits to the State
- Nominate who should be responsible for delivery of the action
- Develop a proposed funding scenario on the above

In initiating the above task the management group should consult with Local Government and appropriate Government agencies.

The management group will report back to the Minister for Transport on the above findings within four months of the Project Manager being appointed.

7.2 STRATEGIC OBJECTIVE 1

To determine short, medium and long-term demands for RBMs, and to identify the necessary resources to meet these demands.

7.2.1 Compile and maintain a database of regional and local needs for RBMs in the short, medium and long term (refer Section 6.2.1).

The management group should compile information from LGs, Main Roads and any other major users, such as Westrail or industry, on regional and local demands for RBMs. It should maintain this as an up-to-date record, using demand figures provided each year by the above bodies.

An extension of this role would be monitoring by the group of the preparation of local and regional plans, ensuring that MfP and LGs incorporate in the plans forecasts of demands that are likely to flow from their implementation.

7.2.2. Initiate field surveys and compile and maintain a database of RBM resources (refer Section 6.2.2)

The management group should initiate field surveys and direct the initial compilation and subsequent maintenance of a database of RBM resources, as well as control the provision of information from the database.

It would be able to recommend to GSD priorities for environmental geology surveys and

to Agriculture WA priorities for soil surveys, targeting areas of greatest resource scarcity where the necessary soils and/or geology data are not already available. It could then arrange refinement of this data by relevant LGs and Main Roads, based upon their field knowledge.

Specific funding for this work would not be necessary if it was part of the ongoing survey work of Agriculture WA and GSD. However, where support funding is required by these agencies to alter their priorities to meet particular needs, the management group would seek funds from LGs and Main Roads or, as a last resort, through specific Treasury allocation.

7.2.3 Encourage research on improved techniques for identifying the location of RBMs (refer Section 6.2.3)

The management group should promote investigation of new and improved techniques for identifying RBMs. Preferably, the work would be within the ambit of existing resource investigations by such organisations as Main Roads, CSIRO, GSD, Agriculture WA and universities. However, where research outside existing programs is warranted, the management group would seek funding from LGs and Main Roads or through specific Treasury allocation.

7.3 STRATEGIC OBJECTIVE 2

To ensure availability of RBMs and security of supplies for asset replacement and growth estimates within land use planing and environmental constraints.

7.3.1 Ensure that local or regional plans protect areas containing important deposits of RBMs, and to make allowance for planned end uses following their extraction (refer Section 6.4.1).

The management group should request the WA Planning Commission to ensure that RBMs are recognised within local and regional plans, and that important deposits of resources are protected to meet the demands which are likely to arise from adoption of the plans.

7.3.2 For areas being considered for inclusion in CALM-managed land, assess road building resource potential so that, where justified, boundaries are modified to permit access to particular deposits (refer Section 6.4.2).

The management group should ensure that the data collection proposed at 7.2.2 includes areas being considered for inclusion in CALM-managed estate. This would ensure that resources of RBMs are identified before boundaries of the estate are finalised.

The group would then be able to facilitate negotiations between affected LGs, Main Roads and CALM to seek reasonable accommodation between the demands of conservation and the need for RBMs.

7.3.3 When necessary, assist negotiations between CALM and affected LGs or Main Roads to secure balanced outcomes with respect to establishing resource availability in a particular area (refer Section 6.4.3).

CALM would continue to have responsibility for assessing demands for RBMs that impinge on existing CALM-managed land. For areas within the conservation estate, the assessment would be within the ambit of the NPNCA Basic Raw Materials Policy. For areas within State forest and timber reserves, the assessment would be within the ambit of CALM Policy Statement No 2.

However, the management group could be called on to provide resource availability data, identify sources of assistance for additional data collection and appraisal, and assist negotiations generally.

Legislative changes should also be effected to secure the requirement for the above approach. The changes should be designed to ensure that the present right of the Minister for Lands (under the

Local Government Act) and of the Minister for Works (under the Public Works Act) to permit access to basic raw materials on CALM-managed land is qualified. The appropriate qualification would be a requirement for prior approval of access from the Minister for the Environment and the vested authority.

7.3.3a Work with the Department of Local Government and WAMA to develop a regulation amending section 3.27(3) of the Local Government Act 1995 to permit extraction of RBMs from certain cultivated and developed land, with appropriate safeguards (refer Section 6.4.3a).

The management group should liaise with the Department of Local Government and WAMA with a view to having a regulation introduced under section 3.27(4) of the Act that modifies the restriction applying to activities on cultivated or developed land. Such modification should replace the present broad-ranging restriction with more specific exclusions relating to certain intensive land uses, as was the case under section 281 of the old Act.

7.3.4 Develop guidelines on access to private land and a system of compensation with a view to establishing equity in current procedures and to maximising the availability of RBMs (refer Section 6.4.4 and 6.4.5.).

The management group should compile and publish guidelines on access to private land and on payment of compensation to landowners. In undertaking this role, it would need to draw upon the findings of the present strategy; complemented, as necessary, by further advice from LGs and Main Roads on avenues they have adopted for securing access and determining compensation. The rights of access to RBMs on rural lands by Crown instrumentalities need to be recognised.

The guidelines should be circulated to all LGs and to regional offices of Main Roads, and be reflected in the new model by-laws proposed at 7.3.5.

7.3.5 Advise how the powers and opportunities provided by existing legislation can be more effectively used to protect RBMs (refer Section 6.4.6 and 6.10.1).

The management group should ensure that Main Roads and LGs are informed on the powers and opportunities presently provided by the Mining Act, the Land Act, and the Extractive Industry By-laws under the Local Government Act for protecting and accessing RBMs. This could be achieved through the education and advisory role outlined at 7.4.7 below.

The management group also should seek further advice from DME on future application of the Mining Act to RBMs in light of possible changes to the Act. It should investigate with DOLA more efficient avenues under the Land Act for securing RBMs than the present cumbersome procedure for creating and vesting gravel reserves.

The management group should work with the Department of Local Government and WAMA on the development of new model Extractive Industry By-laws incorporating appropriate elements of this strategy, including access, compensation, security of resources, and environmental management and rehabilitation. The QRSC has developed one model which could be suitable in this respect.

7.4 STRATEGIC OBJECTIVE 3

To improve efficiencies in the extraction and use of RBMs, recognising them as a commodity of value.

7.4.1 Prepare costs-benefits analyses for obtaining RBMs from CALM-managed land (refer Section 6.6.1).

The management group should request CALM to broaden the cost assessment case study it has prepared for procuring RBMs from the conservation estate. If appropriate, it should be asked to provide a range of costs for different areas of the conservation estate, and also a range of costs

for access to RBMs in State forest and timber reserves. The figures would include environmental costs, such as the loss of environmental values and the cost of rehabilitation.

The management group could then publish these assessments, together with data compiled at 7.4.2 below, for circulation to all LGs and regional offices of Main Roads. The data could be periodically updated. However, it should be recognised that cost are only one component of the assessment and not the sole basis for long-term decision making.

7.4.2 Prepare cost-benefit analyses for obtaining RBMs from areas other than CALM-managed land to assist those seeking resources from land with different uses, tenures or environmental value (refer Section 6.6.1).

The management group should seek data from Main Roads and LGs on costs incurred obtaining RBMs from land held under various tenures, supporting different land uses, and with different environmental management and rehabilitation requirements. This data could be published, together with that from 7.4.1, in a set of guidelines to be circulated to all LGs and Main Roads, and periodically updated.

7.4.3 Encourage shared regional exploration for RBMs by LGs (refer Section 6.6.2).

When assembling the database on RBMs under 7.2.2, the management group should ensure that LGs and Main Roads regional offices are brought together to contribute to the information base being compiled, to assist review and refinement of data as it is compiled, and to volunteer and pool funds if financial contributions are required to underwrite the work. The group would also have a role in identifying external funding sources, and in lobbying for contributions from those sources, where justified.

7.4.4 Encourage LGs (with Main Roads) to improve efficiencies in extracting gravel by using common pits, equipment sharing, and - where appropriate - using contractors for more effective access to limited RBMs (refer Section 6.6.3).

The management group should foster improved efficiencies in the extraction and haulage of RBMs by promoting to LGs and Main Roads the development of regional extraction sites, sharing of equipment for extracting and/or hauling materials, or engagement of contractors who can offer a more cost-effective approach to extraction and/or haulage of materials. In so doing, the group might first seek input from LGs and from Main Roads officers who are pursuing these practices, in order to determine potentialities and pitfalls that may shape the advice that they then offer.

The management group should, through the databases outlined in 7.2.1 and 7.2.2, identify and focus on LGs which can benefit most from these initiatives, and foster negotiation between them. At the same time, it should promote the initiatives to all LGs and Main Roads as a matter of general principle for greater efficiency in extraction and use of RBMs.

7.4.5 Investigate the potential for use of old gravel pits in preference to opening new sites (refer Section 6.6.4).

The management group should target areas where resource scarcity and demand for materials identified from 7.2.1 and 7.2.2 indicate the greatest need. It should promote as a priority in these areas, and in other areas as a general principle, the merits of obtaining gravel from old pits rather than establishing new sources.

This would involve an assessment of abandoned pits in relevant areas. The assessment should include cost savings associated with pit opening and final rehabilitation, and the more efficient use of a limited resource.

7.4.6 Encourage research into alternatives and modifications to optimise available road building resource (refer Section 6.6.5).

The management group should seek from LGs and Main Roads advice on problems they are encountering with lower quality RBMs and the application of RBMs to difficult situations. The group should also seek advice on solutions LGs have found through use of appropriate materials, equipment or modifications. It should disseminate this data to all LGs and Main Roads.

Where problems are identified for which there is not a ready solution, the group should seek industry and/or government agency research assistance. Where necessary, it should assist to identify and secure funding sources to underwrite the research.

Main Roads may play a prime role in research which flows from this initiative, particularly in light of its long standing cooperation with ARRB Transport Research.

7.4.7 Facilitate information sharing on access and extraction (refer Section 6.6.6).

A key role of the management group should be the development of an information sharing program incorporating regional workshops, seminars, newsletters, pamphlets and manuals. The program would be designed to ensure the wide sharing of information on the many aspects of securing and using RBMs, and of managing the associated social and environmental consequences.

Funding for seminars and workshops should be provided by participants, while funding for publications should come from the management group budget.

7.4.8 Encourage LGs to augment their technical expertise (refer Section 6.6.7).

The management group should request the WA Government to modify its approach to funding of LG roadworks so that all road grants include an incentive component to encourage efficiency. The incentive would be paid to LGs which employ the engineering and environmental expertise necessary to achieve greater efficiency in road planning, design and construction, and in associated materials procurement and usage; and, which leads to the adoption of sound environmental management and rehabilitation practices.

Performance in this respect might be measured through the provision of forward plans for road construction/maintenance and materials procurement, annual reporting on outcomes, and independent monitoring where possible (notably by the management group under 7.5.4 below).

The management group should investigate the possibility of the Commonwealth adopting a similar incentive component in its grants to LGs to ensure more efficient use of funds and a more responsible environmental performance in securing and using RBMs.

7.5 STRATEGIC OBJECTIVE 4

To ensure that appropriate environmental standards are applied to extraction and use of RBMs, and to rehabilitation of extraction sites.

7.5.1 Discourage extraction of RBMs from areas of remnant vegetation, including that in road reserves (refer Section 6.8.1 and 6.8.2).

CALM and Agriculture WA should continue using their powers under the Wildlife Conservation Act and the Soil Conservation Act to minimise the clearing of remnant vegetation for access to RBMs. Agriculture WA's remnant vegetation protection policy will assist this objective by offering financial grants to assist the protection of remnant vegetation while requiring protected vegetation to be secured by memoranda of understanding on land titles.

The management group should assist the process by drawing to the attention of LGs and Main Roads their responsibilities under the two

Acts and reinforce the objectives of the Acts by promoting the importance of preserving remnant vegetation. The group should also provide information through the work of 7.2.2 and 7.2.3 on location of resources on cleared land, and on avenues for identifying RBMs without recourse to vegetation as a primary indicator.

LGs which continue to clear remnant vegetation without adequate justification would not be eligible for the financial incentive recommended under 7.4.8 above because this would not reflect the sound environmental practices required as one of the criteria for receiving incentive payments.

7.5.2 Require LGs to implement adequate standards of dieback management when obtaining and using RBMs (refer Section 6.8.3).

The management group should foster a more conscientious approach among LGs to dieback management, drawing on the assistance of CALM and Main Roads regional offices, where they have experience, to assist with field training.

7.5.2a Encourage Main Roads and LGs to implement adequate standards of weed monitoring and control when using RBMs and rehabilitating pits (refer Section 6.8.3a).

The management group should foster among Main Roads and LGs an understanding of the need to consider the potential introduction and spread of noxious weeds (Declared Plants) and environmental weeds at all stages of sourcing and using RBMs and of rehabilitating pits. This will involve liaison with the Industry Resource Protection Branch of Agriculture WA.

7.5.3 Encourage users of RBMs to improve rehabilitation of abandoned and new pits, and to foster a practice of progressive rehabilitation, with the aim of improving the availability of the gravel resource by enhancing public acceptance of RBM extraction (refer Section 6.8.4).

The management group should foster among LGs and Main Roads the sound and timely rehabilitation of contemporary pits and quarries. It also should encourage a policy of returning to rehabilitate old pits and quarries, and the progressive rehabilitation of pits and quarries being operated over an extended period.

In pursuing these goals, the group should draw attention to existing guidelines published by DME, CALM, Main Roads and the RCC, foster information exchange through the programs of 7.4.7, identify funding sources and other avenues of assistance for rehabilitation of larger abandoned pits which may be beyond the resources of LGs to repair, and encourage employment of appropriate environmental expertise as proposed at 7.4.8. It should encourage LGs to budget for borrow pit rehabilitation, perhaps setting aside "reserve funds" for the purpose.

The management group should have a monitoring function to assist achieving the above objective if it adopts the role of the QRSC in relation to RBMs, as proposed at 7.5.5.

The ultimate aim will be to enhance the availability of the gravel resource through improved public acceptance of RBM extraction.

7.5.4 Modify current rehabilitation guidelines to meet WA's varying environments and the requirements of different regions (refer Section 6.8.5).

Where regions of the State present problems or opportunities in rehabilitation are not fully addressed by existing rehabilitation guidelines, the management group should assist the development of appropriate modifications or addenda to the guidelines to suit the local situations.

In so doing, it could draw on any information available through LGs, the QRSC, regional offices of Main Roads, CALM and Agriculture WA, and local rehabilitation practitioners, such as mining companies. The outcome of this work should be published and disseminated.

7.5.5 Pursue the recommendations of the Working Party on Conservation and Rehabilitation in the WA Quarrying Industry (refer Section 6.8.6).

The management group should take over the role of the QRSC in relation to quarries and pits extracting RBMs, and continue pursuit of the recommendations of the Working Party on Conservation and Rehabilitation in the Quarrying Industry, with particular emphasis on the educational and monitoring aspects.

7.5.6 Facilitate information sharing on environmental aspects of access and extraction, and on rehabilitation methods (refer Section 6.8.7).

The management group should establish a program for information sharing as discussed at 7.4.7. This would embrace environmental management and rehabilitation, and other aspects of securing and using RBMs.

7.5.7 Advise how the powers of existing legislation can be used more effectively to improve rehabilitation performance (refer Section 6.10.2).

The management group should ensure rehabilitation and environmental management requirements are included in the work undertaken as part of 7.3.5.

7.6 STRATEGY IMPLEMENTATION

The management group should be empowered to undertake the proposed actions listed above to meet strategic objectives in accordance with the schedule in Table 8.

