NATIONAL PRACTICES IN INVESTMENT DECISION MAKING IN ROAD SECTOR

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PREFACE

This report is written under the research project entitled “Investment Decision-making Framework for Civil Infrastructure Assets Management”. The project has commenced at the CRC for Construction Innovation at RMIT University, with the collaboration several public and private industry partners.

In the preparation of this report, the authors have drawn liberally from many publications written by individuals and organisations, and they are the first to be acknowledged. A number of people have contributed to the report. The authors are particularly indebted to Professor Arun Kumar, Dr. Sujeeva Setunge, Dr. Anthony Piyatrapoomi, Dr. Saman De Silva, and Mr. Shah Ashish for their generous assistance and constructive advice.

EXECUTIVE SUMMARY

This document provides the findings of a national review of investment decision-making practices in road asset management. Efforts were concentrated on identifying the strategic objectives of agencies in road asset management, establishing and understanding criteria different organisations adopted and ascertaining the exact methodologies used by different sate road authorities.

The investment objectives of Australian road authorities are based on triple-bottom line considerations (social, environmental, economic and political). In some cases, comparing with some social considerations, such as regional economic development, equity, and access to pubic service etc., Benefit-Cost Ratio has limited influence on the decision-making.

Australian road authorities have developed various decision support tools. Although Multi-Criteria Analysis has been preliminarily used in case by case study, pavement management systems, which are primarily based on Benefit Cost Analysis, are still the main decision support tool. This situation is not compatible with the triple-bottom line objectives. There is need to fill the gap between decision support tools and decision-making itself.

Different decision criteria should be adopted based on the contents of the work. Additional decision criteria, which are able to address social, environmental and political impacts, are needed to develop or identify.

Environmental issue plays a more and more important role in decision-making. However, the criteria and respective weights in decision-making process are yet to be clearly identified.

Social and political impacts resulted from road infrastructure investment can be identified through Community Perceptions Survey. With accumulative data, prediction models, which are similar as pavement performance models, can be established. Using these models, the decision-makers are able to foresee the social and political consequences of investment alternatives.

1 INTRODUCTION

In this report, a comprehensive national practice review, which includes the national policy and the practices in the states of Western Australia, South Australia, New South Wales, and Victoria, is presented. The sections appear in the order of three main components of a decision-making framework: Section 2 goals/objectives, Section 3 decision-making criteria, and Section 4 evaluation methodology. A summary of findings is given in Section 5.

2 GOAL/OBJECTIVE OF CURRENT PRACTICES

2.1 Community Expectation

The goals of road agency should reflect community expectations and government objectives. According to Cox (1997), Australian community expects that road infrastructure policy can achieve:

- Economic growth
- Ecological sustainability
- Social cohesion and equity

2.2 National Principles

According to Federal Department of Transport and Regional Services (2001), there are five main principles for general-purpose grants and an additional one for federal road grants. They are:

- **Horizontal Equalisation**

The equalisation component of the financial assistance grants will be allocated to local governing bodies, as far as practicable, on a full horizontal equalisation basis as defined by the Local Government (Financial Assistance) Act, 1995. This is a basis that ensures that each local governing body in the State/Territory is able to function by reasonable effort, at a standard not lower than the average standard of other local governing bodies in the State. It takes account of differences in the expenditure required by those local governing bodies in the performance of their function and in the capacity of those local governing bodies to raise revenue.

- **Effort Neutrality**

An effort or policy neutral approach will be used in assessing expenditure requirements and revenue raising capacity of each local governing body. This means as far as practicable, policies of individual local governing bodies in terms of expenditure and revenue effort will not affect the grant determination.

- **Minimum Grant**

The minimum general purpose grant allocation for a local governing body will be not less than the amount to which the local governing body would be entitled if 30% of the total amount of equalisation component funds for the State/Territory were allocated on a per capita basis.

- **Other Grant Support**

Other relevant grant support provided to local governing bodies to meet any of the expenditure needs assessed should be taken into account using an inclusion approach.

- **Aboriginal Peoples and Torres Strait Islanders**

Financial assistance shall be allocated to councils in a way, which recognises the needs of Aboriginal and Torres Strait Islander people within their boundaries.

