

ESTABLISHING DETERIORATION MODELS FOR LOCAL ROADS

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Abstract

The paper discusses the importance of deterioration models in any Pavement Management System (PMS) and the need across Australia to establish appropriate deterioration models for local roads, both sealed and unsealed, which better reflect Australian local conditions.

ARRB Transport Research with the support of Austroads, IPWEA(Q), Local Government Association of Queensland and the Queensland Department of Main Roads is planning the establishment of a number of test sites on various local roads that reflect various climates, traffic types, soil conditions and methods of construction across Queensland. The sites are to be monitored over a minimum of five years, at the end of which deterioration models will be established and existing PMS deterioration models calibrated to better represent the performance of local road pavements.

The paper also covers the various steps being undertaken to establish a nation wide deterioration model study for local roads across Australia and the progress to date in the other States.

Key words: Pavement management systems, deterioration models, data collection, performance criteria

Introduction

Local Government Authorities across Australia have adopted a variety of Pavement Management Systems (PMS) to guide the development of their pavement maintenance and rehabilitation programs, and the appropriate allocation of road funding.

Many managers are reporting that forecasts of pavement performance from their PMS packages do not always predict actual conditions. This is due primarily to the pavement prediction models used in existing PMS's being based more on the performance of overseas pavements, and not necessarily reflecting Australian conditions, (Martin 1996).

This paper addresses the need and ways to establish deterioration models for local roads to cover a wide range of conditions relating to both sealed and unsealed roads.

Updating Deterioration Models

A PMS can be defined as a systematic process covering information collection and decision-making which is necessary for the optimisation of resources for maintenance, rehabilitation and reconstruction of pavements. The aim of a PMS is to estimate the resources needed at either the network or program level.

Pavement deterioration models are a **critical** component in any PMS and accurate models are essential in order to manage roads for both strategic (network level) and maintenance works (program level) levels and gain greater value from the funding available. With appropriate deterioration models asset managers can have greater confidence in forecasting future pavement conditions, establishing maintenance programs and substantiating budget requirements.

PMS packages used by most Queensland municipal councils were initially developed using various deterioration models understood to have been based more on engineering judgement than on measured performance data. The validation and calibration of the existing models used is seen as essential to improve the accuracy and reliability of the pavement performance models used.

In order to develop appropriate deterioration models, it is considered necessary to establish a number of sample local road sites across Queensland at which pavement performance can be monitored over time. The sites selected would desirably need to be representative of local road pavements and cover a range of roads types, climatic conditions, traffic loading, soil types, construction techniques and maintenance practices.

Study Methodology

ARRB, with the support of Austroads, LGAQ, Main Roads, Queensland and IPWEA(Q) has initiated a study based on establishing a number of test sites across a range of local roads in Queensland covering sealed and unsealed roads. At these sites measured pavement condition data would be collected at regular intervals over at least a 5 year period.

An outline of the proposed tasks is:

Task 1: Establishment of the key pavement performance parameters

This will involve a review of the key pavement condition parameters and associated distress data that are currently being used in PMS's by councils and that should apply to local roads including sealed and unsealed roads. The review is to be undertaken in consultation with Local Government to ensure the parameters selected are relevant and of practical use in various existing PMS.

Task 2: Identification and location of sample roads

This task covers the selection of various road site(s) in municipalities where pavement condition data will need to be measured and collected over at least five years. The

selection criteria will ensure that the selected road sites cover a wide range of the independent variables effecting deterioration such as levels of traffic load, climatic effects, soil type, and local road type (i.e. sealed and unsealed, brick paving, etc.).

The length of the sample road site is to be about 250m for urban roads and up to 500m for rural roads. Ideally, the sample should be sited on a straight and flat section of the road's alignment, unless the sample is intended to account for roads in hilly terrain.

Where a Council has suitable past pavement performance data at a nominated test site, this will also be included in the analysis to provide the basis for interim deterioration modelling. This information will be later reviewed and updated based on the additional field data collected.

An estimate of the minimum local road sampling across Queensland to cover the various variables of relevance is given in Table 1 (see Appendix at end of paper).