Table 8
Strategy Implementation Schedule

	Action	Intensive activity Years 1-3	Transition Years 4-5	Ongoing responsibility
7.2.1	Compile and maintain database of needs			Devolve to MRWA
7.2.2	Initiate field surveys and compile and maintain database of resources	Carry out transect surveys in priority areas »20 LAS		Devolve to GSD on needs basis
7.2.3	Encourage research into new exploration techniques	Encourage funding (if possible) and research by appropriate agencies		
7.3.1	Ensure that land use planning protects resources	Develop policy and ensure implementation		Devolve to Main Roads and LGs
7.3.2	Assess resource potential of land being considered for reservation			Devolve to CALM/Vesting authority
7.3.3	Advise Government on gravel resource potential of reserved land			
7.3.3a	Secure a regulation amending Local Government Act 1995 to permit RBM extraction on certain developed and cultivated land			Devolve to LGs/WAMA
7.3.4	Develop guidelines for access and compensation			Main Roads and LGs to monitor and update as necessary
7.3.5	Advise on effective use of legislative powers for access and compensation			Main Roads and LGs to monitor and update as necessary
7.4.1	Prepare cost benefit analysis of securing RBMs from: - CALM-managed land			Main Roads and CALM to update as necessary
7.4.2	- other land			
7.4.3	Encourage shared exploration for materials			Devolve to WAMA/LGs
7.4.4	Encourage LGs to improve efficiencies			Devolve to WAMA/LGs
7.4.5	Investigate potential for use of old gravel pits			Devolve to Main Roads and LGs

Table 8
Strategy Implementation Schedule

	Action	Intensive activity Years 1-3	Transition Years 4-5	Ongoing responsibility
7.4.6	Encourage research to optimise available resource		Encourage & fund (if poss) by appropriate agencies	Devolve to Main Roads
7.4.7	Facilitate information sharing on access and extraction			Devolve to Main Roads/WAMA
7.4.8	Encourage improved technical expertise in LGs	Input to funding/grants allocations		Devolve to Main Roads/Grants Commission
7.5.1	Assist relevant authorities in discouraging extraction of RBMs from areas of remnant vegetation	Discourage through use of financial disincentives/education		
7.5.2	Assist CALM in ensuring adequate standards of dieback management when obtaining and using RBMs			Continued by CALM/Main Roads
7.5.2a	Encourage LGs and Main Roads to adopt adequate standards of weed control in extraction operations			
7.5.3	Encourage improved rehabilitation to enhance public acceptance of gravel extraction			Devolve to LGs/Main Roads
7.5.4	Refine current rehabilitation guidelines		Main Roads/DEP/CALM to monitor	
7.5.5	Pursue the role of the QRSC			Devolve to Main Roads/DEP/CALM
7.5.6	Facilitate information sharing on rehabilitation		Main Roads/LGs to monitor and update as necessary	Devolve to Main Roads/WAMA
7.5.7	Advise on more effective use of legislative powers for rehabilitation		Main Roads/LGs to monitor and update as necessary	Devolve to Main Roads/WAMA

Abbreviations

Agriculture WA	Agriculture Western Australian
bcm	bank cubic metres
CALM	Department of Conservation and Land Management
CBH	Co-operative Bulk Handling
CCI	Chamber of Commerce and Industry
CSIRO	Commonwealth Scientific Industrial Research Organisation
CALM	Department of Conservation and Land Management
DME	Department of Minerals and Energy
DOLA	Department of Land Administration
EPA	Environmental Protection Agency
GSD	Geological Survey Division
LG	Local Government
LIS	Land information system
MfP	Ministry for Planning
Main Roads	Main Roads Western Australia
NOE	Notice of Entry
NPNCA	National Parks and Nature Conservation Authority
PGA	Pastoralist and Graziers Association
QRSC	Quarry Rehabilitation Steering Committee
RCC	Roadside Conservation Committee
WAFF	Western Australian Farmers Federation
WAMA	Western Australian Municipal Association
VCL	Vacant Crown Land

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Appendix 1.

SUMMARY OF LOCAL AUTHORITY QUESTIONNAIRE RESPONSES

WESTERN
AUSTRALIAN
MUNICIPAL
ASSOCIATION

LOCAL GOVERNMENT HOUSE
15 ALTONA STREET
WEST PERTH WA 6005
P O BOX 1544
WEST PERTH WA 6872
FACSIMILE (09) 322 2611
TELEPHONE (09) 321 5055

5 August 1994

Please Quote Our Ref:
MIS:MBS/1430.002/survey

TO: Town/Shire Clerk / City Manager / Chief Executive Officer
(As addressed)

Dear Colleague

GRAVEL RESOURCES AND USAGE IN WESTERN AUSTRALIA

The Minister for Transport, Hon Eric Charlton MLC, and the Minister for the Environment, Hon Kevin Minson MLA, have established a State Gravel Supply Strategy Group to report and make recommendations on options to the Government for the supply of road building material within the State.

An audit to determine the present and projected requirements of road building materials in Western Australia is necessary, and your assistance in completing and returning this questionnaire by **31 August 1994** would be appreciated.

NAME OF COUNCIL:	
What is your annual gravel usage?	m^3
How many kilometres of road are gravelled annually?	km
What is the average width of gravel roads in your Council?	m
What is the average compacted thickness of gravel applied?	mm
Estimated number of gravel pits in your Council — Privately Owned — Council Operated	
Do you have sufficient amounts of gravel for the next 15 years?	YES/NO
Does your Council enter into gravel supply agreements?	YES/NO
Does your Council pay Royalties/Compensation?	YES/NO
If so, how much?	$ /m^3
Does your Council have a rehabilitation policy program?	YES/NO
What other road building materials or methods do you use?	
Are there any concerns with gravel extraction, location, rehabilitation that you wish to comment on?	

PLEASE RETURN THIS QUESTIONNAIRE BY 31 AUGUST 1993 TO: Mahesh Singh
Western Australian Municipal Association

SHIRE COUNCIL	GRAVEL USED P.A.	KMS GREAVELLED P.A.	AV WIDTH	AV COMPACTED THICKNESS	NUMBER OF GRAVEL PITS - PRIVATE	GRAVEL SUPPLY FOR 15 YEARS	GRAVEL SUPPLY AGREE -MENTS	ROYALTIES OR COMPEN-SATION	REHAB. POLICY	OTHER MATERIALS OR METHOD	CONCERNS
Capel	5 000	na	6	150 - 200	6	N	Y	1.50 - 3.50	N	Limestone	Not at present
Carnamah	25 000 - 35 000	20/25	8 - 6	150	8	N	Y	0 - 10	Y	Natural Surface Bitumen Aggregate	Access to CALM Land
Chapman Valley	60 000	42	9	100	33	N	Y	50	Y	Loam and Sand Fill	Will require access to Govt Reserves for Gravel supply now and increasing in future.
Coorow	20 000	Varies	8	100	Unknown	N	N	Nil	Y	Enzyme Additive, Gravel, Road base mix, Cement stabilisation	Have gravel material but lack funding to get onto roads.
Cranbrook	16 000	15	8	100	Nil	Y	Y	0 - 10	Y	N/A	L.A.'s should avoid permanent pits. Negotiate with adjacent landowner to source and rehabilitate as soon as finished.
Cuballing	20 000	20	6	75	7	N	Y	Nil	Y	Earth Formed	Most good gravel stocks are in CALM controlled Reserves. Not available for use.
Cunderdin	20 000	10	7.4	204	Nil	N	N	Nil	Y	Nil	Rely on the goodwill of property owners for access and removal.
Dalwallinu	35 000 - 50 000	40	9	100	20	N	Y	0.15	Y	Nil	Reluctance of Land holders to give access to gravel. Problem has been exacerbated with greater focus on soil conservation.
Dowerin	20 000	20 - 25	8	120	30	Y	N	Nil	Y	Metal/Bitumen	Nil
Dundas	2 000 - 3 000	4	7	100	2	N	N	Nil	Y	With reference to Eyre Highway, anything we can find.	Gravel can only be found in the west section of Shire, east Section not available.
Pilbara	45 000 - 50 000	45	5 - 8	100	Nil	Y	N	Nil	N	Water binding and compacting insitu materials (when available) - Gravel is generally available	Nil
Exmouth	12 300	8	10	100	Nil	Y	N	N/A	Y		Gravel Pits under the control of CALM.

SHIRE COUNCIL	GRAVEL USED P.A.	KMS GRAVELLED P.A.	AV WIDTH	AV COMPACTED THICKNESS	NUMBER OF GRAVEL PITS - PRIVATE	GRAVEL SUPPLY FOR 15 YEARS	GRAVEL SUPPLY AGREE -MENTS	ROYALTIES OR COMPEN-SATION	REHAB. POLICY	OTHER MATERIALS OR METHOD	CONCERNS
Gingin	15 000	20	8	150	8	N	Y	1.05	Y	Limestone, clay, marl. Sand mixed with above.	Supplies of Gravel in CALM contolled land is extremely difficult to aquire. Good gravel can be found but high costs are incurreed due to distance involved.
Gnowangerup	20 000 - 40 000	15 - 24	9	150	16	N	N	0.20	Y	Nil	Access to Gravel in nature reserves and national parks would be an advantage.
Greenough	50 000	20	8	200	3	N	Y	0.50	Y	Mixing materials. Readymix quarries and rapid screen quarries. RD base and metal dust.	Location of gravel on reserves not available to council (Burma Rd Reserve). Haul distance 20 km average.
Mount Magnet	35 000 - 40 000	40	7	100	Nil	N	N	Nil	N	Use whatever soil/ blend materials to hand that can be successfully utilised.	In this shire, gravel is a particularly diminishing commodity. With trial material blends, climatic conditions erode "fines" quickly.
Quairading	12 000	9	8	150	10	N	N	N	Nil	Stabilising on trial	Council does not have access to gravel owing to location in some cases. Also section of Shire does not have gravel.
Wagin	8 500	7	8	100	10	N	N	0.10	Y	Nil	Nil
West Arthur	25 000	20	8	150	31	Y	Y	In kind equivalent to value of land used for gravel extraction.	Y	Clay and course gravel mix for sub-base and fill.	Nil
Donnybrook/ Balingup	11 000	10	7	100	4	N	Y	1.00 - 2.00	Y	Fill material sand and loam	The methodology of obtaining agreements with CALM is a long drawn out process - obstacles such as Dieback, Management Control Area Terrain are often difficult to overcome. Private land owners are reluctant to allow Council to obtain gravel from their properties.
Kent	150 000	70	8	100	Nil	Maybe	Y	In private works	Y	Nil	Nil
Kondinin	50 000	33	8	100	Nil	Y	Yes	0.20	Y	Nil	Nil

SHIRE COUNCIL	GRAVEL USED P.A.	KMS GRAVELLED P.A.	AV WIDTH	AV COMPACTED THICKNESS	NUMBER OF GRAVEL PITS - PRIVATE	GRAVEL SUPPLY FOR 15 YEARS	GRAVEL SUPPLY AGREE -MENTS	ROYALTIES OR COMPEN-SATION	REHAB. POLICY	OTHER MATERIALS OR METHOD	CONCERNS
Menzies	48 000	50	6	100	Nil	Y	No	Nil	Y	Local Sands and Limestone type material.	Yes - do have problems with some mining leases.
Chittering	10K - 20K	5 - 10	8	150	3	Y	Y	50c - 1.50	Y	Nil	Lack of free access to CALM and Forrest Reserves.
	30 000	25	7.5	50	Nil	N	N	Acquisition of land $126 acre	N	Nil	Insufficient amounts available.
	40 000	29	9	150	45	Y	N	10c	Y	Decomposed granite when gravel not available.	Nil
York	2 070	23	6	150	6	Y	Y	1	N	Nil	There are suitable gravel resources in CALM managed Forestry Reserves.
Yalgoo	40 000	38	8	100	Unknown	N	N	Nil	Y	Calcrete, Limestone, mixed with gravel, wondery sands, granite shale.	Good gravels are becoming extinct and we should be looking at other resources for road building materials, clays, sand and stone.
Woodanilling	25 000	25	9	.08	8	N	N	N	Y	Nil	Nil
Wiluna	50 000	3	7.6	150	Unknown	Y	N	Nil	Y	Sand	Nil
Waroona	6 500	4	8	150	2	N	Y	1.10	Y	Limestone	Require greater and easier access to gravel resources within CALM Lands.
Trayning	50 000	35-40	8-10	100	Nil	N	N	0.40	Y	Nil	Nil
Wanneroo	Nil	Nil	Nil	Nil	Nil	N/A	N	N/A	N/A	Bitumen stabilised limestone.	The clay content and mixing operation in clay areas is always a concern.
Ravensthorpe	110 000	100	6.8	100/150	Nil	Y	N	If necessary	Y	Limestone	Council extract grave from its r oad reserves adjacent to works where available. However supplies are generally only in small pockets. Pts are reinstated immediately.
Pingelly	5 000	8	6	100	3	N	Y	Yes - compensation	Y	Natural surface	Needs to be some guidance/ legislation re: extraction methods/ standards, rehabilitation standards, compensation amounts, forms.
Murray	15 000	17	6.2	75	1	N	Y	1.20	Y	Sub-base of crushed limestone.	Concerned regarding ongoing supply of gravel.

SHIRE COUNCIL	GRAVEL USED P.A.	KMS GRAV-ELLED P.A.	AV WIDTH	AV COMPACTED THICKNESS	NUMBER OF GRAVEL PITS - PRIVATE	NUMBER OF GRAVEL PITS - COUNCIL	GRAVEL SUPPLY FOR 15 YEARS	GRAVEL SUPPLY AGREE -MENTS	ROYALTIES OR COMPEN-SATION	REHAB. POLICY	OTHER MATERIALS OR METHOD	CONCERNS
Ngaanyat-Jarraku	60 000	20 - 30	8	200	Nil		Y	N	Nil	N	Nil	Nil
Northam (Shire)	20 380	5	8	150	6		N	Y	2.00	Y	Nil	Difficult to locate. Landowners reluctant to release gravel. Pits located many kilometres from job. Rehabilitation a Council polity.
Northam (Town)	1 500	Nil	7	150	2		Y	N	4.00	Y	Road base ferricrete	Gravel in Northam poor quality.
Northampton	24 000 - 30 000	20 - 30	8.6	150	20		N	Y	0.50	Y	Some limestone	Nil
Perenjori	30 000	15	10	150	58		Y	N	154	Y	Waterbound pavements.	Lead distances to gravel forever increasing.
Mundaring	30 000	13.5	5	100	Nil		Y	N	Y	Y	Road base	Nil
Mt Marshall	180 000	100	6	18	12		N	N	Nil	Y	Nil	Nil
Lake Grace	70 000	70	8.5	100	Nil		Y	N	Nil	Y	Nil	Problem of salinity if gravel pits are not reinstated.
Leonora	7 200	6	8	150	Nil		N	N	N/A	Y	Pindan sand	Our prime concern by far is to find gravel as it is scarce in Leonora Shire.
Kulin	50 000	45	11	150	35		N	Y	0.20	Y	Cement, bitumen, enzymes, Colas	Lack of good materials, reluctance of CALM to cooperate.
Kellerberrin	5 000	6	8.4	100	11		Nil	Y	Purchase by negotiation per ha.	N	Cement, enzyme, chemical stabilisation	nil
Kalgoorlie - Boulder (City)	26 000	12	8	100	Several		N	N	N/A	Y	Coarse capstone, limestone on trans Stabilisation.	Most gravel in shire is poor quality and on leads up to 60 mm. Good quality gravel for urban works purchased from private quarry near Bullabulling at $13/km.
Katanning	15 000	20 - 22	7	80	7		Y	Y	0.80	N	Stabilisation using existing clay/gravel enzymes or bitumen.	Long distance haulage - Govt reserves to be reopened. and Controlled by CALM.
Kalamunda	25 000	12 - 15	6	150	1		N	Y	Nil	N	Mainly gravel basecourse however, Road base material is used occasionally.	Possibly the only concerns would be the spread of die-back and the rehabilitation of any sites.

