Pavement Stabilisation in Local Government & Policy Change for a Sustainable Future

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ABSTRACT
More than 90% of rural councils and 70% of urban councils do not have adequate funding to renew their assets that need to replaced or upgraded each year. This equates to a funding shortfall of between $400m and $600m per annum.

Campbelltown City Council is just one local government organisation that is reaping the direct and indirect cost benefits from using insitu stabilisation as a front line rehabilitation treatment in their road maintenance strategic plan. Since 1990 they have recycled 450,000m² of their roads, kept 9,000 trucks off their network resulting in 2.6 million less litres of diesel being consumed, they have saved 50,000m^3 of tip space and eliminated the need to exhaust non renewable materials to the tune of 115,000 tonnes.

Seven recommendations have been presented in this paper that will assist local government initially and the wider community in the long term on the journey towards providing sustainable roads.

KEYWORDS
Campbelltown City Council
Insitu Stabilisation
Sustainability
Pavement Recycling
Local Government
Policy Change

INTRODUCTION
Australia's road network comprises over 800,000km of pavement and the diverging gap between maintenance funds and required funds continues to haunt not only our political landscape, but our local government engineers as well, who taxpayers expect are closing this gap.

With Local Government representing only 5% of all governments in Australia [Ref.9], it is no surprise that most local councils through an understated lack of funding struggle to keep up with the economic demands required by road maintenance.

The way in which we approach maintenance strategies within our road networks needs to be reassessed and for significant change, policy adjustment is required.

This paper explores where insitu stabilisation has been used by Local Government and focuses on the sustainability and cost advantages that underpin the exact type of policy change that is needed. A case study is presented that highlights how Campbelltown City

Council has been embarking on this journey for two decades. It is proposed that the learnings achieved in Campbelltown City Council from twenty years of success using insitu stabilisation can be shared with other local government areas as a means to providing additional knowledge and therefore capability within their own network management framework.

It is assumed that the reader has a basic understanding of the process of insitu stabilisation and how it is executed on a project site. From a sustainability perspective and how insitu stabilisation as a maintenance technique is being aligned with a need for policy change at a local government level, the key focus in this paper is aimed at maintenance of pavement base course layers, as opposed to using the process in new construction.

HISTORY

Insitu Stabilisation has been used as an effective pavement rehabilitation treatment in Australia for over 60 years [Ref.5]. Recycling urban and rural base course materials is not a new practise in Australia. The process of improving the properties of a given soil through the addition of a binder and water has been adopted at all levels of government and the performance of roads that have been maintained using this technique has been measured and reported on many times.

In 1994, the NSW RMS (formerly RTA) carried out an extensive field study into the performance of deeplift stabilisation. The findings from this study revealed cost savings of up to 40% compared to traditional granular overlay treatments [Ref.6].

In 1996 Hodgkinson [Ref.7] reported the favourable economic performance of stabilised roads in local government, with savings of up to 50% of full reconstruction alternatives being observed. Local Council data from NSW, Victoria, Queensland and South Australia formed part of this study.

In 1998 a study was conducted by Hurstville City Council in Sydney, with a focus on the benefits obtained from adopting a pavement maintenance strategy that included insitu stabilisation for base course rehabilitation [Ref.6]. Some of the savings presented included:

- Cost savings to rate payers in the order of 60%
- Saved 111,000 tonnes of quarry products
- 200,000 litres of council fuel saved
- Reduced tipping space of some 61,600m^3

In 2005 a study into the environmental and social advantages of using pavement recycling techniques [Ref.4] not only supported the direct cost saving potential, but exposed the indirect cost savings associated with social and environmental benefits. The example of a deteriorated pavement rehabilitated using insitu stabilisation versus a deeplift asphalt treatment with an equivalent design life revealed indirect cost savings of 63%. Clearly these contribute strongly to the sustainable outcomes being sought by local government and further exploitation of these successes are needed.

With such well supported performance data available, it is interesting to consider why pavement recycling is not used more as a frontline maintenance technique. Today the use of stabilisation at a local government level is continuing to grow, however there are significant variances in the levels of acceptance of the process. Orange City Council and Wagga City

Council in the central west and south west of NSW have owned their own stabilisation equipment for many years and consider this treatment to be an invaluable tool in their maintenance strategy. Yet there are far more examples of Councils - with differing levels of funding streams and volumes - who do not engage in the use of this process. Arguably these Councils may not be providing their communities with the greatest opportunity to embed a sustainable culture and hence a sustainable road network.