Task 3: Specification and collection of the pavement performance and other data

This will require, for each sample test site, detailed specification of the type, quality and timing of various pavement condition data and other information relating to traffic loading, climate etc. to be collected as determined in Task 1. The performance data to be collected is expected to include road roughness, rutting, surface distress conditions and an assessment of pavement structural condition.

This task will also cover who is to collect the data with the intention that the participating Council, in which the sample site resides, will assist with some of the data collection.

Task 4: Data analysis and establishment of deterioration models

Analysis of the road condition and traffic data will be completed and reported in the fifth year of the project. Progress reports will be made after each data collection in the first and third years.

The data analysis is aimed at the development of various deterioration models

including roughness, rutting, strength (via surface deflection), and cracking for sealed roads and at least roughness and gravel loss for unsealed roads.

Any historical condition and traffic data that has been measured at each road test site selected would be considered and, if suitable, included in the data set for that site to improve the final development of the deterioration models. Regional historic road performance data would also be utilised, if suitable, to assist preliminary model development.

Model development will commence in the third year and will be finalised in the fifth year of the project. The deterioration models, if they are based on a wide range of independent variables, should have the capacity to be transferable to other similar local roads within Australia. The deterioration relationships will enable conversion of some of the existing PMS's road condition ratings into more widely understood objective and acceptable measures of road condition.

Progress to Date

ARRB sent a letter to all Councils in Queensland around mid 2002 outlining the need for improved deterioration models for various PMS, a proposed study to improve these models and sought Councils support and participation in the study.

By the end of August 2002, about 28 Councils across Queensland had chosen to participate in the study with over 55 sites nominated for monitoring. The Councils participating in the study, together with the number of sites nominated, are shown on Map A. At the stage of preparing this paper the local road types nominated have not yet been established. However, it is expected that there will be an adequate coverage of both sealed and unsealed roads including both asphalt and chip seals.

As seen from Map A, while the number of sites nominated is reasonable, the scatter though across the State may not necessarily be representative and more sites would be desirable to ensure a better coverage of road

performance conditions across Queensland. Nevertheless, with the current number of monitoring sites, ARRB should be able to provide a reasonably sound statistically analysis on which to model the performance of both sealed and unsealed roads covering a range of road types, traffic conditions, climates, soil types and construction methods.

In addition to these sites a similar study is underway in Victoria and Western Australia, and these results would be used to increase the data source on which to base the analysis and establishment of the models. In Victoria there are currently 53 Councils participating with 169 sites nominated for monitoring pavement conditions, as shown on Map B. In Western Australia the number of Councils participating is 39 with 79 sites nominated. Details are shown in Map C.

It is also intended to extend the study to the other States and Territories during 2003 to provide additional sites, extend the coverage across a wider range of climatic and soil conditions and further improve the statistical reliability of the models developed.

Performance Parameters Selected

For the Victorian and Western Australian studies the performance parameters selected for monitoring are listed in Table 2 (see Appendix at end of paper). They were derived from responses to a survey questionnaire, and inputs from ARRB and the Steering Committee made up of representatives from Local Government, VicRoads, Main Roads Western Australia and others. A similar process is suggested for Queensland to achieve the most suitable performance parameters to be modelled which takes into account the PMS being used.

Data collection equipment of various forms will be used wherever possible to obtain an objective measure of performance parameters. ARRB will undertake the necessary measurements of all the performance parameters and will aim to measure the same performance parameter with the same equipment at all the sites to

ensure consistency in measurement. Assistance will be sought from Councils to provide traffic count information and historical maintenance information.

Summary

Establishing soundly based pavement deterioration models, which represent the performance of local roads across Australia, is considered critical in the proper application of PMS in municipalities. The models will provide a more scientific basis to forecast future road conditions, maintenance and budget requirements. The models, with various traffic and pavement type variables, will enable "what if" questions to be evaluated such as to the effects on an existing pavement due to a proposed development generating additional traffic on a given road.

The deterioration model studies underway on local roads in Victoria and Western Australia and proposed in Queensland and the other States and Territories, should enable the monitoring of pavement performance

covering a wide range of climatic condition, soil type, traffic and maintenance practices across the nation. The data collected should provide a sound statistical base on which to generate new deterioration models or help calibrate existing PMS models that best reflect local conditions around Australia.