SHIRE COUNCIL	GRAVEL USED P.A.	KMS GRAV-ELLED P.A.	AV WIDTH	AV COMPACTED THICKNESS	NUMBER OF GRAVEL PITS - PRIVATE	NUMBER OF GRAVEL PITS - COUNCIL	GRAVEL SUPPLY FOR 15 YEARS	GRAVEL SUPPLY AGREE -MENTS	ROYALTIES OR COMPEN-SATION	REHAB. POLICY	OTHER MATERIALS OR METHOD	CONCERNS
Augusta/ Margaret River	50 000	30	6	100	20 - 30		N	N	1.00 - 3.00	Y	Limestone, gravel rock crushing.	CALM controls majority of Shire area - sometimes difficult to get gravel supplies from them - particularly limestone.
Beverley	20 000	20	6	100	Nil		Y	Y	Nil	Y	Nil	Some pit locations require 30 km to 40 km turnarounds on various jobs.
Boyup Brook	20 000	30	8	100 - 150	Nil		N	N	0.65	Y	Nil	Nil
Busselton	50 000	10	6 - 7	100	5		N	N	Nil	Y	Cement stabili-sation, lime.	Dieback free gravel is scarce in existing gravel reserves.
Chittering	15 000	7.5	8	150	3	1	Y	Y	1.00	Y	Nil	Lack of free access to CALM and forest reserves.
Dardanup	3 500	2	7	200	3	4	Y	Y	-	Y	-	Price of gravel included in supply charge.
Donnybrook - Balingup	11 000	10	7	100	4	3	N	Y	1.50	Y	Full material Sand and Loan Agreements with Calm long drawn out proceed private land owners reluctant to allow Council to obtain gravel from their properties	
Kent	150 000	70	8	100	70	-	N	Y	-	Y	-	-
Kondinin	50 000	33	8	100	N	-	Y	Y	0.20	Y	-	-
Menzies	48 000	50	6	100	-	100	Y	N	N/A	Y	Local Sands and Limestone type of material.	Problems encountered with mining leases.
Merredin	50 000	30	10	100	12	30	N	Y	-	Y	Compact Natural Soil, utilise metal scalps	The scarcity of good quality gravel is of concern.
Mount Magnet	38 000	40	7	100	-	8	N	N	-	N	Use whatever soil blend materials	Gravel supplies diminishing.
Quairading	12 000	9	8	150	10	3	N	N	-	-	Soil stabilising on trial.	Council has no access to gravel due to location (in gravel in certain areas).
Wagin	8 500	7	8	100	10	4	N	N	0.10	Y	-	-
West Arthur	25 000	20	8	150	31	7	Y	Y	-	Y	Clay and course gravel mix	-
Westonia	63 000	35	9	100	30	3	N	N	-	Y	-	Restricted access to CALM Reserves.
Ashburton	100 000	60	8	150	0	30	Y	N	-	Y	Concrete Cement stabilisation	Marginal quality material in Pilbara/ Kimberley region.

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Albany Shire	28 000	12	6	150	10	15	Y	N	-	Y	Limestone	Supplies becoming increasingly hard to obtain easily.
Albany Town	5 000	3	6	150	0	0	Y	Y	0.82	N	Limestone Sub-base	All pits controlled by one land owner but three supply contractors.
Augusta Margaret River	50 000	30	6	100	20-30	20	N	N	1-3	Y	Limestone, Crushed rock gravel	CALM controls majority of the area. Hard to get supplies.
Beverley	20 000	20	6	100	0	10	Y	Y	-	Y	-	Some pits at 30-40 km turnaround.
Boddington	8 000	7	7	100	8	0	N	Y	0.50	Y	Nil	Poor quality limited pits too far to cart.
Boyup Brook	20 000	30	8	100-150	0	5	N	N	0.65	Y	-	-
Bridge Town Green Bushes	60 000	100	8	100	10	10	N	Y	1.00	Y	Nil	Difficulty in obtaining gravel supply from CALM reserves.
Brookton	5 000	4	9	100	12	6	N	Y	-	Y	Granite Tailings	-
Broome	5 000	4	8	150	2	1	Y	N	-	Y	Pindan Formed Roads.	Availability and access to new pits. Quantity of
Broomehill	30 000	25	9	100	2	1	N	Y	In kind.	Y	Nil	-
Bruce Rock	23 000	27	8.5	100	50	5	Y	Y	0.10	Y	Decomposed granite	-
Busselton	50 000	10	6-7	100	5	3	N	N	-	Y	Cement stabilisation, lime.	Dieback gravel scarce in existing reserves.
Capel	5 000	-	6-7	150-200	6	3	N	Y	1.5-3.5	N	Limestone, Ready-mix type road base	None at present.
Carnamah	30 000	20-25	8-6	150	8	0	N	Y	0.10	Y	Natural Surface, Bitumin/	Access to CALM land.
Chapman	60 000	42	9	100	33	2	N	Y	0.50	Y	Loamy sand fill	Will require access to Valley Government Reserves for
Corrigin Shire	35 000	30	9	100	150	-	N	N	-	Y	Cement stabilisation	Very hard to get gravel close to construction.
Cranbrook	16 000	15	8	100	0	2	Y	Y	0.10	Y	-	LA's should avoid permanent pits. Negotiate with adjacent landowners for source & rehabilitate as
Cuballing	20 000	20	6	75	7	10	N	Y	-	Y	Earth formed	Most good quality stocks in CALM land.
Cue	42 000	175	8	150	-	26	N	Y	Yes	Y	Calcrete	Longer lead distances.
Cunderdin	20 000	10	7.4	204	0	0	N	N	-	Y	-	Rely on goodwill of the property owner for access.

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Dalwallinu	43 000	40	9	100	20	30	N	Y	0.15	Y	-	Reluctance of land holders to give access - problem exaggerated with greater focus on soil.
Derby West Kimberley	100 000	100	8	125	0	100	Y	N	-	Y	-	Good quality laterite not available from all pits therefore inferior materials have to be used.
Dowerin	2 000	20-25	8	120	0	30	Y	N	-	Y	Metal/Bitumen	-
Dumbleyun	25 000	22	8	100	80	70	N	N	0.10	Y	-	Poor quality gravel.
Dundaragan	105 000	80-90	8	100-150	0	12	N	Y	2.00	Y	Marl limestone for sub-base in coastal areas	Gravel in CALM land Council unable to reach agreement.
Dundas	3 000	4	7	100	0	2	N	N	-	Y	-	Gravel on east section of shire not available.
East Pilbara	48 000	45	5-8	100	-	100	Y	N	-	Y	Water bonding and compacting insitu materials when water	-
Esperance	200 000	150	8-9	150	5	30	N	Y	0.50	Y	Limestone Grid crush, Roll and rock buster mobile crusher.	Lack of consistent policy for extraction increasing reluctance by landowners.
Exmouth	12 300	8	10	100	120	20	Y	N	-	Y	-	Gravel under CALM control.
Geraldton	3 000	3	7.4	100	0	0	N	N	-	Y	Limestone, crushed quarry	Frequently using marginal quality gravel would
Gingin	15 000	20	8	150	8	4	N	Y	1.05	Y	Limestone Clay Marl Sand	Difficulty in getting supplies from CALM land
Gnowangerup	30 000	15-24	9	150	16	2	N	N	0.20	Y	-	Access to natural reserves and parks would be an advantage.
Goomalling	30 000	30	8	125	15	10	N	N	-	Y	Quartz on salt affected roads	Good quality gravel becoming scarce.
Greenough	50 000	20	8	200	3	12	N	Y	0.50	Y	Mixing materials Readymix.	Location of reserve. Average haul distance 20 km
Kalamunda	25 000	12-15	6	150	1	0	N	Y	-	N	Road base material	Spread of die-back and the rehabilitation of any
Kalgoorlie-Boulder	26 000	12	8	100	several	1	N	N	-	Y	Coarse Capstone/ Limestone	Poor quality, lead up to 60 km, good quality from
Katanning	15 000	20-22	7	80	7	6	Y	Y	0.80	N	Stabilisation using clay	Long distance. Government reserve to be

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Kellerberrin	5 000	6	8.4	100	11	3	-	Y	By	N	Cement enzyme Chemical	-
Kojonup	28 000	8-12	7.5	100	0	12	N	Y	500/Hect	Y	Various forms of stabilisation	No deposits in some areas. Clearing bans.
Koorda	30 000	25	7.3	100	53	9	N	N	0.10	Y	WATIL Sand	-
Kulin	50 000	45	11	150	35	15	N	Y	0.20	Y	Cement Bitumen Enzyme colas	Lack of quality material, reluctance of CALM to co-operate.
Lake Grace	70 000	70	8.5	100	Many	>200	Y	N	-	Y	-	Salinity problem if pits not restored.
Leonora	7 200	6	8	150	7	-	N	N	-	Y	Pindan sand	Gravel scarce in the shire.
Mandurah	10 000	12.5	8	75	0	0	N	Y	16.6	N	Limestone	Council seeking approval to have a pit at
Meekatharra	10 000	100	8	80	0	4	Y	N	-	N	-	-
Mingenew	25 000	20	6.8	100	0	10	N	Y	0.50	N	-	Longer hauls
Moora	60 000	28-30	7.4-8.6	200	3	32	N	N	5.00	Y	-	With the need to pay royalty in future, Council's road building costs will go up by 10%.
Morawa	15 000	15	8	100	40	10	Y	N	-	Y	Iron ore fines	-
Mt Marshall	180 000	100	6	18	12	80	N	N	-	Y	-	-
Mullewa	32 000	30	7	150	13	4	N	N	-	Y	-	Difficulty in seeking land owner co operation.
Mundaring	30 000	13.5	5	100	0	1	N	Y	-	N	Road Base	-
Murray	15 000	17	6.2	75	1	3	N	Y	1.20	Y	Sub-base of crushed	On-going supply of gravel doubtful.
Nagaanyat Jarraku	60 000	50	8	200	0	20	Y	Y	-	Y	-	-
Nannup	34 125	25	7	150	5	1	N	Y	3.00	Y	Shale	-
Narrogin	5 000	10	8	150	5	25	N	N	-	Y	-	Many areas with gravel being converted into
Neerambeen	12 000	11	9	100	30	4	-	N	-	Y	-	No access allowed into CALM Reserves
Northam Shire	30 380	5	8	150	6	0	N	Y	2.00	Y	-	Difficult to locate, Land owners reluctant
Northam	1 500	-	7 Town	150	2	0	Y	N	4.00	Y	Road base, Ferricrete	Gravel in Northam, poor quality.
Northampton	27 000	20-30	8.6	150	20	3	N	Y	0.50	Y	Some limestone	-
Nungaring	30 000	25	8	60-100	6	9	N	N	-	Y	Nil	-
Perenjori	30 000	15	10	150	58	8	Y	N	154.00	Y	Water bound . pavement	Lead distance.
Pingelly	5 000	8	6	100	3	12	N	Y	-	Y	Natural Surface	Need for guidance/ legislation re extraction.

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Plantagenet	22 000	6-8	7.3	100	?	9	N	Y	-	Y	Cement stabilisation no gravel in some areas.	-
Ravens-thorpe	110 000	100	6.8	100-150	0	Ref Concerns	Y	N	0.20	Y	Limestone	Gravel from pits adjacent to works where
Roebourne	20 000	17	8	100-150	?	8	Y	N	-	N	Proprietary produces	-
Tambellup	3 000	30	4.8	20	0	6	N	N	-	Y	Nil	
Three Springs	45 000	32	11	150	16	4	N	N	-	Y	None	Waiting for funding for gravel pit rehabilitation.
Trayning	50 000	36-40	8-10	100	-	-	N	N	0.40	Y	None	-
Wanneroo	0	0	0	0	0	0	N	N	-	N	Bitumen stabilised, Limestone	-
Waroona	6 500	4	8	150	2	1	N	Y	1.10	Y	-	Need greater and easier access to CALM
Wickepin	20 000	18	8	150	7	7	Y	N	-	Y	-	-
Williams	18 000	15	8	100-150	0	3	N	N	-	Y	-	-
Wiluna	50 000	3	7.6	150	?	?	Y	N	-	Y	Sand	-
Wongan-Ballidu	40 000	20	8-10	100	30	0	Y	Y	0.10	N	-	Good quality gravel diminishing. Future
Wooda-nilling	25 000	25	9	80	8	2	N	N	-	Y	-	-
Wyal-katchem	4 000	4-5	9	130-150	6	4	N	Y	0.05	Y	Metal Dust on salt problem areas and Bitumen reseal.	Lack of gravel throughout shire. Farmers reluctant to part with deposits.
Wyndham-East Kimberley	-	-	8	150	10	3	Y	Y	-	N	shale material where	-
Yalgoo	40 000	38	8	100	?	?	N	N	-	Y	Calcrete, Limestone mixed with gravel, wondery sand.	Good quality gravel becoming extinct, need to look for other resources.
York	2 070	23	6	150	6	1	Y	Y	1.00	N	Nil	Suitable reserves in CALM managed forestry.
?	40 000	29	9	150	45	5	Y	N	0.10	Y	Decomposed granite when gravel not available.	-
?	30 000	25	7.5	50	?	5	N	N	126/Acre	N	Nil	Insufficient quantity.
?	50 000	30	10	100	0	15	Y	N	-	N	Calcrete sheeting	-
?	1 000	-	8	100	0	1	N	N	-	Y	Road base, insitu cement	-
Collie	20 000 - 30 000	10	8	150	1	1	N	N	-	N	-	76% CALM (WAWA, Forestry and Mining). 24% Rate -(Samll Holdings 400 km)

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Coorow	20 000	varies	8	100	Unknown	All	N	N	-	Y	Enzymes Addition to gravel Road base mix.Cement stabilisation	Have gravel material but lack the funding to get it onto the roads.
Denmark	30 000	20	8.4	150	-	10	Y	Y	1	Y	-	If access available to CALM and private lands.
Harvey	9 600	20	6	200	3	1	Y	Y	-	Y	Limestone	Difficulties with private operators rehabilitating pits.
Irwin	10 000	100	9	150	-	6	N	Y	0.50	Y	-	-
Jerramungup	35 000 - 40 000	32	8-10	100	9	2	N	N	Y	-	-	-
Manjimup	40 000 - 60 000	12	8	300	30-50	10-20	Y	Y	50	Y	Mechanical stabili-sation with clay.	Policy what's good for CALM should apply to the LA's. (Co-operative agreement.)
Mukinbudin	1 100	11	8-10	100	4	10	Y	N	-	Y	Small distances, blue metal dust as Road base.	No.
Nannup	34 000	25	7	150	CALM	-	N	Y	3.00	Y	No shale.	CALM - Inflexible policy.
Narrogin	1 000	0.5	8	-	1	-	N	N	-	Y	Road base Cement stabilisation.	
Tammin	10 000	6-10	7	100	-	21	Y	N	-	N	Quartz	Becoming increasingly difficult to obtain gravel. 6 sites have quality gravel and limited supply.
Toodyay	20 020	14	8	150	3	3	Y	N	0-1	Y	Crushed Rock	CALM policy - use on roads serving their reserves within 5 km.
Victoria Plains	30 000	30	9	100	40	Nil	Y	N	20	Y	Insitu materials in ome areas.	-
Wandering	-	5	5.6	150	-	Unknown	N	Y	-	-	-	Problem access to gravel sources - CALM agreement eg Wandering Conservation Park.
Wickepin	20 000	18	8	150	7	7	Y	N	N/A	Y	-	-
Williams	18 000	15	8	100-150	Nil	3	N	N	-	Y	-	-
Yilgarn	80 000	50	10	150	-	-	N	N	1.80	Y	Insitu treatment stabilision.	Restrictions placed on gravel resources by CALM.
Bunbury City	2 000	2	7	200	3	Nil	Y	Y	-	N	Gravel/ Limestone 2:1 Mix	Several Supplier - Contractors deliver direct from the City to Council Terminal at $7.50/m2.

Appendix 2

NPNCA POLICY AND CALM POLICY FOR STATE FORESTS AND TIMBER RESOURCES

NATIONAL PARKS AND NATURE CONSERVATION AUTHORITY

BASIC RAW MATERIALS (BRM) POLICY
Government and Local Government access to Conservation Estate (National Parks, Nature Reserves and Conservation Parks)

INTRODUCTION

The reserve system (mainly National Parks and Nature Reserves) was created for the purpose of ensuring that representative areas of our natural heritage are set aside and managed in a sustainable way and protected from damaging and degrading agents and activities.

The conservation estate includes some large individual areas within the State that integrate with an assortment of road networks. Many of these roads are within gazetted road reserves or easements forming enclaves within the conservation estate and some roads are on the particular reserve/park tenure. Additionally, some road reserves remain undeveloped. There has been a long standing practice by road making authorities to access basic raw materials (BRM) from "crown" lands, irrespective of reserve status. In the 1970's both the National Parks Authority and the WA Wildlife Authority advised all LG's of their policy. Numerous requests have been made to access BRM's from conservation lands (primarily by shires) for use on roads within separate easements. Illegal access based on customary behaviour has occurred on occasions. In some instances the roads contribute to the management and protection of the conservation estate.

Targeting BRM deposits in conservation lands and other remnant vegetated areas (ie "unimproved" farmland) results in incremental loss of the related vegetation type and can place a wider area of the estate at risk of dieback infection. Although pits occupy relatively small areas often in large reserves they generally effect specific sites. This can have serious implications for long term conservation status of those communities which grow on substrates associated with BRM's especially in the wheatbelt and other poorly conserved regions (for example the Regional Manager Wheatbelt estimates up to 2000 ha of kwongan vegetation has been mined on wheatbelt nature reserves). Much of the current practice in the wheatbelt for example stems from the fact that environmental loss is not costed. Practices contributing to this situation include operators using native vegetation as an indicator of gravel soils in a largely cleared landscape; and attitudes such as the view that native vegetation is worthless and inferior to pasture. Also LG's wish to avoid possible conflict with private landowners/ratepayers citing that access to private land is too difficult and expensive, and that there is no intrinsic or actual dollar cost to the mining of native vegetation.