- **Identified Road Component**

The identified road component of the financial assistance grants should be allocated to local governing bodies as far as practicable on the basis of the relative needs of each local governing body for roads expenditure and to preserve its road assets. In assessing roads needs relevant considerations include length, type and usage of roads in each local governing area.

2.3 New South Wales

The main objectives of road investment of Road and Transportation Authority, New South Wales (RTA 2001) are as follows:

New construction and improvement:

- Promote economic growth;
- Improve access to rural communities;
- Improve road safety;
- Encourage greater use of public transport;
- Meet environmental targets;
- Actively contribute to the 'whole of Government' and
- Approach to land use and transport.

Maintenance work

- Maintain state roads and bridges to be more reliable, durable and safe.

2.4 Western Australia

The role of Main Roads (Main Roads Western Australia 2001) is to ensure that the ongoing public investment in road and road transport initiatives is properly planned, managed and protected. The objectives of Main Roads Department, Western Australia are as follows:

- A safe and accessible road system for all road users including public transport, pedestrians;
- Cyclists and people with disabilities;
- A balanced road investment program;
- Regional development and improved service and
- Time and cost savings for all road users.

In line with changing community expectations, Main Roads' focus has moved in recent years from the role of direct builder and maintainer of roads to one of effective and responsive operational planning and management of the road asset and road network while promoting opportunities for community consultation and involvement (Main Roads Western Australia, 2001). The challenge is then to develop more transparent decision-making tools at the agency level, which can factor in the complexity of outcomes desired by the community (Lang, 1998).

It was mentioned in the "Report on our output performance" (Main Roads Western Australia 1998) a shift from the standard solutions adopted in the past to a position where more emphasis is placed upon risk assessment and economic analysis, to maximize benefits and

investment options. This ‘fit for purpose’ philosophy is being strengthened with the development of a best practice of Asset Management Planning Process.

2.5 Victoria

The main objectives of road system maintenance and development of VicRoads (2001) are:

- Assist economic and regional development by improving effectiveness and efficiency of transport system;
- Assist the efficient movement of people and freight and improve access to service;
- Reduce the number and severity of road crashes and the resultant cost of road trauma;
- To be sensitive to the environment through responsible management of the transport network.

2.6 South Australia

Transport SA as an organisation has made the following as its priorities according to its annual report (2001):

- Adopt a common corporate framework to ensure all of Transport SA works towards consistent goals;
- Build our capability to support a whole-of-transport system approach to planning and projects;
- Involve our key stakeholders in planning and projects by building more effective external relationships;
- Improve awareness, understanding and use of transport performance information both within Transport SA and the wider community;
- Improve business efficiency and financial management to ensure the best use of funds;
- Enhance our capacity to reduce greenhouse gas emissions from the transport sector;
- Ensure that the community has access to convenient, cost-effective options for Transport SA transactions and services.

3 CRITERIA

3.1 New South Wales

The main criterion for measuring investment performance of new construction and improvement works is Cost – Benefit Ratio. For maintenance work, Ride Quality, which is a measure of the roughness of travel over road surfaces, is a primary criterion of road condition and customer needs. Pavement Durability, which is a measure of road surface cracking, is also used to measure the network condition.

3.2 Western Australia

The criteria used in measuring investment performance of maintenance works, road improvement and new construction are different (Main Roads Western Australia 2001).

Maintenance

Smooth Travel Exposure is a key indicator of the effectiveness of road maintenance expenditure. It represents the proportion of travel undertaken each year on all roads with surface roughness less than 110 NRM (NAASRA Roughness Meter), the national standard that provides acceptable travel conditions for passenger car users.

Community Perceptions of Ride Quality Through the annual Community Perceptions Survey, customers were asked their opinion of the condition or ride quality of the road network under Main Roads' control. This indicator complements the Smooth Travel Exposure indicator by presenting road user perceptions of the condition of freeways and highways.

Table 1 Multi-Criteria Analysis Model by Department of Main Road, WA

Criterion	Assessment Procedure
Benefit-Cost Ratio (BCR)	The appropriate criterion score can be found using the outcome criterion suggested by the author according to the BCR value.
State and National Economy	The score is assigned according to the benefits of increased industry output, income and employment to the State and National Economy.
Local Business Community	The score is assigned according to the effect, such as the volume of the passing traffic, future business opportunity in the local community.
Contribution to Regional Product	The score is assigned according to the costs and the aggregate benefits to regional products.
Road freight Transport	The score is assigned according to the improvement produced by the project.
Mining & Resource Development Access	The score is assigned according to the impact of the project to the welfare standards for those dependent on mining and other resource based industries.
Tourism	The score is assigned according to the improvement of the services to the tourists.