WHY IS POLICY CHANGE NEEDED

More than 90% of rural councils and 70% of urban councils do not have adequate funding to renew their assets that need to replaced or upgraded each year. This equates to a funding shortfall of between $400m and $600m per annum [Ref.9].

Sustainable local roads are paramount to reversing the shortage of available funds to maintain our deteriorating networks. In NSW there are 5.6million registered vehicles that has grown at a rate of 2.3% year on year [Ref.1]. Compare this to the NSW population that has been growing at a rate of 1.1% year on year as shown in Figure 1.

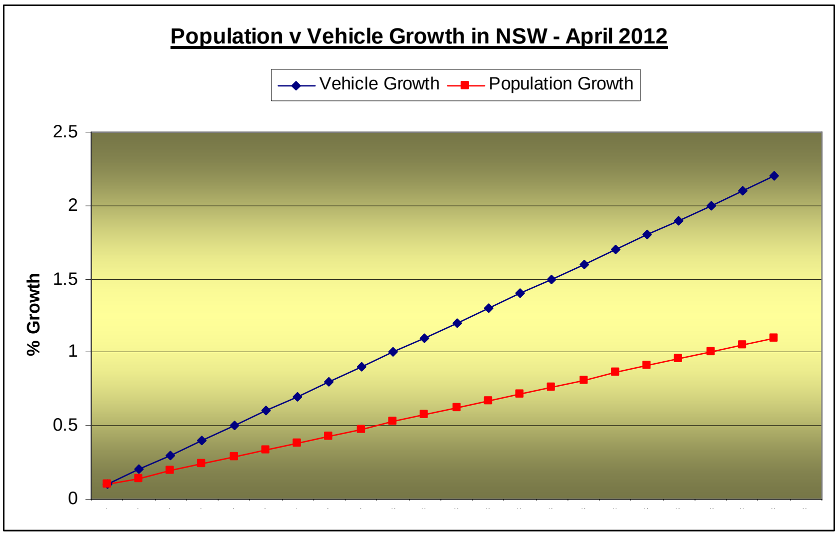

Figure 1 Vehicle v Population Trend in NSW

This clearly illustrates the impact on our road network as more and more vehicles per capita impart load and therefore distress onto our pavements. As a consequence, increased funding is required for construction of new roads to ensure they have sufficient load carrying capacity. This then results in less funding being available for maintenance and hence the viscous cycle of divergence surrounding available funding versus required funding continues.

Sustainable practises are generally well understood in the maintenance sector, however they are not executed at levels that are available. Often this is because benefits relating to a sustainable approach are not tangible at a direct cost level, but positively impact on the environment and community as indirect cost savings. Sustainability in pavement maintenance over the life cycle is achieved by [Ref.2]:

- Reducing waste and subsequent use
- Reducing energy consumption
- Reducing pollution

- Minimising material transportation
- Minimising use of quarried materials
- Reusing materials wherever possible
- Reducing impact on the people and communities

These sustainable practises can be best illustrated by the waste minimisation hierarchy shown in Figure 2.

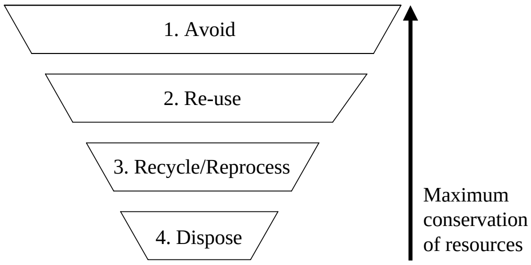

Figure 2 Waste Minimisation Hierarchy [Ref.6]

Acknowledgement and recognition of direct cost benefits using insitu stabilisation over other rehabilitation alternatives is not the argument in this case. If we as a community are to be serious about truly developing a sustainability culture within our pavement maintenance approach with an objective of closing the gap on funding divergence, then indirect cost benefits must form part of the overall treatment selection process.

The Bureau of Infrastructure, Transport and Regional Economics uses the Road Construction and Maintenance Price Index (RCMPI) to measure movement in key inputs used in construction and maintenance in Australia [Ref.3]. The key inputs are:

- Cost of asphalt
- Cost of sand
- Salaried and other labour costs
- Cost of diesel
- Cost of concrete
- Cost of plant hire and depreciation
- Cost of other inputs

Figure 3 illustrates the movement of the RCMPI since 1992.