In contrast and notwithstanding the environmental cost it can be argued that current standards require high quality rehabilitation on reserved land costing more than pasture; that pasture production can be returned; and that a nominal royalty rate of 10¢/tonne (equivalent to one tonne kilometre of cartage) combined with best practise rehabilitation would overcome farmer resistance, as is the case with the Cranbrook Shire and Main Roads.

The majority of proposals to access BRM on conservation estate have not stood up to scrutiny because alternative supplies have been available, usually on cleared private land, and in many cases have involved roads which do not directly serve the conservation estate often being remote from the particular reserve.

By virtue of the CALM Act Sections 33(3), 33(a) and 56 CALM and the NPNCA are constrained as to what activities can be included in management plans and allowed under necessary or compatible operations. The current Basic Raw materials policy has reflected this position limiting the use of BRM's strictly to the land from which it was sourced.

The previous Governments mining policy "resolution of conflict" constrained access via the Mining Act, denying access to National Parks and requiring detailed environmental assessment through the EPA. The current mining policy establishes a rigorous regime involving EPA assessment, Two Houses of Parliament or National Park and "A" class Nature Reserves for example.

Such constraints by the CALM ACT and the MINING ACT on the use of BRM's for purposes that are not on the particular Park or Reserve from where they were sourced apply to gazetted road reserves within the boundaries of reserves/parks. These restrictions can cause difficulties as it may not be desirable to import resource from outside the conservation reserve due to the need for dieback and weed hygiene. Additionally mining of the road easement often causes more serious visual impact than a well sited pit within the reserve. The Mining Act offers a mechanism (mining lease) for access to BRM's however, as stated it can be a drawn out process involving several layers of approval involving Ministers, the EPA and Parliament for "A" class reserves.

There is potential to use the LOCAL GOVERNMENT ACT (Sec 281) and the PUBLIC WORKS ACT (Sec 112) to allow extraction of B RM from the conservation estate for use on other tenures for "road making" and "public works" respectively. Consent by the Minister for Lands and the Minister for Works respectively is required. There is no statutory requirement for the consent of the Minister for the Environment or the vested authority. This requires Legislative changes.

The NPNCA and CALM take the view that materials should be available if the road reserve is an enclave within the reserve/park boundaries, the road is required for the management and protection of the estate and the environmental cost to the conservation estate, on balance, is neutral (imperative being to exclude weeds and dieback) and suitable alternatives are not available. The NPNCA also take the view that wherever possible the matter of Local Government Authority (LG) quarry reserves is resolved before the Gazettal of the reserve/park.

Access to BRM's on conservation estate under the MINING ACT by commercial operators is strongly opposed. The Authority seeks to have these materials removed from the MINING ACT definition of "minerals" for the conservation estate.

POLICIES

1. Access to basic raw materials from conservation estate will only be granted by the NPNCA where the road or facility is within the boundaries or road reserve enclaves in that reserve/park and where the use of that BRM provides access for the protection and management of the reserve/park and provided that a more environmentally acceptable alternative is not available.

2. Ensure the biophysical values of the estate are maintained by:
   * Siting pits only in areas that are adequately represented in the local conservation estate and with lowest biophysical values;
   * Siting pits in areas that are protectable from dieback disease introduction and spread;
   * Siting pits in low phytophthora dieback hazard vegetation.
   * Siting pits in areas that put minimal area downslope at risk of disease infection.

* Applying best practice management in accordance with the Departments dieback disease hygiene manual;
* Applying best practice rehabilitation.

3. Seek changes to the Local Government Act and the Public Works ACT to require the consent of the Minister for the Environment (CALM) and the NPNCA to access BRM on conservation estate.

4. When the material is for use on areas easements not managed by CALM ensure all biological survey (in particular priority/threatened flora} and dieback assessment and related costs are borne by the authority accessing the BRM.

5. Seek the removal of BRM's (sand, gravel and limestone) from the jurisdiction of the Mining Act on conservation estate.

6. Access by LG's to BRM's in the conservation estate will require the provision (by the LG) of rolling 3 year plans for all works that require resource from conservation estate plans to include evaluation of alternative resources, resource surveys, biological surveys, works programs. LG's must demonstrate the establishment of reserve funds for the proper environmental management and rehabilitation of pits. Access to BRM's for emergency works is subject to the Executive Director's and The Minister for the Environments consent.

STRATEGIES

1. See attached table.

STRATEGIES FOR SUPPLY OF BASIC RAW MATERIALS FROM NATIONAL PARKS, NATURE RESERVES, CONSERVATION PARKS

NOTE: "Park" denotes any of the above. "Calm Lease": means agreement document under relevant statute. "Agency" responsible for comprehensive rehabilitation.

PROPOSED USE	AGENCY	ACT	CALM LEASE	APPROVALS	EPA ASSESS	COMPEN-SATION	REMARKS
Park roads & facilities on same "Park" tenure	CALM or CALM agents	CALM ACT Secs 33, 56	NO	CALM District	NO	N/A	Evaluate resource from outside Park. Balance dieback risk, values and costs. Site in area of lowest biophysical value if in Park.

Road reserve enclaves within "Park" boundaries	LG
	
	GOVT
		Local Govt Sec 281
		
		or Public Works Sec 112
			YES
			
			YES
				Min Lands Min Envmnt NPNCA
				
				Min Works Min Envmnt NPNCA
					NPNCA refers if required
					
					NPNCA refers if required
						N/A
						
						N/A
							Source preferences:
							1: Old pits requiring clean up andrehabilitation
							2: External to Park
							3: Road reserve if impacts minimal. Supply from Park may be considered if:
							// External source presents dieback risk.
							// Park values are not compromised.
							// Road reserve mining respect to Park values.
							Proponent pays for all required assessments.

Private railway easements with-in "Parks"	Private	Mining Act or Land Act (excision)	NO	See Mining Act S24 NPNCA MIN ENV	If required	YES	
Excision for BRM reserve vested in LG or NPNCA	Proposing LG or Dept.	LANDS	NO, but conditions placed on vesting order	Min ENV NPNCA Parliament if "A" Class	Refer to EPA if required	YES	Land addition where appropriate. No alternative resource conclusively demonstrated. Minimal impact on biodiversity Choice of vesting in LG as "quarry reserve" or in NPNCA as Section 5g C cklass reserve for "cons & resource" purpose if control to be retained.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

POLICY STATEMENT NO 2
(Amended February 1993)

Local Government Authority Access to Basic Raw Materials from State Forest and Timber Reserves

This Policy Statement amends local government authority access to basic raw materials as provided in Policy Statement No 2, October 1989.

1. OBJECTIVE

To regulate the supply of basic raw materials (BRMs) to local government authorities (LGs) from State forest and timber reserves while ensuring minimal environmental damage, the replacement of values foregone and the rehabilitation of excavations.

2. BACKGROUND

The Departments of Conservation and Land Management (CALM) and Minerals and Energy (DOME) have an agreed strategy that allows the extraction of certain minerals from lands managed by CALM for agricultural, pastoral, household, road making and building uses. The allocation of BRMs (ie gravel, shale, sand, clay, limestone and rock) by the State to LGs is provided by CALM leases or mining tenements. The former applies where use of the material benefits CALM management programs. The latter applies where use of the material is for commercial purposes not associated with State forests.

Southwest LGs have not fully supported State arrangements requiring them to seek BRMs via the provisions of the Mining Act (1978) through mining tenements (or private property) where use is not associated with the CALM managed estate. Sections 97 of the CALM Act (1984) allows the granting of leases on State forest and timber reserves for purposes consistent with gazetted land uses and provides an alternative means of access.

A particular objection of LGs is that the cost of BRMs through the mining tenement process is significantly greater relative to CALM leases. For example a one hectare mining tenement yielding 10000 cu.m of material would cost up to $7500 per annum in land rent, survey fees and royalty charges. In addition the Mining Act requires tenement holders to spend a minimum of $5000 per annum in operating costs and CALM would seek compensation for lost forest values of approximately $3500 per hectare. Furthermore mining tenements holders are required to rehabilitate worked out excavations according to conditions associated with the mining tenement. Costs range between $5000 - $6000.

A review conducted jointly with LGs and SWDA has now obtained Cabinet approval for LG access to BRMs under CALM leases for uses not associated with State forest.

3. POLICIES

These policies are subject to the condition that where proposed BRM leases coincide with existing mining tenements as described by the Mining Act, the proponent shall receive written permission from the title holder before the lease is issued by CALM.

3.1 CALM will provide BRM leases on State forests and timber reserves to LGs for all uses including those not associated with the CALM managed estate provided no alternative resources are available. Material is not available for resale by LGs.

3.2 CALM will charge BRM royalties to replace forest values foregone.

3.3 CALM will require LGs to fully fund the rehabilitation of worked out BRM leases to State specifications.

4. STRATEGIES

To accomplish the objectives within the framework of the policies CALM will;

4.1 Provide BRMs to all LGs associated with State forests and timber reserves;

4.2 Be responsible for the siting and area demarcation of leases on State forests and timber reserves in consultation with LGs. Ensure that material extraction occurs at locations and in a manner that maintains both local and regional natural biophysical values;

4.3. Establish leases between 0.5 hectares (minimal) and 2 hectares (maximum) for periods not less than 12 months;

4.4 Estimate the volume of BRM resource with LGs;

4.5 Until June 1993 charge a BRM royalty of $1.00 per cu.m for uses not associated with the CALM managed estate. Initial establishment costs of $200.00 will apply for each lease. BRMs will be provided free of charge where the use of the material mutually and directly benefits CALM management programs;

4.6 Annually "phase-in" BRM royalty increases of $0.10 per cubic metre per annum to an amount of $1.50 per cubic metre per annum all indexed to the Perth Consumer Price Index;

4.7 Require LGs to pay royalties "up-front" based on a CALM/LG estimate of BRM volume for the maximum 2 hectare lease;

4.8 negotiate royalty adjustments with LGs where BRM volume estimates are more or les than 25 percent of the initial agreement;

4.9 Develop criteria that gives special consideration to royalty adjustments for small LGs or where BRMs are remote, small and/or scattered; and

4.10 Require rehabilitation subject to DOME's "Environmental Management of Quarries" (1991) and CALM's "Guidelines for Gravel Pit Rehabilitation" (1992). The work may be undertaken by the authorised contractors of LGs including CALM.

5. PROCEDURES

Procedures to implement the strategies are attached to the Policy Statement Summary.

Syd Shea
EXECUTIVE DIRECTOR

February 1993
Distribution: Lists A, B, D, E and L

Agency	Tenure	Mining Act Tene-ment	CALM Lease	Rebahil - itate Pits	Comp-ensation to CALM	Royalty DME	Royalty CALM	Approvals	Remarks
1. CALM	Use on CALM land	No	No	Yes	No	No	N/A	CALM District	
2. CALM agents authorised works	Use on CALM lands	No	No	Yes	No	No	N/A	CALM District	Directly benefiting means within 5 kms and servicing State forest or timber reserve.
3. Shires, MRWA or other author-ised agengies	Public roads on or directly benefiting State forest or timber reserve.	No	Yes	Yes	No	No	N/A	Executive Director	Where no alternative exists.
4. Shires, MRWA or other author-ised agencies	Local Government or Government works not within (3) above.	No	Yes	Yes	No	No	Yes	Executive Director	
5. Contractors	For use on other tenures or on private property	Yes	No	Yes	Yes	Yes	No	CALM would oppose mining tenements	
6. Private individuals - small lots	For use on private property	-	No	-	-	-	-	-	Obtain from contractors.

LOCAL GOVERNMENT AUTHORITY

ACCESS TO BASIC RAW MATERIALS FROM STATE FOREST AND TIMBER RESERVES

PROCEDURES

1. LG approached CALM for any BRM pit. If pit is on existing mining tenement LG needs written approval from the tittle holder before CALM proceeds. Responsibility for search and letter rests with LG.

2. LG pays $200 establishment charge to CALM District Office.

3. CALM officer and LG jointly:

   (a) select the site. Pits not to be located within environmentally sensitive locations or have significant impact on status of regional and local natural biophysical values;

   (b) demarcate the site clearly with pegs and blazes and calculate area. Note - minimum area 0.5ha, maximum area 2ha; and

   (c) estimate the volume. Need to probe or excavate pits. LBA to provide equipment and driver.

4. LG pays "up front" fee to CALM District Office, calculated on the volume estimated as follows.

to June 1993	-	$1 per cubic metre
to June 1994	-	$1.10 -CPI per cubic metre
to June 1995	-	$1.20 -CPI per cubic metre for 2 years
to June 1996	-	$1.30 -CPI per cubic metre for 3 years
to June 1997	-	$1.40 -CPI per cubic metre for 4 years
to June 1998	-	$1.50 -CPI per cubic metre for 5 years
to June 1999	-	June 1998 - CPI for 1 year etc

5. District Office advises SOHQ as follows :

   (a) Finance Branch - of $ received

   (b) Land Branch - to issue lease document.

6. Finance Branch deposits $ in a separate fund "Royalties from LG BRM leases"

7. Land Branch issues lease to LG. In lease document CALM guidelines for gravel pit rehabilitation (1992) is made a condition and attached to the lease document sent to the LG.

8. Royalty adjustments(if required) will only be made when a new lease or an extension to an existing lease is being negotiated with a district, eg

$ due to CALM		or any adjustment	)	
for renewal lease	+ or -	from previous	)	= $ paid by LG
(at new rate)		lease (at rate paid)	)	

9. It is preferable if leases for which charges are levied are kept physically separate from leases used for servicing State forests or within 5km of state forest.

10. Where a LG has an urgent need for limited quantities of BRM (SAY <1.000M3) this can be provided by :

    (a) issuing an excavation lease, or

    (b) from an existing CALM pit or LG lease;

    provided that an establishment fee of $200 for a new lease and the appropriate royalty per cubic metre are paid. These should be limited to a 3 month period.

11. Existing leases to LG for roads on State forest will continue to be renewed subject to District and Regional approval. In the renewal of the least CALM Guidelines for Gravel Pit Rehabilitation (1992) will be made a condition and attached to the least document sent to the LG. A $200 establishment fee and nominal rental ($10 per annum) will apply.

12. Excavation leases will continue as per Administrative Instruction 20. Rehabilitation will be as per CALM Guidelines (1992).

February 1993

Appendix 3

LEGISLATION RELATING TO ACCESS TO ROAD BUILDING RESOURCES

ACCESS TO LAND BY MAIN ROADS WESTERN AUSTRALIA TO REMOVE MATERIAL

LAND TENURE	LEGISLATION/POLICY AUTHORITY	COMMENTS
Freehold (Crown Grant or Conditional Purchase Lease)	Order in Council Gazetted 20/6/30	Main Roads has powers under Section 5(2)(C) of the Main Roads Act. 7 days notice of intention to enter is to be given to the owner or occupier. Nil Compensation is to be paid for materials removed.
Freehold	Land Act 1933 - Third Schedule	Main Roads has powers under the Main Roads Act. Nil Compensation is to be paid for materials removed.
Freehold	Local Government Act 1995 section 3.27 and Subdivision 3	Main Roads has powers under Section 16(1)(b) of the Main Roads Act to utilise the Local Government Act Written notice of intention to enter is not required, however a written notice of intention to open a fence (if applicable) is to be given to the owner or occupier. Compensation is payable for material taken.

LAND TENURE	LEGISLATION/POLICY AUTHORITY	COMMENTS
Freehold	Public Works Act Section 112	Main Roads has powers under Section 16(4) of the Main Roads Act. Written notice (7 days) of intention to enter, and the period of anticipated occupation is required. The owner of the land may, during the period of occupation give notice in writing to the Minister that they (owner) require compensation. Nil compensation is payable for material taken except when entitlement to claim is explicitly mentioned in the Grant.
Crown Reserves	Consent of Minister responsible is required under Public Works Act Section 112.	Class A reserves are excluded. Refer to Operations Group Circulars No 32 and 53.
Vacant Crown land, other than reserves ie unreserved.	Not needed	The Commissioner of Main Roads as a body corporate is an instrument of the Crown, and, as such requires no permission to enter or take materials from this land. As a matter of courtesy approval will be sought from the Department of Land Administration.
Crown Land	Local Government Act 1995 section 3.27 and Subdivision 3	Main Roads has powers under Section 16(1)(b) of the Main Roads Act to utilise the Local Government Act.
Pastoral Lease	Public Works Act Section 112 (See also Section 106(1) of the Land Act)	Main Roads has powers under section 16(4) of the Main Roads Act. Notice of intention to enter (7 days), together with anticipated period of occupation is required. In accordance with Section 113 of the Public Works Act and Section 105(1) of the Land Act, no compensation is payable for any material taken. However, a claim for compensation for any adverse effect on existing improvements will be considered.