(Main Roads Western Australia 2001).

Road Improvement

Investment Efficiency*:*

Improvement Expenditure Improvement works (including reconstruction) are undertaken to maintain and improve the capacity of the existing road network through works that improve road standards and incorporate major geometric improvements.

Investment Effectiveness**:**

- **Road Standards** is a demand related measure of the effectiveness of improvement expenditure;
- **Road Network Permitted for Use by Heavy Freight Vehicles** The use of larger vehicles with greater payloads can increase the overall efficiency of freight operations, resulting in lower transport costs.

New road construction

- Improved safety and access
- Regional growth
- Resources development

- Tourism opportunities
- Reductions in congestion, pollution and travel times

Department of Main Roads, Western Australia developed a Multi-Criteria Analysis model for rationally prioritising road projects (De Silva & Tatam 1996). The criteria used in the approach are Benefit-Cost ratio, state ad national economy, local business community, contribution to regional product, road freight transport, mining and resource development and tourism. In comparison with conventional Benefit-Cost Analysis, the model had the advantages in addressing social equity and investment efficiency. It is explained in details in Table 1.

In workshop for Department of Main Roads, Western Australia, Lang (1998) pointed out that "The real challenge for future policy maker is human and social factors; balancing the myriad of community interests, values, ethics, and morals." New indicators are needed to accommodate the challenge. The author suggested a sample of components, which were chosen by community to measure progress towards their vision for the future.

Sample components related to transport include:

Liveability/amenity/mobility
Average daily vehicle hours of delay on the freeway system
Number of adverse lifestyle habits such as not wearing seatbelts
Number of fatal and injury accidents involving at least one car
People reporting commuting time 25 minutes or less
Average number of bus riders per 1000 population on a weekday
Average weekday miles of the bus service
Community appearance
Response time of emergency services
Worker commuting patterns
Fuel consumption

Health
Number of motor vehicle deaths
Number of coronary heart-disease deaths
Rates of sedentary lifestyle
Number of people overweight

Environment
Number of days per year that air quality standards are exceeded
Number of trees
Energy use and CO2 emissions
Maximum concentration levels of air pollutants
Percent of people who perceive pollution as a priority
Water run-off flows
Energy consumption per person
Vehicle kilometres travelled

Infrastructure/travel demand
Proportion of transit service miles to total street miles
Waiting time at signalised intersections
Average number of passengers per vehicle
Availability of centralised parking space
Number of bicycle route miles
Level of government funding
Geographic coverage in state
Physical environment bridges/roads
Road congestion

Modal split
Percent of population without cars
Number of vehicles registered
Percent of subsidy spent on public transit
Percent of subsidy spent on private transportation
Vehicles entering city by mode
Pavement condition

Transport service level
Accessibility to and reliability of transportation services for seniors and the disabled
Transportation options
Average number of public transport patrons
Bus headways within 30 minutes peak and 60 minutes non-peak
Number of crimes on transit

Governance
People who rate government leadership as good or excellent
Government leadership, ethics and access
Percentage of citizens who are satisfied that government services are necessary, responsive and cost effective
Percentage of citizen volunteers in a governmental advisory capacity who are satisfied that their recommendations were carefully and respectfully considered
People feeling public services are frequently effective

3.3 Victoria

VicRoads (OECD 2001b) uses both outcome-based and efficiency criteria to monitor its performance at strategic level. One example is the use of the "Smooth travel exposure" indicator to monitor road conditions. This criterion has been cascaded down from the state level to regional level to assist in the determination of road maintenance priorities. As part of the budgetary planning cycle, VicRoads uses the criteria, such as travel time, road maintenance, etc. in support of its budgetary submissions. The advantage of this approach is that it focuses the debate and establishment of priorities on the real objectives for the road system sought by stakeholders.

At tactical level, VicRoads' practice is based on economic terms (1998). VicRoads' road maintenance strategy uses road roughness and road user costs as major criteria. Maintenance efficiency is measured by minimise life-cycle cost of the road. The maintenance priority is given to high-speed roads.