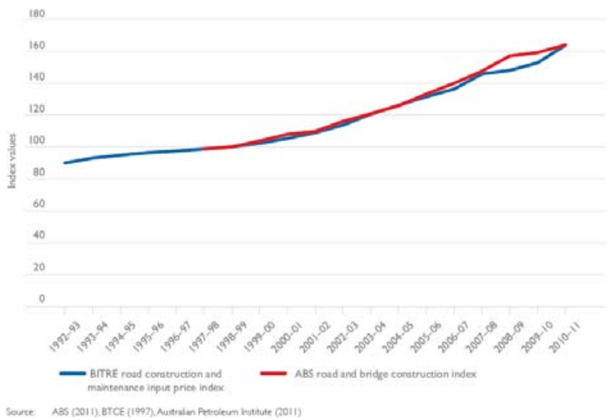

Figure 3 Road Construction and Maintenance Input Price Index [Ref.3]

The relative movement over this 18 year period is 82% from the 1992/93 baseline, or approximately 4.5% on average, year on year. Compared to an average rate of inflation over the same period of 2.65% [Ref.10], it is obvious that a strategic approach to reducing or slowing down the rate of increase of the RCMPI will provide a positive outcome towards achieving sustainable local roads.

Hence the objective should be to consider which of these inputs can be targeted for reduction and identify how they relate to the use of insitu stabilisation in local government. In evaluation of the key inputs and their direct relationship to movement of the overall RCMPI, weightings are applied to each input. Table 1 demonstrates each weighting accordingly.

Table 1 Weights used in RCMPI [Ref.3]

Input	RCMPI Weighting
Fuel	6.8
Concrete	9.7
Other materials	10.8
Bitumen/asphalt	12.0
Quarry products	15.3
Plant hire/lease	19.6
Labour	25.8
Total	100.0

Review of these weightings highlights the importance of time that a maintenance project takes. With labour, equipment and fuel contributing over half (52.2%) of the total price index, it makes sense that maintenance treatments that are completed quicker have the greatest impact on influencing a reduction in the price index and generating a sustainable local roads policy.

When comparing a typical insitu stabilisation treatment against a granular overlay for a rural project or an asphalt treatment for an urban project, the bitumen/asphalt and quarry products inputs offer additional areas of focus, with another 27.3% of the overall price index being influenced by these two elements.

Effectively these price index inputs can be categorised into two simple definitions:

1. Time (labour, equipment and fuel)
2. Depletion of Renewable Resources (quarry materials, bitumen/asphalt and fuel)

The ensuing case study will explore how Campbelltown City Council has been able to take advantage of indirect cost savings by embracing the process of base course insitu stabilisation as a rehabilitation treatment, while at the same time minimising key price index inputs.

CASE STUDY - CAMPBELLTOWN CITY COUNCIL

Although today there is still some reluctance to accept road recycling by insitu stabilisation as a long term and sustainable approach to managing road networks by some local government areas, Campbelltown City Council (CCC) in Sydney's south west corridor believe that recycling their road pavements is continuing to provide successful and sustainable outcomes for the management of their road network. This is based on sound performance results and the provision of economical benefits to the ever challenging shortage of funds required in local government to satisfy the increasing expenditure needed to maintain roads to the standards expected by rate payers.

This case study will explore the stabilisation projects that have been completed by CCC in the period 1990 to 2011 inclusive. During this period, CCC has executed approximately 455,000m² of rehabilitation projects using stabilisation. Table 2 shows the breakdown of this area by road classification.

Table 2 Stabilisation History in Campbelltown City Council 1990-2011

Road Classification	**Area Treated (m²)**	**Proportion**
Local Residential	43,738	35%
Collector/Bus Route	247,888	55%
Regional/Arterial	157,656	10%
Total	449,282	100%

The above history represents 192 separate projects (refer detailed project listing in Appendix A), which for the sake of this review resulted in CCC executing an average of nine projects per year at circa 2,325m² each.

Upon CCC completing a stabilisation treatment, either a sprayed seal or asphalt wearing course would be applied. Although several varied pavement design configurations have been adopted by CCC, it is reasonable to demonstrate Council's typical approach to design outcomes as shown in Figure 4 where two designs represent treatments applied with and without level control respectively.