LAND TENURE	LEGISLATION/POLICY AUTHORITY	COMMENTS
Freehold Land	Local Government Act 1995 Section 3.5	Extractive Industry Permit from Local Government is required, this could require MFP approval if a Town Planning Scheme is in place. May also require clearance by DEP or WC. Each permit is valid for one year only.
Crown Land	Mining Act	Full provision of the Mining Act.
Freehold Land	Local Government Act 1995 sections 3.22 and 3.27, Subdivision 3 and Schedule 3.2, item 3	A LG may enter land to take timber, earth, stone, sand or gravel that is required for LG works, although it is precluded from access to land that is developed or cultivated. On entering land, the LG is required to have the consent of the owner or occupier, or to have given a Notice of Entry. If the owner or occupier objects on receipt of a Notice of Entry, the LG cannot enter the land unless it secures a warrant for entry from a Justice. Subject to the owner or occupier requesting compensation, it is payable for both damage caused and for the value of material taken, except on pastoral or timber leases.
Crown Land	Local Government Act 1995, Part 3, Subdivision 3	A council may enter a Reserve with the approval of the Minister for Lands.

Appendix 4

CASE STUDIES

The information in the following case studies has been secured from interviews with representatives of the various LGs involved, supported in some instances by advice from regional staff of CALM, MRWA and Agriculture WA. While some of the information is factual, much of it is based on the opinions of the persons interviewed.

No judgements have been made on the validity or otherwise of these opinions, there being insufficient time during preparation of the Strategy to carry out field checks which might have permitted such judgements.

SHIRE OF WYNDHAM - EAST KIMBERLEY

The Shire of Wyndham - East Kimberley has offices in both Wyndham and Kununurra and has an area of 121,189 sq km. Horticultural and agricultural production on the Ord Irrigation Area, diamond and other mining activities, pastoral production and tourism are the principal industries.

The Shire manages 449 km of sealed road and 1,310 km of unsealed road.

Planning and Gravel Usage

Concepts of the nature and size of the gravel resource are influenced by the responsibilities which the Shire has for road maintenance and construction.

It has responsibility for town and Ord Irrigation Area roads, for station access roads, and for the Gibb River to Kalumburu road. It does not, however, have responsibility for the Duncan Highway, the Kununurra to Gibb River road or the Great Northern Highway. The Shire's principal concern is therefore to secure adequate gravel near the townships of Wyndham and Kununurra.

About 50,000 cubic metres of gravel are used each year on Shire roads. 20,000 cubic metres of this are used on shoulder work.

Gravel Supplies

The Shire has three pits near Kununurra and a contractor has a pit at Wyndham. These pits are considered to be adequate for foreseeable needs, and potential, though unproven, resources are judged to be more than sufficient for the future.

There are localised problems with gravel quality for shoulder work on sealed roads, with gravels eroding because they are sandy. The problem may be rectified by using gravels with a higher clay content, although these are slippery when wet.

There are no supply problems with the Gibb River to Kalumburu Road, there being sufficient material close to the road to meet the limited road building undertaken each year.

Access

Contractors commonly supply sub-base and base course material, as they can bring it to site with road trains more cheaply than the Shire can do with its smaller haulage equipment.

Alternatives and Modifications

Because of the plentiful supply of laterised material, it is not necessary to seek alternatives. Nor has it proved necessary to improve gravels, as materials with required properties can always be obtained. Road construction over the black soil plains of the Ord Irrigation Area does, however, present particular problems which require further investigation.

Environmental/Social Considerations

Aboriginal interests are protected by the Shire through checks on sites, but formal procedures are yet to be adopted.

Rehabilitation

Council does not have a specific policy on rehabilitation of gravel pits, although an informal approach has been developed by its Engineering Division. Cost of rehabilitation under this

approach is about $1.50 per cubic metre of material extracted.

SHIRE OF BROOME

The Shire of Broome has its offices in Broome and covers an area of 56,000 sq km. Principal industries are tourism, pearl shell and pearl production, fishing and pastoral production.

There are 108 km of sealed road and 700 km of unsealed road under the management of the Shire. There is declining emphasis on upgrading and maintenance of access roads and increasing emphasis on township roads.

Usage

Most gravel is used in the maintenance and construction of sealed roads in Broome itself, and on the road to Cape Leveque. Gravel is used sparingly, if at all, on other roads, depending on availability at the site.

Gravel Supplies

There are few resources of road-making material within easy reach of Shire roads, as most of the area is covered with a variable depth of Pindan sandplain. This has adversely affected the ability to build and maintain roads, other than at great expense, and has compelled road builders to develop alternative techniques.

Local gravel supplies are available near the townships at Coconut Wells and Crab Creek, but their plasticity is high. The Shire also has a pit at Lake Edar, 70 km from Broome, there are private pits south of Roebuck Plains Station, and there is a significant resource at Port Smith, 140 km south-west of Broome. Another source of gravel is found at Sandfire, but this is a too great a distance from Broome.

Locating Gravel

Attempts to locate additional resources using remote sensing have been partially successful, although the distance of materials from the roads where they are required means that they are of marginal benefit. Further comprehensive surveys of the available resources is desirable, adopting a range of techniques and employing diverse disciplines in the search.

Access

The long haul distance from gravel sources to site works makes employment of contractors almost mandatory, as Shire plant is inadequate for the task. Private contractors also have a greater capacity to search for gravel resources.

The Shire pays $21 per cubic metre for gravel delivered to site for town roads, and up to $30 per cubic metre for road base meeting set specifications. Road base is also obtained, at a price, from Pioneer Quarries which crush quartz and sedimentary rock.

Alternatives

The lack of conventional road building materials in the Shire may warrant a change in attitude to what are considered appropriate materials. Novel approaches similar to the use of Pindan or sandplain sand in the Pilbara might have to be seriously considered.

Geological evidence suggests that alternative road making materials might be found under the veneer of Pindan near Broome. Clearing of overburden to use this supply may, however, be beyond the resources of the Shire. Concern has also been expressed about the potential for suspended silica dust resulting from processing of these materials should they be used for road making.

The bed of the Fitzroy River between Broome and Derby could also be a potential source of alternative road building materials, but it has never been investigated thoroughly.

Modifications are another approach which has been tried. These included cement stabilisation and matting, but both proved unsuccessful.

Environmental/Social Considerations

The Shire has identified a need to confer with Aborigines about Aboriginal land, as there is a concern that the limited resource may be tied up by land claims.

Rehabilitation

Council has supported a program of rehabilitation for pits following DME guidelines.

SHIRE OF ROEBOURNE

The Shire of Roebourne has its headquarters at Karratha and is 15,196 sq km in area. It contains the historically noteworthy towns of Roebourne, Whim Creek and Cossack, as well as Port Samson, and the newer townships of Dampier, Karratha and Wickham.

There are 178 km of sealed road and 400 km of unsealed road under the management of the Shire. Sealed roads within the principal towns are a significant component of the road network.

Planning and Gravel Usage

There is commonly at least 12 months lead time in planning of road upgrading and maintenance. Associated with this, the Shire determines gravel requirements on something of an ad hoc basis, obtaining supplies as projects demand.

The annual demand is for about 20,000 cubic metres of material which is used on about 17 km of road. A large proportion of this is for upgrading of the Wittenoom - Roebourne road, with the remainder used in Shire townships and on recreation and tourist roads.

An apparent lack of concern over planning for gravel supplies may stem from the limited length of unsealed road which is upgraded as Special Purpose Grants permit. The existence of supplies close to Shire townships and which are estimated to be sufficient for the next 15 years may also be a factor. The Shire Council has not implemented the Sand and Gravel Resource Development Plan prepared by DME for the Karratha area in 1989,

Gravel Supplies

For maintaining the road network through pastoral areas of the Shire, gravel resources are generally expected to be locally available, although this will not always be the case. For townships, existing supplies are considered sufficient for the foreseeable future, but may not suffice in the long term.

The gravels which are being used are very plastic, with Plasticity Indices of 18-25. Their use on roads therefore presents some problems. Notwithstanding this shortcoming, there is only limited recourse to materials testing, and it is never carried out on materials used for improvement of unsealed roads.

Locating Gravel

The townships are supplied from existing pits, and there is no immediate concern to identify additional sources for these locations. It is, however, common practice for the gravel on urban roads to be recycled and cement-stabilised before resealing, suggesting that there may be a potential shortage of gravel supplies around the towns.

Where gravel is required for new roads or for upgrading unsealed roads (eg. the Roebourne - Wittenoom Road), the road gang foreman identifies sources immediately ahead of the road construction plant, seeking it as near as possible to the road reserve.

This approach is considered unsatisfactory, but the Shire does not have the staff, the expertise or the funds to divert to the search for gravel sources. This suggests it will require assistance in locating new supplies when current resources are exhausted.

Access

Gravel supplies are secured from seven private and eight Council pits, while road base for urban roads is obtained from Readymix. Access to gravel presents no problems in pastoral areas, and there is co-operation between the Shire and MRWA at the field level in the use of the resource.

NPNCA Policy Document No 2 applies to winning of gravel for road making within National Parks and Nature Reserves. In this respect, CALM has developed an Interagency Agreement on Roading Issues with the Shire of Ashburton, to facilitate maintenance, by that Shire, of roads through two National Parks for which it has responsibility. Agreement covers aspects of road making and repair, including management and rehabilitation of gravel pits, rehabilitation of closed roads, and movement of vehicles used in road making. It also provides general recommendations on road dimensions and construction techniques. There is no indication that the Shire of Roebourne will follow the same path.

Alternatives

Alternatives to gravel are not generally considered, apart from 200-300 cubic metres of prepared road base which is purchased annually from Readymix at Karratha.

Environmental/ Social Considerations

No conflicts have arisen to date between the Shire and Aboriginal interests. There are strong Aboriginal interests in sand leases at Nickol Bay which may create tension and unrest between the respective parties.

Rehabilitation

There is no policy on rehabilitation of gravel pits in the Shire, although advice has been sought from MRWA on appropriate rehabilitation techniques. As a general rule, abandoned pits are shaped and ripped using a bulldozer, and are then left to revegetate naturally. The cost of this operation is minimal. It is unlikely that this cursory treatment will be effective since it doesn't provide adequately for protection from grazing, for the residing of perennials, for progressive rehabilitation, for the replacement top soil or adequate erosion control measures.

SHIRE OF MINGENEW

The Shire of Mingenew comprises 1,927 sq km, with Mingenew the principal town and farming the main industry. There are 183 km of sealed roads and 477 km of unsealed roads under Shire management.

Planning and Gravel Usage

Council does not have a long term gravel supply strategy, but is moving to develop one, as recognised supplies of gravel are diminishing. An acquisition policy has also been adopted and is discussed below. About 25,000 cubic metres of gravel are used each year, with most required for sheeting and shoulder work. Little is used for road base.

Gravel Supplies

Outcropping lateritic gravels and gravels beneath the sandplain are the principal resource. Certain parts of the Shire are better supplied than others, with sections of the Mingenew to Mullewa Road being badly served.

As the Shire area is small, there are no long leads from sources to road operations.

With respect to quality of the materials, Yandanooka Shale has proved sound, but some lateritic materials used recently have failed. In consequence, the Shire is now committed to testing road building materials.

Locating Gravel

Landholders tend to obstruct the search for gravel, sometimes misdirecting Shire officers. MRWA has not been approached for assistance.

Private Land

Mingenew is a small Shire with generally good road making resources, but most are within freehold land. Council is now encountering a problem of access to this land and apparent conflicts of interest which face councillors in this respect.

In this light, the Shire would like to see the Local Government Act make more explicit the rights of councils to enter private land to extract road-making materials. They would also like it to set out clearly the basis for compensation and the rehabilitation guarantees to be given.

Although the Local Government Act presently provides powers in respect of access to private land, Council has been unwilling to exert these powers. At the same time, it has not developed any formal access strategy. Rather, access is treated in an ad hoc fashion, with councillors and Shire officers increasingly negotiating with landholders as greater quantities of gravel are obtained from freehold land.

Compensation in kind is provided, with a scale of compensation ranging from 30 cents to 50 cents per metre, depending on the quality of the gravel. The total payment calculated for each pit is applied to the operating costs of Shire equipment which then carries out work for the landholder to that value.

There is, nonetheless, a reluctance amongst landholders to permit access to their land for gravel extraction. The primary reason for this reluctance is believed to be the poor record of rehabilitation. This can be changed only if rehabilitation is shown to be effective and aesthetically pleasing. Landholders also need to be assured that completion criteria set at the beginning of a rehabilitation program will be met.

Private Contractors

Use of private contractors to secure gravel has not been considered because of perceived adverse social effects: council wishes to retain a centre of population at Mingenew and employs a local workforce, whereas contractors may not. A contingency sum for the use of contractors is, nonetheless, allowed in the annual budget, as Shire equipment is inadequate for the task of extracting the last of the resource in pits, and to re-contour for rehabilitation.

CALM Estate

Aside from entering private land, Council has sought access to Nature Reserves in the past but has been refused. It was advised that removal of gravel from reserves would be difficult to support if there were not a prior comprehensive search for materials on all land in the Shire.

The question of such access is dealt with by CALM. This agency has only recently exerted an impact upon authorities and individuals in the Mid-West, as it has fewer resources here than in the South-West. As a consequence, specific protocols and policies relating to extraction of gravel and for rehabilitation of pits in the region have not yet been developed.

Alternatives

Alternative materials could include shales found near Yandanooka, a hamlet south of Mingenew. These and other alternatives have not, however, been investigated as there is no perceived need for them at this stage.

The Shire is aware that materials modifications could be used to good effect in some circumstances, but considers they are likely to prove too costly, although no analysis of costs has been undertaken. It would prefer to devote its efforts to seeking good quality gravel.

Rehabilitation

Council has developed its own policies and guidelines for pit management and rehabilitation, embracing overburden management, pit reshaping, ripping and revegetation.

It is particularly concerned that rehabilitation should proceed in parallel with the development of each pit, and has found such progressive rehabilitation to be comparatively cheap. On the other hand, if rehabilitation is left until pit closure, it is considered to add 25 percent to the cost of same.

SHIRE OF CARNAMAH

Carnamah Shire covers an area of 2,834 square km. Its headquarters is in Carnamah, with Eneabba the only other town.

The Shire has responsibility for 62 km of unformed road, 117 km of formed road, 294 km of gravel road and 315 km of sealed road.

Major industries are sheep, wheat and cattle farming, crayfishing, mineral sands mining and natural gas production.

Planning and Gravel Usage

Road maintenance and upgrading has been carried out primarily on a needs basis, although there is a long-term program for resealing and seal widening.

The Shire's strategy for obtaining gravel, marl and limestone is to secure a number of locations to which it has long term, unrestricted access. Such access would overcome problems it encounters in securing gravel from private land where restrictive conditions are commonly imposed by the landowner.

The Shire uses between 25,000 and 35,000 cubic metres of gravel per annum for maintenance and upgrading of 20-25 km of road.

In the eastern and central portions of the Shire, where gravel is to be found, average haul distances for the material are 12-15 km, but can be as much as 22 km. In the west, where there is no gravel, it is hauled up to 60 km to the coast road. Here it is used in conjunction with marl for binding, as the former is water-sensitive.

Quality of gravel presents some problems, with the Shire progressively widening the seals on its bitumen roads because of a decline in quality of gravel for shoulder maintenance.

Gravel Supplies

In the east there are pockets of good gravel, but the supply is limited and scattered, and the general picture is one of declining quality of material. Moving westwards there is a sandplain area with no gravel, while beyond this there are gravel ridges with material of limited depth. From Tathra National Park to Eneabba gravel is again in scattered pockets of shallow deposits. West of the Brand Highway there is little gravel. Towards the coast, in Beekeepers' Reserve, there is capstone which is too hard to crush and is too sharp when crushed. Marl found here is, however, suitable for road construction.

Road building materials are not generally tested for quality, although marl has been tested in the past.

Locating Gravel

The gravel resource is located by the Works Supervisor based on his knowledge of the Shire and of the location of old pits. Assistance in identifying its location is provided by some farmers.