3.4 Queensland

Department of Main Roads, Queensland (DMR) is the government agency in charge of the investment and management of Queensland's prime public road infrastructure. The current practice of project evaluation for capital work and major maintenance follows a " Two-stage" process, including Benefit-Cost analysis and multiple non –cost factor analysis. The detailed information is included in Chapter 7.

4 EVALUATION METHODOLOGY (INCLUDES FUND ALLOCATION)

In current Australian practices, Benefit-Cost Analysis (CBA) is the dominant methodology used in prioritising road projects. Multi-Criteria Analysis (MCA), which has stronger ability in accommodating multi-objective decision-making than CBA, has been adopted by some state road authorities. However, the use of MCA is in preliminary stage and mostly based on individual consideration of projects, e.g. environmental assessment of a proposed project conducted by a consulting company.

4.1 New South Wales

Until 1996 the RTA allocated road maintenance funds with a strong historical bias. The Road Network Infrastructure Maintenance Program now seeks to maintain the network as a long-term renewable asset.

Project Priorities

As shown in Table 2, in allocating funds for State Funded Roads first priority is given to ensuring access to, and safety of, roads and bridges.

Second priority is given to improving pavement condition to minimise wear utilizing pavement rehabilitation to improve route smoothness. Funds are allocated according to the routes:

- Strategic importance
- Use by freight
- Traffic volume
- Travel speeds

Table 2 Project Priorities for State Funded Roads

Priority	PROGRAM AREA	Activities
1	Access/availability of State Roads for travel	Major repairs to (non bridge sized) culverts Structural bridge maintenance Repairs to slopes and retaining walls rehabilitation of causeways
2	Management of risks to Safety Outcomes	Routine and heavy patching of pavements Maintenance of roadside vegetation obscuring traffic facilities Rehabilitation of lane and shoulder widths
3	Management of risks to Asset Integrity	Roadside drainage Pavement resurfacing/bridge repainting
4	Delivery of Pavements Levels of Service	Pavement rehabilitation

(NSW Audit Office 1998)

Regional Asset managers recommend the nature and level of maintenance needed for roads and bridges. This recommendation is based on the standards for, and service level required

from, the road network or bridge. Once approved, a Project Brief is prepared for each project, which defines the extent of the intervention required.

The RTA follows better practice in planning for and setting priorities in road maintenance projects. The RTA:

- Supports the life cycle approach to road maintenance. In this sense, the RTA supports the OECD Engineering-Economic approach to road maintenance and Austroads Asset Management principles

- Attempts to consider whole of life cycle costs in determining priorities. Some costs are not factored in e.g. all costs associated with environmental and heritage assessment and management. This issue is examined later in this report

- Requires evaluation of project candidates at regional level and business cases to be considered centrally for projects of statewide importance.

4.2 South Australia

A Special Local Roads Program was established under the joint approvals of the South Australian Government (2001), Commonwealth Government and Local Government. The program commenced in 1985-86 and facilitates funding of significant works throughout the State.

In South Australia, the identified local road grants pool is divided into formula grants (85%) and special local road grants (15%).

The formula component is divided between metropolitan and non-metropolitan councils on the basis of an equal weighting of road length and population. In the metropolitan area, allocations to individual councils are determined again by an equal weighting of population and road length.

In the non-metropolitan area, allocations are made on an equal weighting of population, road length, and area of council.

Distribution of the special local road grants is based on recommendations from the Local Roads Advisory Committee. This Committee is responsible for assessing submissions from regional associations on local road projects of regional significance

4.3 Western Australia

De Silva and Tatam (1996) proposed a methodology for identifying road investment proposals in a multiple objective decision environment. A number of outcome criteria, which cover a wide range of social, environmental, economic issues, were identified in the study. The impact of a road project was assessed as highly detrimental, detrimental, neutral, beneficial or highly beneficial. The impacts were translated into corresponding criteria scores. The proposed road projects are ranked based on their scores. Better social equity and investment efficiency can be achieved through the MCA process.