It is hoped that many more Councils across Australia will appreciate the need and benefit from participating in the study by nominating sites for monitoring local pavement conditions. This will ensure that the cost of the study is shared by many and provide greater coverage conditions to provide a more robust and representative database to better model the performance of local roads for the benefit of all municipalities.

Reference

MARTIN, T. (1996). A review of existing pavement performance relationships, ARRB Transport Research Report ARR 282, pp 61, ARRB TR Vermont South, Victoria.

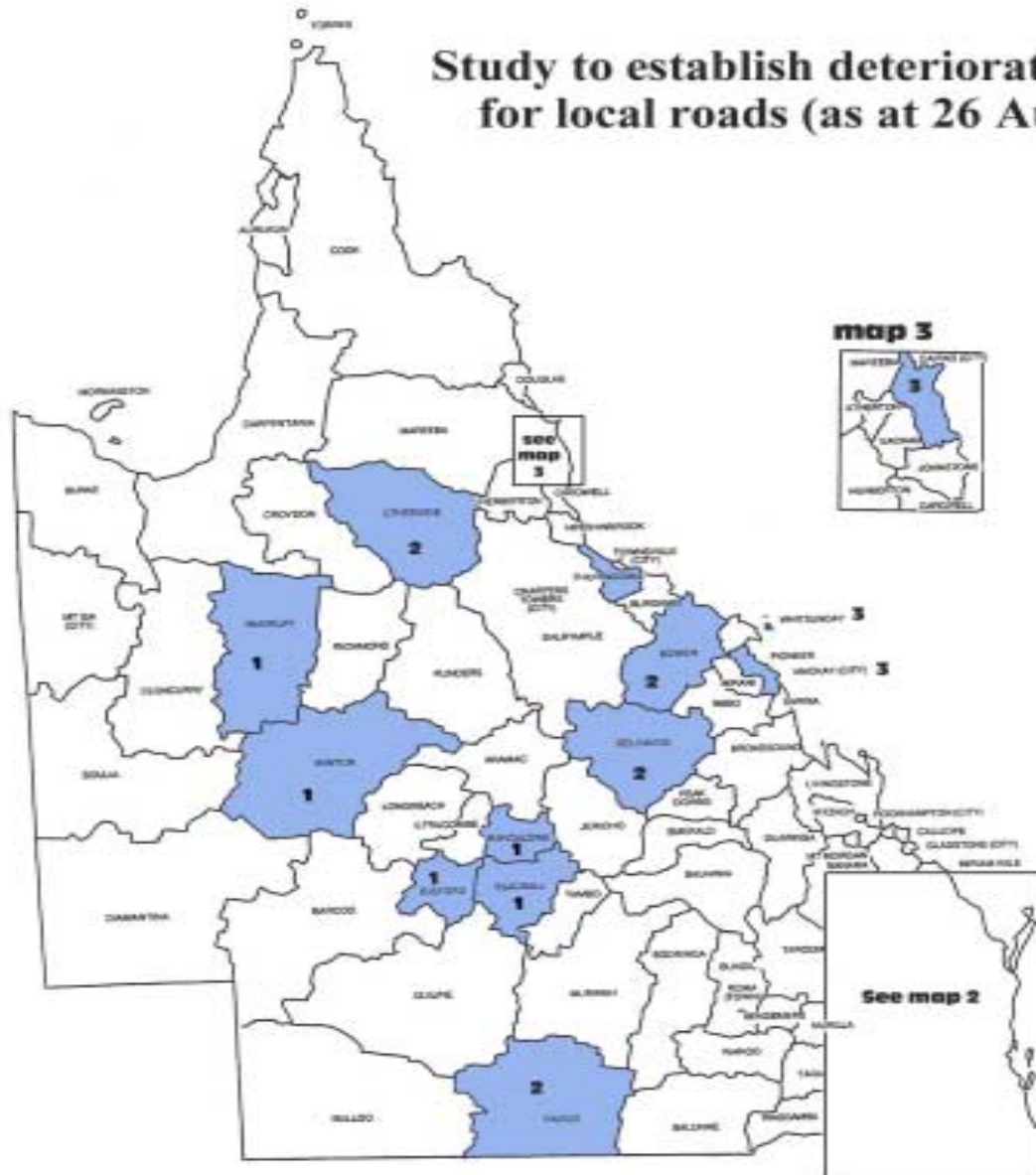
Table 1: Summary of Minimum Local Road Sample Sites