Access and Compensation

Gravel is secured almost entirely from private land. Access to such land has been facilitated since the Shire commenced rehabilitating pits several years ago, at a time when the MRWA was offering grants to assist pit rehabilitation. The principle of rehabilitating was subsequently formalised by council two years ago.

The difficulty remains that access to private land commonly has various restrictive conditions. These include such stipulations as the portion of the farm to which access is permitted, where the gravel can be used, and the period for which a pit may be left open. Up to the present time, the Shire has been loathe to force the issue on access conditions and has not yet insisted on access where farmers deny it.

In securing access, the Works Supervisor approaches the landholder personally. In a few instances he is then assisted by the farmer in locating gravel. Pits are commonly excavated on paddock areas that have already been cleared, with the landholders compensated, receiving 10 cents per cu metre of material removed, usually by payment in kind.

On the coast the Shire is negotiating with CALM for access to marl pits in Beekeepers' Reserve. CALM has been amenable to permitting such access where the land is degraded, but requires a management plan which incorporates rehabilitation criteria.

Alternatives and Modifications

Large rocks that might be crushed are left in numerous pits. Crushing has not been undertaken, however, because quantities of rock are considered insufficient to warrant mobilising a crusher. The Shire nonetheless acknowledges that there has not been a cost comparison of crushing versus hauling gravel over increasing distances.

At the same time, the recent acquisition of a combination roller is permitting use of some larger rocks which this roller will crush.

No use has been made of materials modifications to improve the performance of lower quality gravels, owing to doubts about their cost-effectiveness. There is also a problem in applying materials modifications because of a lack of water to permit mixing and water binding.

In the east of the Shire, there are a number of roads employing no introduced surface materials. These are found where the intensity of road usage and the nature of in-situ materials are such that the cost of importing gravel is not justified.

Environmental/Social Considerations

Whilst the Shire has not had to adopt dieback hygiene practices in the past, if it obtains marl from Beekeepers' Reserve it expects to be subject to dieback hygiene requirements.

There has been access in the past to gravel within road reserves, with associated clearing of remnant vegetation. This practice is now rare.

Rehabilitation

Adoption of rehabilitation practices in recent years has improved farmer acceptance of access to gravel on their land. The practice has been extended to include old pits left as scars in the landscape, as well as being applied to current pits as they are worked out. The Shire proposes to prepare a register of these old pits as a basis for planning their progressive rehabilitation over future years.

Rehabilitation techniques have been developed using published guidelines. They involve deep ripping and topsoiling by the Shire, with the landowner then supplied with seed and fertiliser. In scrub areas, cleared vegetation is also spread with the topsoil, acting as a seed source and a surface mulch. Where pits are open for more than one year, the Shire aims to undertake progressive rehabilitation so that large areas are not left open for extended periods.

Technical Expertise

About 50% of the Shire Clerk's time and 90% of the Works Supervisor's time are devoted to road-related matters. They perceive there would be benefit in having access to the time and expertise of an engineer, to assist primarily in planning for road development and upgrading using the latest available technical methods.

Information Sharing

The Shire is party to information sharing through an annual Mid-West Supervisors' conference discussed below.

MID-WEST GENERAL

Access to CALM Estate and Private Land

The recent arrival of CALM in the region and imposition of its policies for protection of Nature Reserves and National Parks has caused tension between it and some councils which had previously enjoyed unconstrained access to reserves for gravel supplies. Transfer of those areas to the CALM estate has required these councils to reappraise their attitudes to, and their use of, road-making materials.

CALM has no specific concerns in the Mingenew Shire. There are, however, significant supply problems and tensions elsewhere. CALM's view is that, with regard to access for road making materials, its estate should be treated with the same integrity as private land. CALM feels its land should not be regarded as being more readily accessible than freehold land. A consequence is that some councils must bear the added cost imposed by longer haul distances.

If the environment of National Parks and Nature Reserves is to be protected.

CALM believes that any search for road-making materials should be comprehensive, embracing all land. It considers there should be a statement of government policy making clear a commitment to protect the remnants of the natural environment. Such a statement should in turn lead to legislative changes clarifying the rights of Shires to obtain road-making materials from private land.

Rehabilitation Manual

At a regional level, there needs to be a more comprehensive manual for rehabilitation of gravel pits, suited to the specific problems of the Mid-West Region. While existing guidelines are satisfactory as a general statement of objectives, they are deficient in outlining practices which might be more efficiently employed in the Mid-West.

Information Sharing

An annual conference of Works Supervisors and Leading Hands is held by Mid-West Shires to facilitate information exchange. The conference is attended also by guest speakers from industry to explain and promote their products and machinery.

18 Mid-West councils presently participate in what is proving to be a fruitful avenue for exchanging ideas and learning new techniques. Furthermore, two delegates from the group attend the Local Government Works Supervisors conference in Perth each year for further information exchange and communication back to the group as a whole.

SHIRE OF MOORA

Moora Shire covers an area of 3,788 square km. Its headquarters is in Moora, with other towns including Miling, Watheroo, Bindi Bindi and Coomberdale.

The Shire has responsibility for 350 km of sealed road, 427 km of gravel road, 269 km of formed road and 254 km of unformed road.

Major industries are wheat and livestock farming. Wildflower farming also occurs, and there is a quartz mine north of Moora supplying the Simcoa Silicon Smelter at Bunbury.

Planning and Gravel Usage

The Shire does not have long term road plans, with changes in Councillors sometimes seeing changes in views on priorities and issues. Thus road maintenance and construction tends to be responsive to councillor and ratepayer pressure, as well as reflecting changes in traffic patterns on different roads, rather than being based on long term planning perspectives.

Gravel to meet road needs is drawn from a scarce resource which is particularly sparse around townships and in the centre of the Shire. Between 60,000 and 100,000 cubic metres are used each year on about 30 km of road.

The material is hauled a distance which is generally 7 to 8 km, though in some cases it is up to 15 km. This compares with haul distances in the past, when the resource was more readily available, of no more than 3 or 4 km.

Gravel Supplies

Lateritic gravels are found in the far north and the east, but are sparse in the centre and around townships. Even in areas where it has been found in the past, the better quality material has generally been exhausted, with most pits worked out.

As the better quality material has been exhausted, there has been increasing recourse to poorer material, to recycling of old material, or, in some cases, to delays in road works. With quality becoming more marginal, the Shire perceives it may require laboratory testing - something which has not been undertaken in the past.

Locating Gravel

When the Works Supervisor first arrived in Moora, he scoured the countryside to locate gravel. He now develops new pits based on the knowledge gained in this manner and augmented over subsequent years. Farmers are also perceived as a good source of this knowledge, but they do not generally volunteer information on location of gravel.

Access

The majority of gravel is secured from cleared paddocks on private land. In securing access to this land, the Works Supervisor approaches landowners himself and negotiates with them.

His knowledge of the area and of many of the landholders assists in this respect. The Shire President also makes a point of acknowledging in his annual report those landowners who have afforded access to gravel.

The Shire does not offer landholders cash for gravel removed, but offers recompense through assistance in kind. While most landholders permit access, the assistance they negotiate under this compensation policy varies widely. Those who refuse access are probably influenced in their attitude by the lack of rehabilitation of pits in the past.

Once access to a landholding has been negotiated and a pit has been opened, it is likely to remain operational for several years, as the Shire finds it easier to reactivate established pits than to open new ones. The pits are not fenced, so that farmers can continue to graze them while they are active.

The Shire has had the experience of competing with MRWA for scarce gravel resources in some localities where the two have operated adjacent pits. In this circumstance, the local farmers are generally more receptive to Shire approaches than to MRWA, being unhappy with what they may perceive as a dictatorial approach by the latter, this perception being reinforced, it appears, by the MRWA Notice of Entry.

There is also a perception amongst some farmers that MRWA, because they compensate for lost production, are inclined to enter paddocks with less concern than the Shire and consequently cause more damage.

Alternatives and Modifications

As the gravel resource has been progressively exhausted there has been increasing recourse to recycling of older materials and to use of poorer quality gravels.

The Shire is also crushing an increasing amounts of larger sized gravel since it purchased a vibrating roller which crushes larger material as it rolls the road surface. This crushing capacity will permit a return to a small number of old pits to obtain additional resource.

Looking to the future, there is the likelihood of increasing use of poorer quality materials, adopting appropriate modifications to achieve a satisfactory result. The Shire is, however, waiting to learn from the experience of other councils rather than conducting its own trials. It is also monitoring MRWA experience before embarking on any significant use of modifications. Its hesitancy stems from its limited income, which restricts funding that might be spent on trials.

There has, however, been some field use of cement stabilisation on floodways in salt affected terrain where the road surface has failed under heavy loads. This failure may be aggravated by the emergence of salinity, with the salt possibly softening the gravel.

Environmental/Social Considerations

Gravel pits on private land are on cleared ground, but gravel is also sometimes secured from road reserves where remnant vegetation must be cleared.

Environmental assessment has been carried out for certain road widening activities, assessing the likely occurrence of rare flora and, with local input, the likely presence of Aboriginal sites.

Rehabilitation

Pits are commonly kept open until all gravel has been exhausted. They are then rehabilitated by breaking down their embankments, returning topsoil and scarifying with grader tynes. The farmer re-sows them, but productivity is rarely as good as it was originally.

In developing its rehabilitation techniques, the Shire has drawn upon guidelines developed by MRWA.

Technical Support

The Shire has, in the past, secured technical information from MRWA, but this is declining as that organisation's services become more scarce. For specific problems, the Shire approaches private companies marketing materials which might address those problems.

The Works Supervisor, who spends about 50% of his time on road related matters, believes there is insufficient exchange of information with other councils and perceives benefit in workshops for field operators such as MRWA conducted in the past.

SHIRE OF DANDARAGAN

Dandaragan Shire covers an area of 6,934 square km. Its headquarters is in Dandaragan, with other townsites including Badgingarra, Jurien, Cervantes and Regans Ford.

The Shire has responsibility for 388 km of sealed road and 1,040 km of unsealed road.

Major industries are wheat and sheep farming, wildflower production, sand mining and crayfishing.

Planning and Gravel Usage

Road upgrading and maintenance is planned on a year to year basis, although there is a 15-year strategy for sealed roads. A set of priorities has also been established for townsite street upgrading, with this involving seal widening, drainage, kerbing and resealing to meet a drainage backlog in the Shire's townsites.

The annual road maintenance program for rural roads is based on the recommendations of the Works Supervisor, requests from ratepayers, and the findings of four inspections carried out through the year by councillors.

As soon as the annual program has been set, the Works Supervisor seeks gravel from local landholders. Where this is not possible, the required gravel is secured from the road reserves.

The Shire uses between 95,000 and 110,000 cubic metres of gravel per annum to treat 80-90 km of road. In addition, marl is used as base material on coast roads, with a gravel surface placed over it.

Gravel Supplies

In the eastern two-thirds of the Shire there are believed to be plentiful supplies of lateritic gravel overlain by duricrust. In the west, limestone is available but it is of poor quality. Access to both is restricted by CALM estate which occupies more than one-third of the Shire.

Marl has been found only in Cervantes where it is obtained from the Shire's rubbish tip reserve, although its excavation was initially complicated by existence of an overlying mineral tenement. This source is almost exhausted and the Shire faces a problem in locating alternative sources of marl. In the Jurien area, low grade limestone is used.

Locating Gravel

Gravel sources within road reserves account for about 80% of the gravel excavated in the Shire. The works supervisor locates sites by ground reconnaissance and through the location of old pits, followed by backhoe testing.

The Shire is, however, concerned at a lack of information to assist it in identifying new gravel sources. Available knowledge on likely locations, particularly on cleared private land, is restricted, and there appears to be no one who can provide competent guidance to location of the resource.

The same problem arises in identifying marl resources, with no known vegetation, soils or other characteristics that can pinpoint likely sources.

With respect to quality of gravel, the Shire used to draw upon MRWA's Moora office to test samples, but with the closure of this office they now rarely have materials tested, unless they are undertaking contract works. In this case they use commercial testing services.

CALM Estate and VCL

Access to gravel in Reserve 35593, adjacent to the Mt Leseuer National Park, was a previous point of contention with the Shire. The particular reserve contains an extensive gravel resource of limited depth. It was used for many years by the Shire until it was proposed for inclusion into the National Park.

At the time the Shire indicated that continued use of gravel from the reserve was critical to its needs, regarding it as the only significant resource available for servicing Jurien township, Cockleshell Gully Road, and the surrounding road network.

The previous Government determined that the Shire's access to the reserve would be terminated and that it would be included in the National Park. They were given three years' notice to locate alternative sources.

With the change in Government, this arrangement was altered, with the area designated a 5g reserve under the CALM Act and the Shire given a 21-year lease. This relieved the urgency of finding alternative sources on surrounding private land, where there is little information to indicate location of gravel, where the Shire perceives the best gravel has already been removed anyway, and where much of the remaining resource has been earmarked by MRWA for use on the Jurien-Greenhead Road.

The agreement of Government on continued access to Reserve 35593 was assisted by the fact that vegetation in this particular area is not as important as in other areas of the National Park. It was also an advantage that drainage from the reserve is away from the park, reducing the risk of dieback introduction.

Stemming from this experience, the Shire has raised a concern about the lack of security local government enjoys over gravel resources - a lack which, in its case, saw it almost lose access to the important source in Reserve 35593.

The Shire has also taken marl from pits provided by CALM within the Nambung National Park, but this was specifically for use on a road within that park which was upgraded by council under contract to CALM.

In the east, the Shire has negotiated continued access to two pits on Vacant Crown Land on the northern edge of Watheroo National Park. CALM agreed to exclude these from the park until the pits are exhausted, when they will be rehabilitated and the areas will be absorbed into the park.

CALM also agreed not to include one gravel reserves in Badgingarra National Park until the gravel within it is exhausted.

Private Land

In the east, gravel from private land accounts for about 20% of Shire supplies. In seeking access to such land the Shire offers compensation in kind rather than in cash. Landowners are approached by the Works Supervisor who negotiates an agreement with them beforehand.

In about 50% of cases the farmers reject this approach outright or seek excessive compensation. In these circumstances the Shire does not pursue the matter.

Where access is obtained, pits are generally open for no more than 12 months. If they wished to keep a pit open for a longer period, the Shire would first reach agreement with the landholder involved.

While landholder attitudes to gravel extraction have improved since rehabilitation was commenced, there is still considerable opposition based on perceptions of past actions, when pits were left as scars in the landscape. To remedy this situation, they need to be convinced that land can be farmed again within 12 months of pit closure and rehabilitation. Councillors themselves, and possibly LCDCs, may be an avenue for changing attitudes in this respect, to permit more ready access than presently obtains.

Road Reserves

The balance of gravel in the east comes from within road reserves and from old gravel reserves, although the latter are only a minor component.

Access to pits in road reserves has been brought about by council's ownership of a scraper which can rapidly excavate gravel from a pit and deposit it on the adjoining road.

The preferred distance for gravel haulage by this scraper is less than 1 km. Consequently a proliferation of road reserve pits has been created by the scraper over the years. These pits are generally open for no more than a year, although some may be re-activated up to 10 years later, when resurfacing of the adjacent road occurs.

MRWA Pits

There has been some cooperation between the Shire and MRWA in obtaining gravel. The latter handed one of its former gravel reserves to council - the one mentioned earlier which was excluded from Badgingarra National Park. Council has also allowed access by MRWA to some of its pits.

Alternatives and Modifications

In some areas of short supply or poor quality material, the Shire has used a sand-gravel mix to overcome problems associated with gravel that is too clayey. They have not, however, used modifications, as they believe them to be too costly and, because of cost, have been unable to test their durability.

They are aware of research done by MRWA on stabilising limestone, but have not attempted this themselves. MRWA investigations indicate that it is cheaper to cart gravel up to 50 km to coastal roads in this locality to lay it over a limestone base, rather than stabilise the limestone.

In eastern areas of the Shire, duricrust overlying lateritic gravel is being crushed by dozer and vibrating roller for use where the gravel itself is scarce.

Environmental/Social Considerations

Where it is winning gravel from road reserves, the Shire takes account of plans provided by CALM indicating where rare plants have been found. It avoids opening pits in these areas.

For areas vested in council as gravel reserves, DOLA requires rare flora and fauna assessment and dieback appraisal.

The Shire has also had an environmental consultant prepare a program for dieback management. This includes such aspects as identifying present distribution of the disease and priority areas for protection, and good planning and management of pits.