Efforts (Taplin et al 1996) were given to study policy-sensitive selection and phasing of road investments in Western Australia through a Goal Programming (GP). Five economic benefits and twelve environmental, developmental and accessibility objectives constitute the goals in a rural road project. The non-economic objectives were converted into money value based

on the project cost. The authors agreed that the procedure was arbitrary and merely a starting basis from which policy priorities could be explored by varying the priority weights

4.4 Victoria

According to the annual report of VicRoads (2001), VicRoads is conducting the first major Australian trial of the HDM-4 road pavement management software package in the Metropolitan North Region. HDM-4 will be implemented across VicRoads in 2001-2002.

Two maintenance strategies were implemented, Stitch in Time (1993-1994) and Victoria's Bridges Strategy (1995). A road maintenance program is developed, which balances community and economic priorities within available funds, covering projects which:

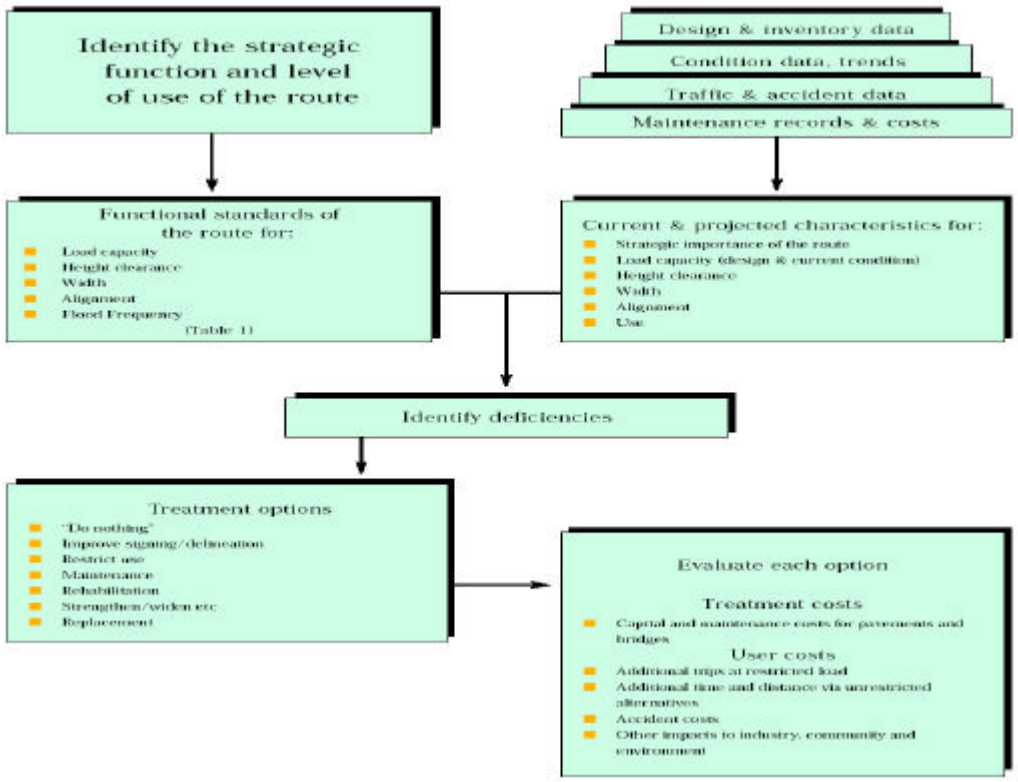
- Address deficiencies in road conditions;
- Reduce vehicle operation costs; and
- Prevent the need for future expensive reconstruction.

In order to making informed allocation decisions, the following performance measures need to be identified:

- The quantity of outputs to be delivered;
- The quantity or standard of outputs expected;
- The timeliness of delivery and
- The cost of output delivery.

In Victoria's Bridges (1995), benefit/cost ratio and net present value of the project should be evaluated (Figure 1). A standard spreadsheet package is available for this purpose. Maintenance expenditure proposals will be evaluated and prioritised considering unit costs against benchmarks and the expected effectiveness of the proposed treatment in reducing long-term management costs.