Region	Local Road Types	No. of Samples	Features/Comments
Rural	Sealed	25 - 35	Samples include various soil types, climatic conditions with light to heavy traffic loads
	Unsealed	15 - 25	Samples include light to heavy traffic various terrain and forest areas
Metropolitan	Sealed (asphalt)	15– 20	Samples include both light residential streets and busy collector roads
Regional Urban	Sealed (asphalt)	10 - 15	Samples include both light residential streets and busy collector roads
Total Samples		65 - 95	

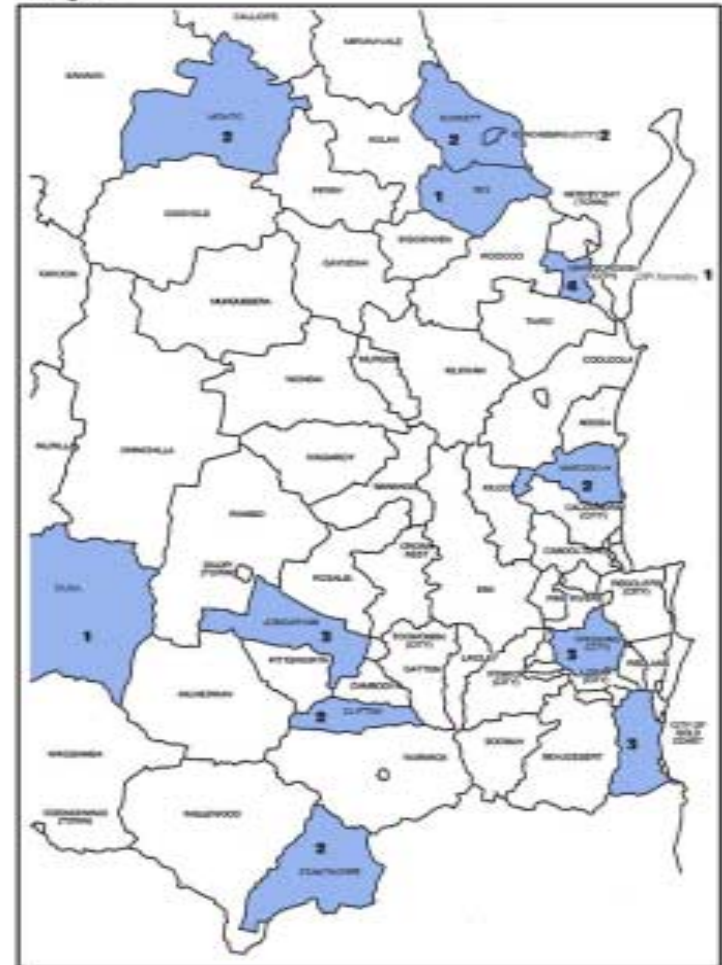
Table 2: Performance Criteria Selected for the Victorian & Western Australian Studies

Performance criteria to be monitored	
Sealed Roads	Unsealed Roads
Cracking	Gravel loss
Binder hardness	Loss of shape
Stone loss	Roughness (ride quality)
Rutting	Loose stone
Roughness (ride quality)	Material grading
Skid resistance	
Structural strength	

Study to establish deterioration models for local roads (as at 26 August 02)