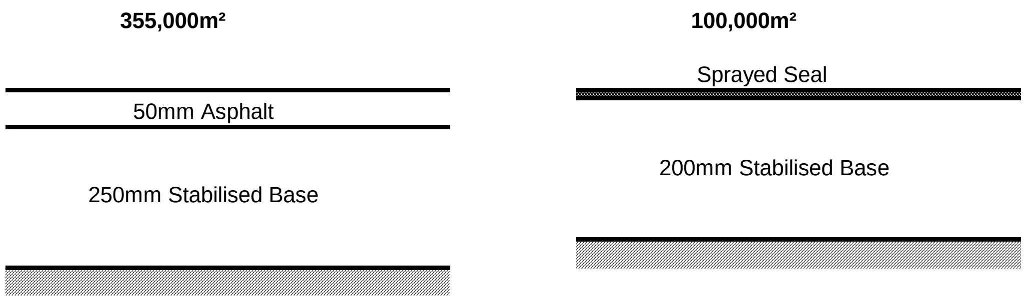

Figure 4 CCC Typical Stabilisation Designs

The alternate urban pavement if these designs were not utilised according to CCC would have been a full depth asphalt pavement. Figure 5 shows this alternate which for clarity reflects a typical design adopted by CCC in other locations within the city.

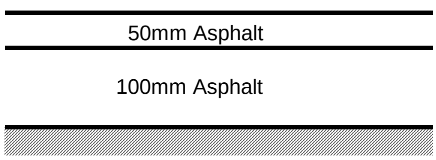

Figure 5 CCC Typical Full Depth Asphalt Design

It is worth noting that although CCC is a metropolitan based Council, the options shown in Figure 4 can apply equally in regional and rural locations. The only difference is that the majority of alternate pavements in rural locations where no level control exists would most likely result in a different design to that shown in Figure 5. A granular overlay alternative is shown in Figure 6. Use of this alternate in this paper is considered conservative, as many regional/rural Councils in NSW in addition to adopting this treatment also utilise granular and asphalt reconstruction methods.

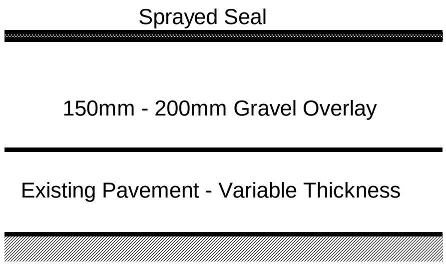

Figure 6 Regional/Rural Pavement Design Alternative

Evaluation of the key price index inputs outlined earlier against the pavement designs shown in Figures 4, 5 and 6 reveal a number of varying outcomes. Table 3 lists the primary input elements along with additional indirect cost elements for each of the rehabilitation treatments. The data provided has been extrapolated across the 455,000m^2 of stabilisation projects completed by CCC in the 21 year analysis period.

Table 3 Indirect Cost Inputs

		Figure 4 Stabilisation	**Figure 5 Full Depth Asphalt**	**Figure 6 Gravel Overlay**
A	Material to be disposed (tonnes)	37,275[1]	135,870	0
B	Equivalent tipping space (m^3)	17,750	64,700	0
C	Quarry products to be imported (tonnes)	40,470[2]	155,610	200,200[3]
D	Number of cartage trucks for disposal & importing	918	9,546	3,840
E	Fuel consumption for D (litres)[4]	275,400	2,863,800	1,152,000
F	CO^2 Emissions for D (tonnes)	744	7,732	3,110
G	Project duration (shifts)[5]	384	576	576

1. Material disposal based on requirement to maintain level control.
2. Required for the 50mm asphalt wearing course.
3. Total thickness of 200mm.
4. Six hours per shift per truck & 50 litres per hour consumption (300l/truck/day)
5. Per 2,325m2 section - Fig 4: 2 shifts; Fig 5: 3 shifts; Fig 6: 3 shifts

Some of the above key advantages that CCC have realised are displayed in Figures 7 through 9.