The pit planning procedures embrace

- paying attention to good drainage and appropriately located access;
- isolating clean pits from those which are diseased, and using only clean machinery in the former;
- avoiding introduction to clean pits of potentially infected spoil or rubbish; and
- planning rehabilitation to ensure good drainage and no ponding on the former pit site.

Rehabilitation

The Shire has been rehabilitating both old and current pits for six years. With the multitude of pits opened over the years within road reserves, there is an enormous backlog of the former to be rehabilitated.

The rehabilitation program has been developed with assistance from DME rehabilitation guidelines and from an environmental consultant engaged by the Shire. It entails return of overburden or topsoil, deep ripping and, where the pit is within remnant vegetation, spreading of the scrub cleared at the start of the extraction operation.

Technical Support

The Shire Clerk spends about 25% of his time on road issues, while the Works Supervisor spends the majority of his time on roads.

Council used to have an engineer working in this sphere, but they he was not replaced when he left the area. There would, however, be evident benefit in having the additional staff time and expertise which an engineer could offer.

There appears to be limited information exchange on technical issues related to roads between Shire personnel and others, with such exchange as does occur being mainly by personal contact over the phone. Benefit was seen in the possibility of regional workshops, such as the Mid-West councils run, to improve the situation.

SHIRE OF GINGIN

Gingin Shire covers an area of 3,325 square km. Its headquarters is in Gingin, with other towns including Guilderton, Seabird, Ledge Point and Lancelin.

The Shire has responsibility for 335 km of sealed road and 440 km of unsealed road.

Major industries are farming and grazing, with an increasing presence of orchards and market gardens. On the coast, fishing and crayfishing are significant.

Planning and Gravel Usage

The Shire has not had formal long term road maintenance and upgrading plans in the past, but it is now commencing to develop a 5-year road plan.

It secures adequate gravel in the east and limestone and marl in the west to meet its road maintenance and upgrading needs. These resources come from private land, Vacant Crown Land and CALM managed estate. The Shire is proactive in negotiating access to the first but experiences some difficulties in securing access to CALM managed estate.

The Shire consumes about 25,000 cubic metres of gravel annually which it uses on 20 km of road. Limestone and marl use are additional to this.

The limestone by itself is not satisfactory and requires addition of gravel. This sees the latter hauled up to 30 km for use on coastal roads, although median haul distances are nearer to 10 km.

Gravel Supplies

East of the Brand Highway there are adequate supplies of gravel, although access is constrained in some areas by National Parks, Nature Reserves and State Forest, and along the Darling Scarp only isolated pockets are to be found.

West of the highway, towards the coast, gravel does not occur and limestone and marl are substituted for road base. State Forest affects the availability of these resources.

Locating Gravel

The knowledge of council staff who are familiar with the local area is the basis on which new gravel sources are identified. This knowledge is complemented in some cases by that of farmers.

CALM Estate

There are extensive areas of National Park, Nature Reserve and State Forest within the Shire which constrain access to limestone and gravel resources. Notable amongst these is the Boonanarring Reserve towards the centre of the Shire which contains the most useful gravel in that particular area.

The Shire has been permitted continuing access to two gravel pits in the north of this reserve which it had been using prior to vesting of the area in CALM. This access is subject to a management plan agreed with CALM, but no royalties are payable.

The Shire believes the potential life of these two northern pits is limited. Consequently they are seeking excision of additional pits in the south of the reserve and have asked for that they be rezoned for "public purposes". This matter has been the subject of negotiation over several years and is yet to be resolved.

To the west, the Shire has a CALM lease in State Forest over a limestone pit which it acquired from MRWA. Extraction of the limestone is subject to a management plan agreed with CALM. This plan primarily covers rehabilitation requirements.

The lease is renewable every 12 months and will presumably continue to operate while the Shire abides by the requirements of the management plan.

Private Land

Outside the CALM estate, the Shire negotiates access to private farmland on which it develops gravel pits and marl quarries that are usually open for several years.

In some of these cases it purchases gravel from the landowners, negotiating payment in cash or in kind for a predetermined quantity. Cash payments are usually equivalent to about $1 per cubic metre of gravel removed.

In other cases the Shire may purchase land that contains gravel, marl or limestone, securing either that part of the holding which contains the resource or, in one case, purchasing the entire holding. Where such land purchase occurs, the former landowner may be allowed continuing access to the area at no charge, or it may be leased back to the landowner or to someone else for depasturing of livestock.

Access to private land under these arrangements has not presented significant difficulties in the past. However, farmer resistance is now appearing, particularly where some perceive gravel as becoming scarce - and thus increasing in value.

Joint Pits

The Shire and MRWA occasionally use each others pits, a practice which does not appear to present any problems.

Alternatives and Modifications

As mentioned above, on the coast limestone and marl are used instead of gravel for road base, although they still require addition of a gravel surface to be satisfactory.

On minor roads where gravel is scarce, clay is sometimes mixed with sand to provide a running surface.

The Shire has considered the possibility of using a rock crusher to secure gravel from duricrust. In this context they are already returning to some earlier gravel and limestone pits to crush remnant coarse material with a bulldozer.

The Shire has also experimented with modifications but has not used them on a large scale.

Environmental/Social Considerations

The Shire was required to do dieback and rare flora assessments prior to obtaining gravel from the two pits in the Boonanarring Reserve.

Rehabilitation

In the past the Shire did not rehabilitate gravel pits, but it is now doing so. This includes work on old pits, battering the sides, spreading any topsoil or overburden which may remain, and ripping.

The approach to rehabilitation of pits on private land has been developed based on local knowledge of techniques. There is, however, recognition that Shire officers will have to improve their knowledge in this sphere, probably using published rehabilitation guidelines.

Rehabilitation on the CALM estate is to that organisation's requirements as reflected in their management plans. It includes ripping, topsoiling and spreading of brush as a source of native seeds.

Technical Support

Gingin Shire works well with MRWA, drawing on technical advice from their Northam Office when required.

The Shire Clerk has responsibility for engineering matters and spends about half his time on road-related issues. There would, however, be benefit in using engineering expertise, and the Shire is considering the possibility of engaging a contract engineer on road design. Nonetheless, past performance in this sphere has been satisfactory, due largely to the experience of the local works team.

SHIRE OF KELLERBERRIN

The Shire of Kellerberrin occupies 1,852 square km, with its headquarters in Kellerberrin. It includes the townsites of Doodlakine and Baandee.

The Shire has responsibility for 808 km of roads, primarily serving cereal cropping and sheep farming enterprises which are its major industries.

Planning and Gravel Usage

The Shire does not have a long term plan for road maintenance or development. The Shire Clerk, however, sees this as the next step to improve their approach, developing rolling medium to long term plans.

There is generally adequate gravel within the Shire to meet needs of road maintenance and upgrading. It is obtained through a network of longer term pits which provide adequate cover of the area, with 5,000 cubic metres used each year to treat about 6 km of road. Maximum haul distance from these pits to works areas is 15 km, that being to Kellerberrin where the resource is most scarce.

Gravel Supplies

There is moderate to good potential for lateritic gravel throughout the Shire, with scarcity only through a salt lake chain in the south.

With the widespread nature and good quality of the resource, some recycling of material with modifications, and success in reworking older pits, there has been no necessity to open new pits in recent years.

The reworking of old pits has involved use of larger equipment which can win deeper material than the smaller equipment used in the past.

Locating Gravel

When a new gravel source is required, knowledge of Shire personnel complemented by farmers' knowledge of their land is the primary source of information for locating the resource.

Access

Gravel is obtained entirely from cleared private land, with no necessity to enter areas of remnant bushland. A professional approach, the widespread distribution of gravel, benefits landholders perceive they enjoy from road maintenance, and possibly the compensation which is offered contribute to the success of the Shire in securing this access.

The Shire never compels landholders to permit entry, finding sufficient material without having to force the issue. They establish agreements with landholders which involve purchase of the material at 50 cents per cubic metre or purchase of the land containing the gravel.

In the latter case, council determines what they consider a fair price, but if the landholder objects they do not pursue the matter. After the gravel has been removed, the land is returned to the original owner.

Whilst the above compensation is comparatively generous, most payments to individual farmers amount to only a few hundred dollars per annum, as only modest quantities of gravel are removed.

Those who object to the Shire entering their land generally do so because they are unhappy with the disturbance of their land, particularly in light of the length of time for which pits are open.

Alternatives and Modifications

In recent years the Shire has been recycling old road material using enzyme stabilisation. The treatment is costing about $2,000 per km. It increases road life and reduces the frequency of maintenance grading.

The enzymes are applied to clayey gravels, making them firmer, impervious to water, and thus less inclined to be slippery or to rut in wet weather.

Cement and enzyme stabilisation have also been used on floodways.

Rehabilitation

No rehabilitation is carried out at present and there is no commitment to rehabilitation in agreements with landholders. This being said, the lack of rehabilitation probably reflects the fact that the Shire is continually using the same pits over an extended time frame. Consequently it has not been in the position of abandoning any pits in recent years.

Technical Expertise

A professional approach adopted to road design and maintenance in the Shire reflects on the background and experience of the Shire Clerk and the Works Supervisor in this sphere. A recent improvement reflecting this professional approach has been the establishment of a formal road hierarchy, with all roads classified and design standards developed for each level within this hierarchy. This leads to a planned approach to road maintenance, based on real needs rather than responses to ratepayer lobbying.

Landholder Cooperation

Another initiative is the provision of financial incentives to farmers for activities on their holdings that reduce problems - and thus maintenance requirements - on adjoining roads.

This embraces such works as drainage improvements to reduce stormwater discharge into road reserves. It also includes shifting of boundary fences into paddocks adjoining road reserves, with planting of trees in the strip thereby added to the road reserve.

Varying Road Design Criteria

One problem pointed out by the Shire is the inadequate and widely varying road design criteria adopted in different rural Shires. These problems might be reduced if MRWA insisted on certain criteria and standards for any roads constructed using funds they provide. MRWA might also become a more regular source of design advice to assist this process.

SHIRE OF CUNDERDIN

Cunderdin Shire covers an area of 1,872 square km. Its headquarters is in Cunderdin, with Meckering the only other town in the Shire.

The Shire has responsibility for 830 km of road serving its major industries of wheat and sheep farming.

Planning and Gravel Usage

In the first quarter of each year, roads which are to be upgraded are identified. An approach is then made to landowners for access to gravel on their properties before crops are sown. To date the Shire has been successful with this approach in gaining access to material from private landholdings throughout the area.

20,000 cubic metres of gravel are consumed in upgrading about 10 km of road each year. This is hauled a maximum distance of 20 km, the maximum haul being for gravel used on roads in Cunderdin townsite.

Gravel Supplies

The greatest scarcity of gravel is around the two townships. Otherwise the resource is widespread, though it is sometimes soft and of poor quality. This applies in particular to gravel under the sandplain north of Meckering and on the north side of the Meckering-Goomalling Road.

Locating Gravel

The Shire foreman is most experienced at locating prospective sites. He tests these with a loader before new pits are opened.

Access and Compensation

All gravel is secured from private property, although it is becoming increasingly difficult to gain access to private land. Most pits are on cleared ground, with only three in the past 10 years being in remnant scrub.

The Shire does not offer compensation to landowners of properties and generally gains access through persuasion. This persuasion is assisted by the fact that roads to be upgraded commonly serve the farms from which the gravel is to be secured, and possibly also by the comparatively short life of each gravel pit - generally no more than 12 months.

The Shire has had the experience of farmers approaching them to offer gravel when MRWA showed interest in securing the resource. The farmers in question indicated they would prefer the Shire to be taking the gravel rather than MRWA.

Alternatives and Modifications

The Shire has not to date considered it necessary to use any modifications. Its attitude has been influenced by the cost of treatments and possibly by the absence of engineering expertise which might help in this arena.

Rehabilitation

Where pits are in a cropping area, when gravel extraction is completed they are ripped and topsoil is returned. No further treatment is undertaken.

In scrub situations, no rehabilitation is carried out as future access is anticipated to these pits in the long term.

Technical Support

The Shire Clerk/Supervisor is responsible for roads. Whereas he originally devoted about 40% of his time to these, he now devotes only 20% because of other commitments.

There could be the possibility of sharing an engineer with another local authority, but engineering issues are not considered as imperative as might be the case elsewhere.

SHIRE OF BUSSELTON

Busselton Shire covers 1,454 square km and includes the towns and villages of Busselton, Dunsborough, Yallingup, Jarrahwood, Vasse and Carbunup.

The Shire is responsible for 517 km of sealed road and 401 km of unsealed road, with sealed roads in the towns of the coastal strip a major component of the road network.

The area is a major tourist destination, has a significant dairying industry, some vineyards and sand mining.

Planning and Gravel Usage

The Shire has a 5-year road plan, but identifying gravel to meet construction and upgrading requirements is done on a month to month basis. Material is obtained as required, primarily from private land in the west and from CALM estate in the south.

About 50,000 cubic metres of gravel are used each year on 100 km of road. Haul distances can be up to 20 km.

Gravel Supplies

Abundant lateritic gravel occurs in the south and west, but the former is largely covered by State Forest. Gravel is not located on the coastal plain in the northern third of the Shire; here limestone is available from private pits.

Gravel used by the Shire thus comes primarily from the hills in the south and west, from both private land and State Forest.

Up to the present time, the Shire has been able to rely on existing pits on private land. It anticipates increasing scarcity from this source, and thus expects increasing recourse to alternatives and to amended materials.

Locating Gravel

The gravel resource is identified through the local knowledge of Shire personnel, complemented by landowner knowledge. In the latter respect the Shire has, in the past, advertised for landowners to offer gravel if they knew of the resource on their properties. This drew only a limited response, with some later withdrawing their offers to hold out for a higher price than the $2 per cubic metre being offered at the time.

Access

The Shire has paid up to $4.50 per cubic metre compensation for gravel won from private land. This high price is a reflection of landowners holding out for what they perceive the market will bear, particularly where the requirement is for new subdivision roads in growing urban areas. Such high compensation will probably continue to obtain until recycling and stabilisation of old materials on existing roads becomes cost-competitive.

Alternatives and Modifications

There is increasing recourse to duricrust in old pits. This is crushed for $6 per cubic metre. There is, however, pessimism about how much of this material may be available to meet future needs.

Treatment of lower quality materials is also being adopted, with lime and cement stabilisation applied to some old gravel roads. This adds 25% to costs compared with the importation of new gravel, but the result may be more enduring.

Increasing recourse to such treatments is anticipated as gravel becomes more scarce.

Rehabilitation

The Shire is not only rehabilitating existing pits but is also allocating up to $30,000 per annum for rehabilitation of old pits. They make this money go further by encouraging voluntary help in this work.

The Shire's rehabilitation is based on in-house knowledge and their own guidelines. Landholders are generally happy with the results.

SHIRE OF AUGUSTA - MARGARET RIVER

The Shire of Augusta - Margaret River covers 2,370 square km, with its headquarters in Margaret River township. It includes the towns of Augusta, Margaret River, Cowaramup, Gracetown, Prevelly Park, Witchcliffe, Karridale and Rosa Brook.

It is a noted tourist and recreation destination, as well as the centre of a major wine growing industry, and is increasingly the home of hobby farmers and retirees from Perth.

The Shire has responsibility for 380 km of sealed road and 610 km of unsealed road.

Planning and Gravel Usage

Although there is a 5-year road construction program, each year's construction plans are finalised only when the annual budget is approved. Consequently gravel requirements are generally identified at short notice and there is no long term supply strategy.

The Shire obtains gravel from pits scattered over a range of strategic sites, some on private land and some older pits in State Forest from which duricrust can be secured. These provide the approximate 50,000 cubic metres of gravel which are consumed annually in surfacing about 30 km of road. Haul distances for this material generally do not exceed 10 km.

The Shire Engineer estimates that about 80,000 cubic metres of gravel are lost each year from Shire roads as sediment eroded by water and as dust eroded by wind.

It is the Shire's perception that most of the easily accessible - and thus cheaper - gravel is now gone and that in the future more expensive alternatives, such as crushed laterite, will predominate.

Gravel Supplies

Although the northern one-third of the Shire has good lateritic gravel deposits, easily accessible and better quality material is becoming scarce. Material secured at greater expense by crushing duricrust is, however, widespread, and this is of high quality.

The southern areas of the Shire have low potential for gravel and offer only minor amounts of limestone. The latter is largely within Nature Reserves and National Parks.

Quality assessment of materials used on Shire roads is by field appraisal rather than laboratory testing. Materials from different pits are mixed, when necessary, to achieve desired grades.