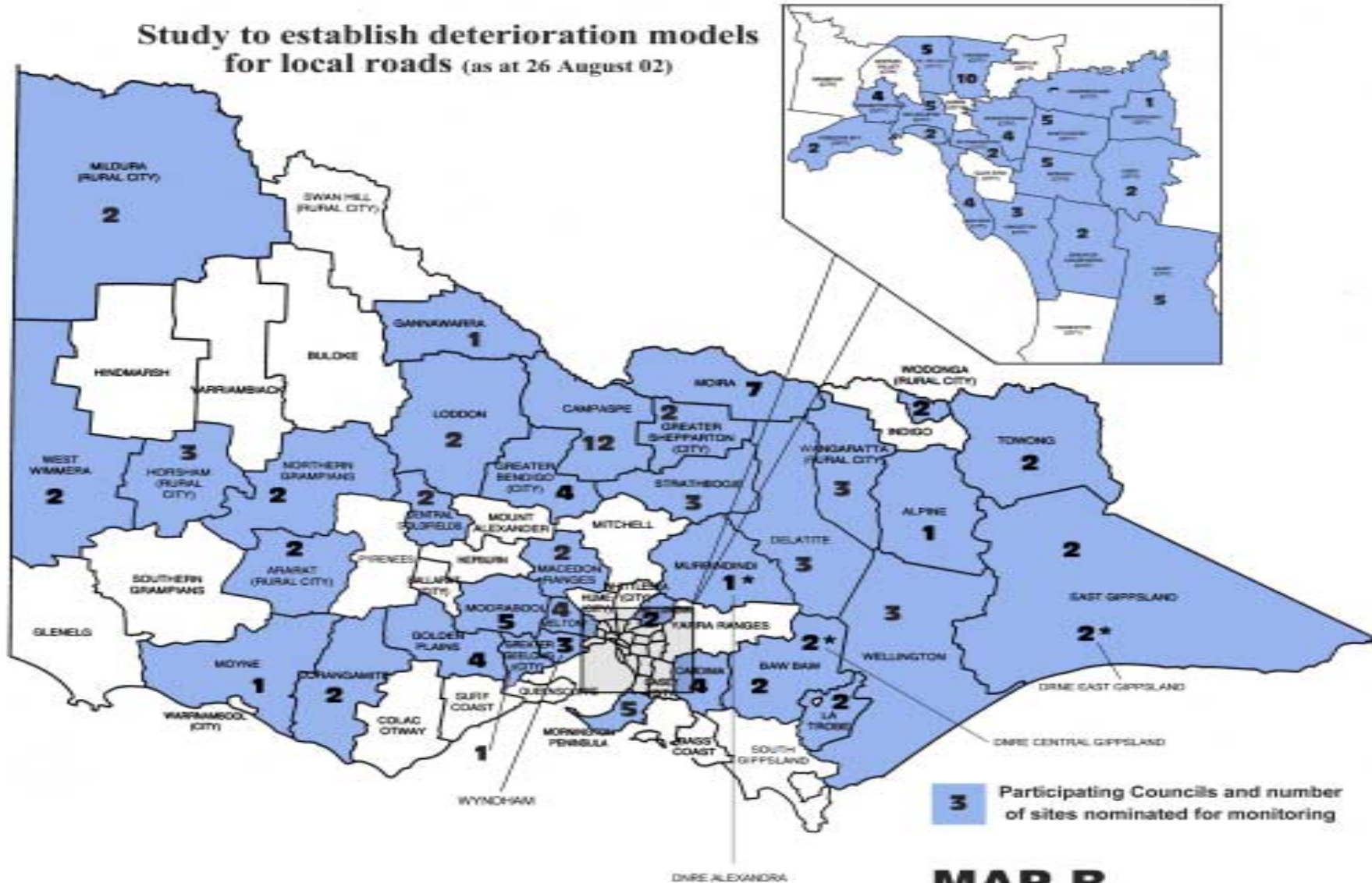


map 2



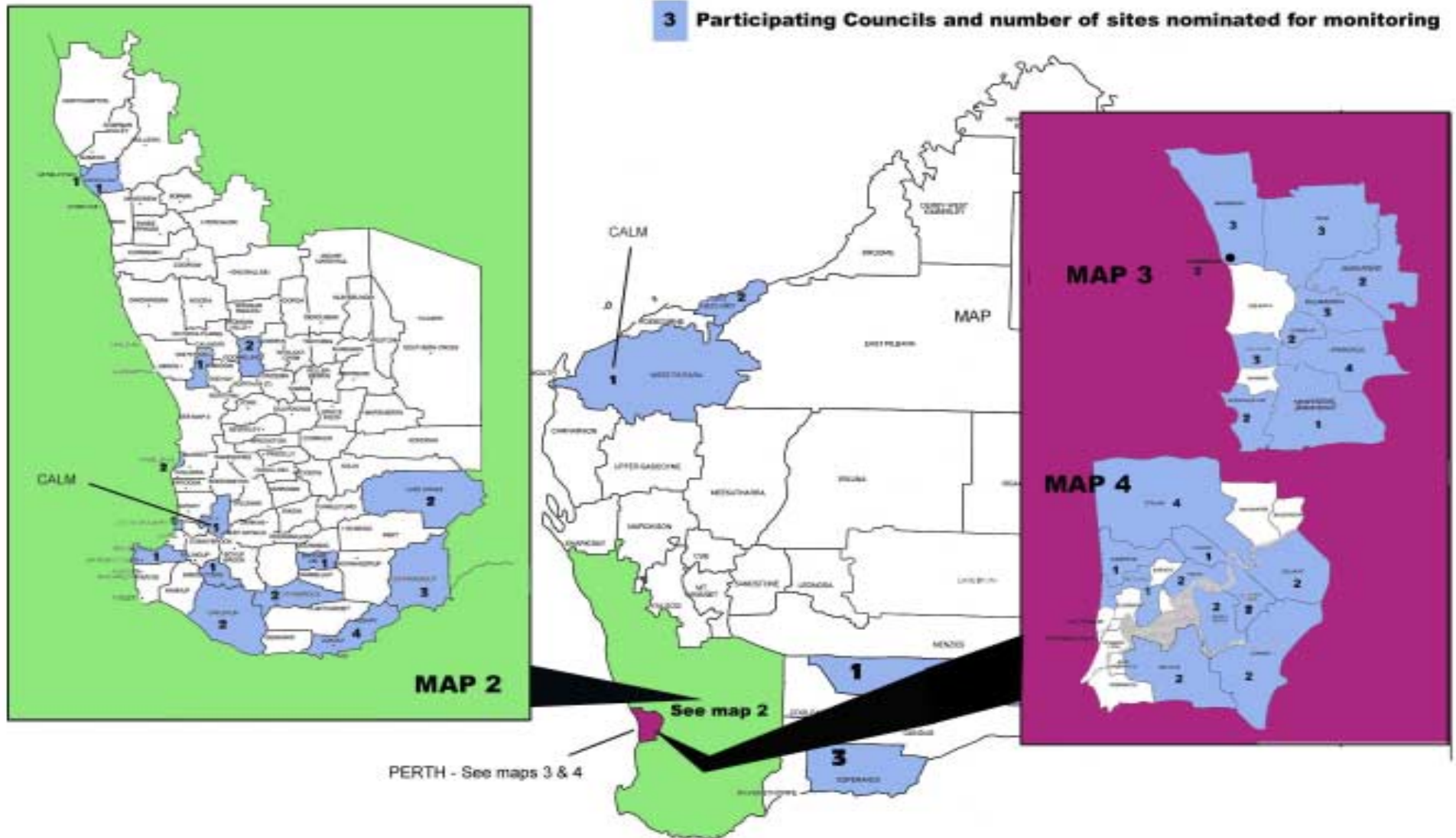
MAP A

**Study to establish deterioration models
for local roads (as at 26 August 02)**



Study to establish deterioration models for local roads (as at 28 Aug 02)

3 Participating Councils and number of sites nominated for monitoring



MAP C

Author Biography



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George's work experience has extended across a wide range of engineering activities including transport planning, road design, construction, research and traffic engineering. Much of George's work, before beginning at ARRB, was associated with VicRoads and its predecessors, and a secondment to a Local Government planning authority.

At ARRB, George has been responsible for the establishment of research programs and technology transfer activities for Local Government and other agencies associated with local roads across Australia and overseas.

George has been successful in providing a number of projects aimed directly at meeting the needs of local roads. This has included the preparation of Manuals relating to Unsealed Roads, Sealed Local Roads and Local Roads Bridge Management.

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