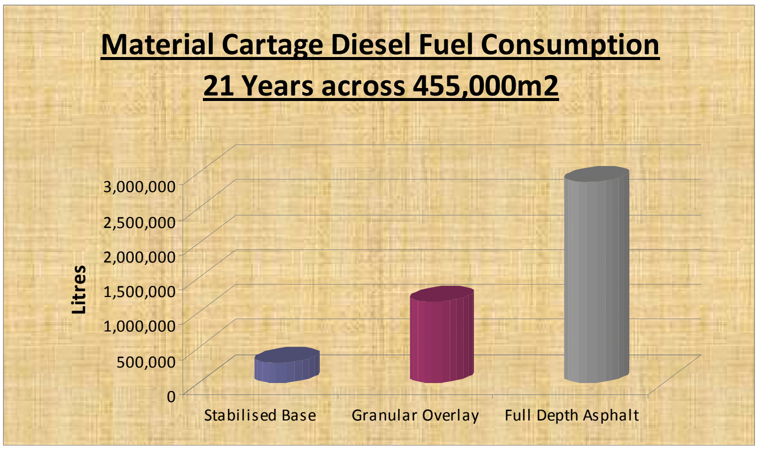

Figure 7 Fuel Savings by Treatment Type

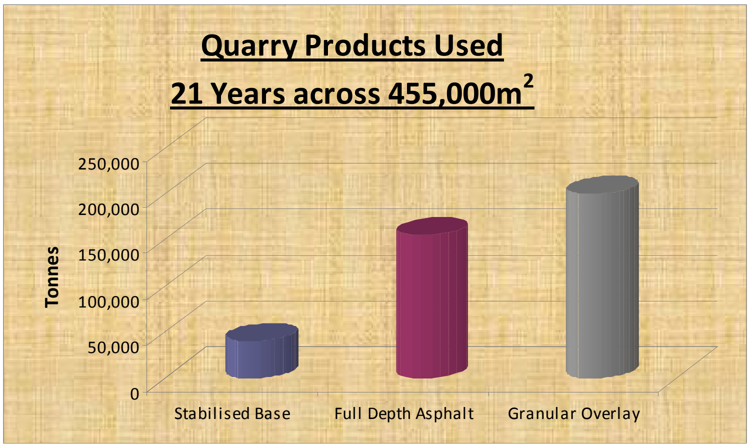

Figure 8 Non Renewable Material Usage by Treatment Type

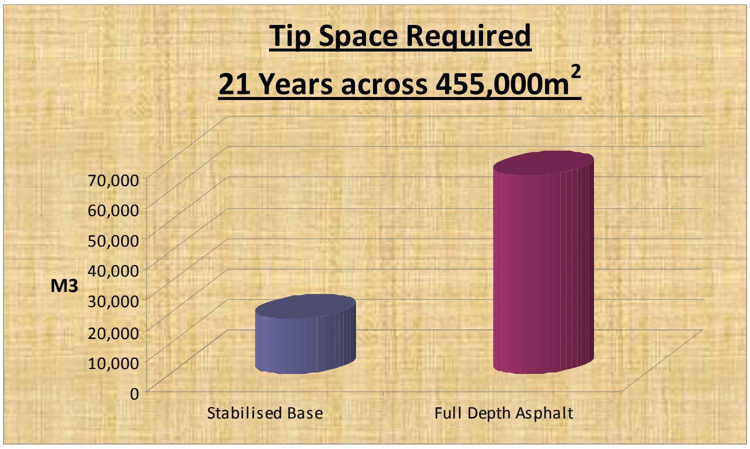

Figure 9 Tip Space Savings by Treatment Type

The following observations can be made upon review of Table 3, split amongst comparisons within the CCC rehabilitation strategy and theoretical comparisons with regional/rural assumptions in place:

Urban Comparison - Stabilisation v Full Depth Asphalt

By using stabilisation, Campbelltown City Council has been successful in...

- saving ~100,000 tonnes or ~ 50,000m3 of tip space
- eliminating the need to use ~115,000 tonnes of non renewable materials
- keeping nearly 9,000 trucks off the CCC road network during rehabilitation
- eliminating the use of ~2.6million litres of diesel fuel
- emitting ~7,000 less tonnes of CO^2 into the atmosphere
- eliminating maintenance related traffic disruption for ~200 shifts, or two weeks every year

<u>Regional/Rural Comparison - Stabilisation v Gravel Overlay</u>

By using stabilisation, one Regional Council over the same analysis period has the ability to...