Locating Gravel

Local knowledge is the principal basis on which new gravel deposits are found. Evidence of gravel on upturned tree roots, hillsides and firebreaks indicates sites to be targeted for assessment.

Access

The Shire has been securing satisfactory access to private land on the basis that it negotiates compensation between $1 and $3 per cubic metre of gravel removed, and that it rehabilitates both current and abandoned pits. The compensation may be paid in cash or in kind, and may be reduced if a landowner requests more expensive types of rehabilitation.

The Shire may, in the future, buy poor quality farms that have extensive laterite outcrop, with a view to crushing it for road building material. They would subsequently rehabilitate the pits with trees.

Whilst access to private land has been satisfactory in the past, it is becoming increasingly difficult as more people from Perth move onto hobby farms in the area. In this light, the Shire would like easier access to gravel deposits in poorer quality areas of the CALM estate (eg. areas infected with dieback, or pockets of forest that are surrounded by private land).

Alternatives and Modifications

There are many old pits, particularly within State Forest, from which the surface gravel has been removed to expose duricrust. This material, when crushed, represents a major potential resource. Removing this duricrust also offers the advantage that it permits pit rehabilitation - something which the duricrust layer prevents.

In 1994 the Shire will crush 20,000 cubic metres of this material at a cost of $5.10 per cubic metre. While this is an added cost, the material is of high quality and there are savings in that it has few roots or other organic contaminants to be screened out.

CALM believes that there are hundreds of thousands of cubic metres of gravel potentially available in the duricrust of old pits within State Forest. They cite the example of the 30 ha Slee Road pit in Busselton Shire which has already yielded 15,000 cubic metres from just 1.5 ha.

Within Augusta-Margaret River Shire, the 2 ha Brockman pit near Cowaramup, from which all gravel has previously been removed, has been re-mined to yield 8,000 cubic metres of duricrust, and will yield another 8,000 cubic metres this financial year, with further still remaining. Land adjoining this pit, which has no gravel and accordingly has never been mined, does carry hard rock which offers additional potential material.

Potential efficiencies and associated savings might be realised in use of rock crushers for treating duricrust by operating them on a regional basis. The Shire Engineer suggested the possibility of having a crusher operate in northern parts of the State in the winter, transferring to southern areas in the summer. It would thus operate throughout the year, spreading its overheads.

When available, limestone is being used instead of gravel for wet areas. It offers the advantage that it allows water to pass through.

Where it is cost-effective, the Shire is recycling old road materials with appropriate modifications, rather than importing new gravel.

Rehabilitation

The Shire is not only rehabilitating current pits but also has a program to rehabilitate abandoned pits. It carries out pit shaping, ripping, sowing or planting, and fertilising.

The rehabilitation includes return of farming land to a productive state, and reinstatement of trees within State Forest and, where requested, on farmland.

Both private landowners and CALM are satisfied with the standard of rehabilitation, and this is a factor facilitating Shire access to new gravel resources.

SHIRE OF CRANBROOK

This Shire embraces 3,390 square km and includes the towns of Cranbrook, Frankland and Tenterden. It is primarily a cereal growing and grazing area, with the Stirling Range National Park extending into its south-eastern sector.

The Shire has responsibility for 260 km of sealed road and 840 km of unsealed road.

Planning and Gravel Usage

The Shire has a 5-year works program which is followed closely. Gravel requirements are, however, determined on an annual basis, when the annual roads program has been approved. The gravel is obtained almost entirely from private land.

Landholders are contacted and gravel supplies are organised within three months of the annual roads program being approved, with the Engineer or the Works Supervisor approaching individual landholders to seek access to their land. Where this is provided, pits are opened, the resource is removed to meet immediate needs, and the pits are promptly closed without necessarily removing the entire resource.

The Shire uses about 16,000 cubic metres of gravel per annum in this manner, treating 15 km of road. Haul distances from source to works location rarely exceed 5 km, reflecting the widespread occurrence and ready availability of gravel.

Gravel Supplies

Gravel supplies are adequate in the western half of the Shire to meet long term demands. In the eastern half, supplies are only fair and are widely separated.

Locating Gravel

Local knowledge of Shire personnel, complemented by farmers' knowledge of their own land, is the basis for initial location of prospective areas. Field indicators such as firebreaks, backslopes of table drains, and vegetation assist this process.

Target areas are tested by a mobile auger. This is followed by test pit excavation with a front-end loader for final definition of pit sites.

Access

There is little difficulty obtaining gravel from private land for several reasons:

- gravel pits are open for only a short time (never more than twelve months);
- they are rehabilitated after extraction of the gravel;
- farmers are compensated up to 10 cents per cubic metre of gravel extracted, the payment being in cash or in kind;
- the Shire has a professional and constructive approach to landholders which fosters good public relations; and
- there is a certain consciousness amongst landholders of community needs with respect to road upgrading and maintenance.

Material from cleared land is preferred as this saves the cost of clearing, the land is easier to rehabilitate, and it yields cleaner gravel, free of roots and other organic material.

Alternatives and Modifications

Cement stabilisation has been used on short sections of established roads to repair minor problems where it is more cost-effective than importing new gravel. In general, however, the widespread occurrence of gravel has precluded a need for alternatives or for modification of inferior quality materials.

Environmental/Social Considerations

The Shire has had to adopt dieback hygiene on one occasion, when obtaining gravel from the Stirling Range National Park. The particular operation presented no great difficulties, with CALM organising and supervising washdown of vehicles entering and leaving the site.

A potential problem with spread of noxious weeds has been recognised. A possible solution, should this prove a problem, is washdown of vehicles before they enter farms, using a mobile high pressure water cleaner for the purpose.

Rehabilitation

Council carries out rehabilitation on both current and old pits. This includes shaping of pits, ripping, topsoiling and installation of drainage if required. Landholders re-seed and fertilise from the compensation they are paid.

Sites that are to be rehabilitated to natural vegetation have not only the topsoil returned but also the cleared vegetation. This, like the topsoil, is stockpiled to one side prior to development of the gravel pit for subsequent return.

The success of rehabilitation is due in part to the rapid turn-around, with most pits being opened, excavated and rehabilitated in three months.

Some pits are, at the farmer's request, rehabilitated as roaded catchments. These are regarded as sites which might be re-opened in the future for further gravel extraction.

Technical Support

One factor in the Shire's success in securing gravel from private property lies in the fact that it has an experienced engineer directing road planning and construction. Of importance in this respect is not only the availability of his expertise but also that he is employed for sufficient time (two days per week) to permit him to effectively assist in planning, design and supervision of road construction, as well as to ensure satisfactory rehabilitation of gravel pits.

The particular engineer was first engaged on a full-time basis by Cranbrook Shire when the Main Roads Department were offering a 6% premium on road grants to Shires employing a qualified engineer. The Shire continued the arrangement on a part-time basis, even though the 6% premium is now offered only on Special Road Grants.

As well as working two days per week for Cranbrook Shire, the engineer is sub-contracted to work for a further day each week for two other Shires. In his remaining two days each week, he consults direct to a further two Shires. Gravel acquisition recommendations are not generally part of his contract brief for these other Shires.

SHIRE OF ESPERANCE

Lying on the South Coast, the Shire of Esperance covers 42,900 sq km. Farming and pastoral activities are the principal industries in the area, although tourism and iron ore export from Esperance Port are also important.

Townsites include Esperance, Gibson, Scaddan, Grass Patch, Cascades, Condingup, Coomalbidgup and Salmon Gums.

The Shire manages 645 km of sealed road and 3,782 km of unsealed road. Most unsealed roads across the local sandplains are constructed of lateritic gravels or limestone to a depth of 100 mm.

Planning and Gravel Usage

The Shire has identified its needs and developed a gravel supply strategy to meet these. In this respect, it has embarked on a survey of gravel resources in the vicinity of Esperance, seeking to determine reserves in this area where recognised supplies within a 20 km radius are limited. On the other hand, in rural areas of the Shire there are no current problems with availability of materials for road building.

The Shire prefers to extract its gravel requirements from pasture land and to avoid remnant vegetation within road and gravel reserves.

Current usage of road building materials amounts to about 200,000 cubic metres per annum. These are applied to about 150 km of roads and include lateritic gravels and limestone. The latter are common north of Scadden, towards Grass Patch, and on the edge of the Nullarbor Plain to the north-east.

The high consumption rate reflects the difficulty of constructing roads on the sandplain, as well as

the length of roads requiring frequent maintenance. The Shire doubts this level of use can be sustained for the next 15 years. It is therefore in its interest to establish good relations with landholders whose properties contain gravel resources.

Gravel Supplies

There are sufficient reserves of gravel and limestone within a 25 km radius of all potential sites where they are required. The Shire, however, considers it uneconomic to haul these materials more than 10 km, and on this basis known resources are scarce near Esperance, Beaumont and Scadden.

While gravel is widespread beneath the sandplain, in some instances the gravel layer is only 30 cm thick - insufficient to permit its excavation and use. North of the sandplain, gravel is found in pockets or is supplanted by limestone as a road-building material.

Quality of road building materials is generally good, although gravels beneath the sandplain are variable and sometimes require upgrading by inter-mixing clay from the underlying pallid zone of the soil profile. Some gravels are also of high plasticity and are unsuitable for use unless amended.

Locating Gravel

The Shire has commenced a program to locate gravel sources near Esperance township, but over the balance of its area supplies are considered to be adequate.

There is some competition between MRWA and the Shire in locating gravel supplies, although each advises the other of areas which are not prospective.

Access

Gravel and limestone are presently obtained from five private and 30 council pits.

Historically, failure to satisfactorily rehabilitate gravel and limestone pits led to difficulties in negotiating access to private land to secure these resources. Although the Shire established protocols on rehabilitation to correct past deficiencies, these did not appear to diminish landholder antagonism.

More recently, the Shire has adopted a policy of devoting a sum in each budget to rehabilitation of old pits and has developed guidelines for the rehabilitation of existing pits. This initiative has persuaded most landholders of the benefits of permitting access to road building materials, although some still have concerns about loss of productivity.

There are two different approaches to securing materials for road construction. Supplies for township needs are obtained from contractors, with required standards specified beforehand. The contractor negotiates a royalty payment to the landowner from whose land the material is to be secured, with no involvement of council. Conflict between the Shire and local landowners is thereby avoided, and the approach also offers design and budgeting advantages.

For rural roads, gravel and limestone supplies are secured by the Shire. This is a reversal of earlier policy when some rural supplies were obtained from contractors. The policy reversal illustrates the influence an operations manager can have on sourcing of road building materials.

In seeking material for rural roads, once a resource is identified, Shire officers seek access through negotiation with the landowner on whose land it is located. Compensation of 40 cents cash or 50 cents "in kind" per cubic metre of gravel removed is offered. "In kind" payment may be by on-farm road works, dam sinking, etc., using Shire machinery.

The negotiated approach is generally proving to be successful, with earlier difficulties in securing landholder agreement almost eliminated. The

alternative approach of compulsory acquisition under the Local Government Act avoided as far as possible.

Alternatives

In the Esperance township, Readymix supply road base for about $8 per cubic metre at site of supply. In other areas of the Shire, all available laterite gravels are used, with addition of pallid zone material where the gravel is too sandy.

Additives are sometimes used to improve poor quality materials, adding up to $3 per cubic metre to their cost.

Environmental/Social Considerations

Roads through National Parks and Nature Reserves

CALM follows the principles of NPNCA Policy Document No 2 in respect of winning gravel from National Parks and Nature Reserves in the region.

Dieback is a major concern in local park management. There is a risk of the disease spreading through indiscriminate use of road making materials, even where these are won from National Park through which the roads pass.

The risk of dieback infection has also led CALM to embark on a program of sealing roads in Cape La Grande Park, so that the amount of gravel sheeting required each year is reduced.

Gravel from cleared private land is preferentially used for roads through parks. CALM authorises the Shire to negotiate access to gravel from such land for use within its parks and reserves, and then directs the road construction and maintenance the Shire undertakes within those areas.

Aboriginal Interests

Requisite procedures for identification of Aboriginal sites are followed, when necessary, and have seen no conflict with Aboriginal interests in the winning of gravel.

Rehabilitation

As mentioned previously, the Shire earmarks a sum in its annual budget to rehabilitation of old pits. It has also adopted CALM guidelines for the rehabilitation of existing pits, although renovated surfaces are not sown with native or introduced species, as experience has shown that pits which are reshaped and ripped revegetate naturally.

Pits on freehold land are re-contoured so that the new surface does not impede the passage of motor vehicles at speed.

The cost of rehabilitation is estimated to be less than $1 per square metre.

SHIRE OF CHAPMAN VALLEY

Chapman Valley Shire covers an area of 4,007 square km. Its headquarters is in Nabawa, with other townsites including Yuna, Naraling and Howatharra.

The Shire has responsibility for 140 km of sealed road and 830 km of unsealed road.

Major industries are wheat, sheep and cattle production.

Planning and Gravel Usage

Road maintenance and upgrading is determined on a year to year basis, with a regular frequency of maintenance (resurfacing every 5 years) occasioned by the heavy wheat and attapulgite haul trucks using Shire roads.

Gravel to meet road needs is generally secured from existing pits. 60,000 cubic metres are used each year on 42 km of roads.

The material is hauled a median distance of about 14 km, with maximum haul distance up to 35 km.

Gravel Supplies

Limited quantities of lateritic gravel are scattered through the Shire, generally on ridges. Scarcity is most marked on the sandplains in the east where the major resource exploited is from gravel pits around the edge of the Wandana Nature Reserve.

Much of the gravel that is accessed is of poorer quality, being either too clayey or too sandy.

West of the North West Coastal Highway, limestone is available, but it is difficult to extract and is not always suitable.

There may be potential to increase the available gravel resource in existing pits through use of larger equipment. This could secure material from greater depth.

Locating Gravel

Gravel is most commonly secured from established pits, but when new sources are required they are located by the Shire foreman who has been in the area for 34 years. Over this time he has gained substantial experience in locating the resource.

Access

The two major sources of material are pits on private land and, in the east of the Shire, pits in the Wandana Nature Reserve.

Wandana Reserve

Pits in the Wandana Reserve account for about 30% of total gravel used by the Shire. They have been in use for many decades and were not embraced by the original reserve when it was gazetted in 1979. However, a 1991 extension did embrace them and the Shire was subsequently asked by CALM to stop using them.

The Shire maintains that these pits represent the only gravel available in its eastern precincts and that continued access to them is essential. Consequently they appealed to the Minister on the basis that they were not consulted on the extensions to the reserve, and that, in any event, the pits occupy only a few hectares on the perimeter of a reserve which is over 50,000 hectares in area.

The Minister allowed a compromise in January 1994 whereby the Council has been afforded access to its pits for a further two years. During this time they are to seek alternative supply sources. Council is disputing this compromise and seeking excision of the pits from the reserve to allow them indefinite access.

In this circumstance, a reasonable solution is that the Shire carry out a thorough investigation of alternative gravel resources in the neighbourhood, drawing on assistance from WADA and GSD of DME for the requisite soils and geological data.

If this investigation demonstrates that there are no satisfactory alternative sources, the Shire should then commission jointly with CALM botanical and biological surveys of the localities of the gravel pits. Purpose of these surveys would be to determine whether or not continued operation and possible limited expansion of these pits would have an unacceptable impact on the flora and fauna the reserve has been established to protect. If the finding is negative, they might operate for several more years until the gravel has been exhausted up to an agreed boundary for each pit.

The two year extension on access which the Minister has allowed should be sufficient for the above purpose.

Private Land

The Shire is also securing gravel from private land. It has not generally experienced problems of access to this source, even though compensation is not paid to farmers. The long history of the foreman working within the Shire and his relationship with local farmers appears to be an important factor in the lack of problems in this respect.

Alternatives and Modifications

With certain gravels being too clayey and others too sandy, there has been some blending of the two to achieve a more satisfactory material. The Shire has also used cement stabilisation on roads that are to be surfaced. It has found the treatment to be successful, but it has proved expensive at $10/square metre.

Rehabilitation

The Shire is rehabilitating its pits by battering down the sides, respreading topsoil and overburden, and deep ripping. A few trees are usually planted as well.

They have made reference in the past to the DME rehabilitation guidelines, but consider them more appropriate to larger quarries and excavations than to their small gravel pits.

Technical Support

In the past the Shire secured road design advice from MRWA but this has ceased in recent years. They now use the services of a consulting engineer for major road design work, with this person spending about 15% of his working time on Shire matters.

They perceive there would be benefit in their having greater access to engineering and environmental expertise.