Figure 1 Bridge project evaluation process



(VicRoads 1995)

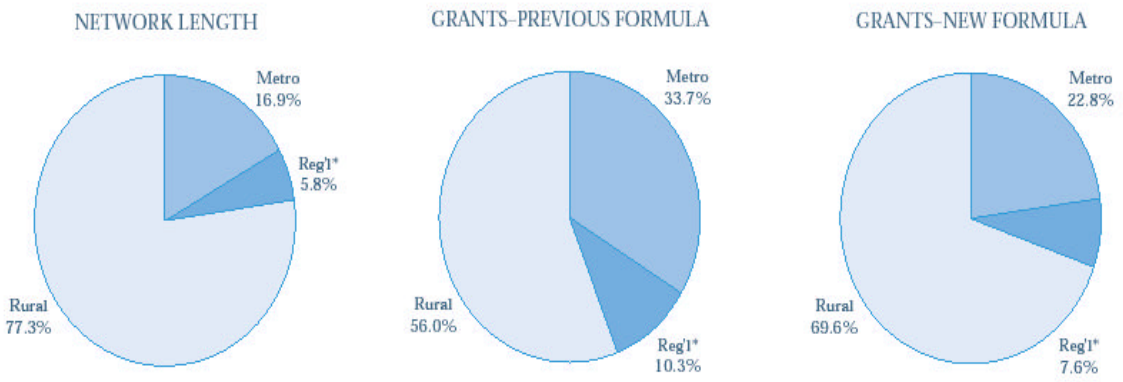
The formula used by the Victoria Grants Commission (2001a & 2001b) up to 2000/01 was based on each council's population and road length (sealed roads plus half the length of formed and surfaced roads) (Figure 2). Natural surfaced roads were not included. Loading factors were used to allow for variations among councils in topography and rainfall. The available funding was divided into three portions prior to allocation: 30% of the total pool was reserved for councils in the Melbourne, Geelong, Ballarat and Bendigo statistical divisions; 7% was shared by other urban councils; and the remaining 63% was allocated among all other councils.

In 2001–02, the Victoria Grants Commission introduced a new methodology for allocating local roads grants to councils. This followed an extensive consultation program that commenced in 1999.

The new formula for allocating local roads grants is based on road length for all surface types and traffic volumes, using average annual preservation costs for given traffic volume ranges. The new formula also uses a series of cost modifiers for freight loading, climate, materials, sub-grades and strategic routes to take account of local conditions.

Grant levels to a number of councils have changed significantly under the new formula. This is due in part to the removal of the artificial constraint in the previous model which arbitrarily provided guaranteed shares of the available funding to groupings of urban and regional councils.

Figure 2 Local Road Fund Allocation in Victoria



(Victoria Grants Commission, 2001b)

5 FINDINGS

A comprehensive national practices review in road investment decision-making is conducted (Table 3). The main findings of the review are as followings:

- The investment objectives of Australian road authorities are based on triple-bottom line considerations (social, environmental, economic and political) rather than are covered by Benefit-Cost Analyses or pure technical considerations. In some cases, comparing with some social considerations, such as regional economic development, equity, and access to pubic service etc., Benefit-Cost Ratio has limited influence on the decision-making.

- In current practices, single-objective approach, such as Benefit-Cost Analysis, is still the main decision support tool. This situation is not compatible with the triple-bottom line objectives. There is need to fill the gap between decision support tools and decision-making itself.

- Multi-Criteria Analysis, which is better in accommodating triple-bottom line decision-making, has been preliminarily used in case by case study in Australian road authorities. This forms a good basis for further improvement.

- There is need to develop or identify social environmental and political decision-making criteria under Australian conditions. The criteria are able to measure investment performance in relation to investment objectives.

- Social and political impacts resulted from road infrastructure investment can be identified through Community Perceptions Survey (Western Australia). With accumulative data, prediction models, which are similar as pavement performance models, can be established. Using these models, the decision-makers are able to foresee the social and political consequences of investment alternatives.

- Environmental issue plays a more and more important role in decision-making. However, the criteria and respective weights in decision-making process are yet to be clearly identified.

- The objectives of new construction, maintenance and improvement works are different. Different decision criteria should be adopted based on the contents of the work.

Table 3 Summary of National Practices in Road Investment Decision-Making

States	Current Practices	Models and tools
Western Australia	• *Benefit cost analysis* • *Assessment for social and environmental impacts*	• *Engineering economic model* • *Multi-criteria framework*
Victoria	• *Benefit cost analysis* • *More details to be identified*	• *Engineering economic model including user costs* • *HDM4*
New South Wales	• *Benefit cost analysis* • *More details to be identified*	• *Engineering economic model* • *Life cycle cost analysis*
South Australia	• *Benefit cost analysis* • *More details to be identified*	• *More details to be identified*

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