- eliminate the need to use ~160,000 tonnes of non renewable materials
- keep nearly 3,000 trucks off the road network during rehabilitation
- eliminate the use of ~0.9million litres of diesel fuel
- emit ~2,400 less tonnes of CO^2 into the atmosphere
- eliminate maintenance related traffic disruption for ~200 shifts, or two weeks every year

Apart from the direct cost benefits associated with the use of stabilisation as has been reported in detail many times before, clearly there are further significant benefits to be realised by local government.

RECOMENDATIONS

The following recommendations and future actions are proposed for consideration amongst local government:

1. Establish a benchmarking system within local government that facilitates comparisons to be made across various levels of performance from design, planning, execution and review of maintenance projects.
2. Establish productivity targets for maintenance programs that revolve around time, direct and indirect cost savings.
3. Facilitate the implementation of indirect cost saving targets within annual budgets.
4. Review long term planning for road maintenance to ensure all life cycle analyses which include indirect cost savings are included and total benefits are realised, rather than focus primarily on upfront capital costs.
5. Establish a financial rebate system that recognises achievement of minimum indirect cost saving targets that impact positively on our economy, culture and community.
6. Work with industry to develop and enhance educational programs that will assist local government to obtain a greater knowledge base of how insitu stabilisation processes can provide benefit and strive to achieve a sustainable road network.
7. Establish a legislative framework that limits the use of non renewable resources that can be used in direct and indirect mode for maintenance activities [Ref.8].

CONCLUSION

With Local Government representing only 5% of all governments in Australia, it is no surprise that most local councils through an understated lack of funding struggle to keep up with the economic demands required by road maintenance. No matter how many reviews, inquiries or economic reforms are proposed or implemented, history supports the simple fact that policy change is required if local councils are to develop sustainable roads.

Campbelltown City Council is just one local government organisation that is reaping the direct and indirect cost benefits from using insitu stabilisation as a front line rehabilitation treatment in their road maintenance strategic plan. There are numerous other examples of local councils who have recognised similar benefits. Conversely there are other councils who have not.

Campbelltown City Council have recognised significant cost savings that contribute directly to their sustainable road network, simply because they understand the associated benefits. Since 1990 they have recycled 450,000m^2 of their roads, kept 9,000 trucks off their network resulting in 2.6 million less litres of diesel being consumed, transformed and emitted into their atmosphere, they have saved 50,000m^3 of tip space and eliminated the need to constantly exhaust non renewable materials to the tune of 115,000 tonnes.

There are a total of seven recommendations that have been presented in this paper that will assist local government initially and the wider community in the long term on the journey towards providing sustainable roads.

ACKNOWLEDGEMENTS

This paper would not have been possible if it were not for the valuable assistance and data provided by Campbelltown City Council in preparation of the case study. Particular thanks must go to Council's Coordinator Asset Services, Mr Mahbub Hossain for his assistance.

REFERENCES

1. NSW Government (2012), *NSW and Sydney Transport Facts*, Bureau of Transport Statistics, Haymarket NSW

2. AustStab (2011), *Pavement Recycling And Stabilisation Guide*, North Sydney NSW

3. Australian Government (2011), *BITRE Road Construction and Maintenance Price Index 2011 Update, Information Sheet 42*, Department of Infrastructure and Transport, Bureau of Infrastructure, Transport and Regional Economics, Canberra ACT

4. Smith. W (2005), *Recognition of Environmental and Social Advantages of using Stabilisation in Road Rehabilitation*, IPWEA NSW Division Annual Conference

5. Vorobieff. G (1998), *Performance and Design of Insitu Stabilised Local Government Roads*, Technology Transfer Seminar, Brisbane QLD

6. Vorobieff. G (1998), *The Australian Experience*, Proceedings of National Pavement Stabilisation Strategies for the Future, Rotorua NZ

7. Hodgkinson. J.R. (1996), *Long-Term Performance of Local Government Road Pavements Recycled by Cement Stabilisation*, Joint AustStab and C&CAA Road Recycling Seminar

8. Wilmot. T (2003), *Strategies for Sustainable Roads*, 21st ARRB Conference, Cairns QLD

9. Independent Inquiry (2006), *Are Councils Sustainable?*, Final Report: Findings & Recommendations from the Independent Inquiry into the Financial Sustainability of NSW Local Government, Sydney NSW

10. Reserve Bank of Australia (2012), *Measures of Consumer Price Inflation*, Statistical Tables, Sydney NSW

AUTHOR BIOGRAPHY

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