

BTCE Road Construction and Maintenance Price Index

Information Paper

The revised Bureau of Transport and Communications Economics road construction and maintenance price index (RCMPI) is designed to allow the Australian road industry to monitor price movements of inputs to road construction and maintenance.

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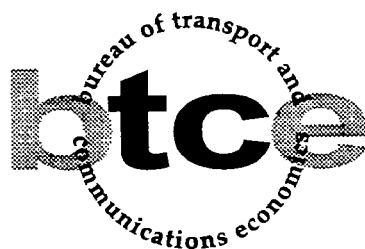
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BTCE ROAD CONSTRUCTION
and
MAINTENANCE PRICE INDEX



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FOREWORD

Indexes for road construction and maintenance costs are used by various federal, state and local government authorities, particularly for estimating the level of real expenditure on roads.

The regimen and weights used in the BTCE road construction and maintenance price index until recently were well over a decade old. Significant technological change, and the shift to contracting out government service functions, made revision of the index imperative.

K.Y. Loong and P.F. Sydney prepared the paper.

The bulk of the work was undertaken under the supervision of the previous Research Manager, David Luck. Brett Evill reviewed the calculations. Leo Dobes reviewed the paper and supervised its finalisation.

Dr Leo Dobes
Research Manager

Bureau of Transport and Communication Economics
Canberra
October 1996

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SUMMARY

The revised Bureau of Transport and Communications Economics road construction and maintenance price index (RCMPI) is designed to allow the Australian road industry to monitor price movements of inputs to road construction and maintenance. It is an input-price index and so does not measure movements in the actual cost of the provision of roads. Nor does it reflect changes in productivity in road construction and maintenance.

Input components for the RCMPI include salaried labour, other labour, bitumen, concrete, quarry products, plant hire and depreciation and fuel. Where possible, time series for these input components are based on nation-wide information.

Weightings for the input-price components have been revised to keep up with changes that have taken place in the road construction and maintenance industry. Weights are based on information obtained from surveys of state road authorities, local government authorities and private contractors. The overall input component weights are shown in table 3.4.

A significant finding is that the weight for the total labour component for all groups has been revised from the BTE's 1982 weighting of 56 per cent, to 26 per cent. This reflects substitution of capital equipment for labour by state road authorities, improved technologies, and a growing trend towards contracting out of road construction and maintenance activities.

The revised BTCE index for the decade 1984–85 to 1994–95 is presented in table S.1 and figure S.1.

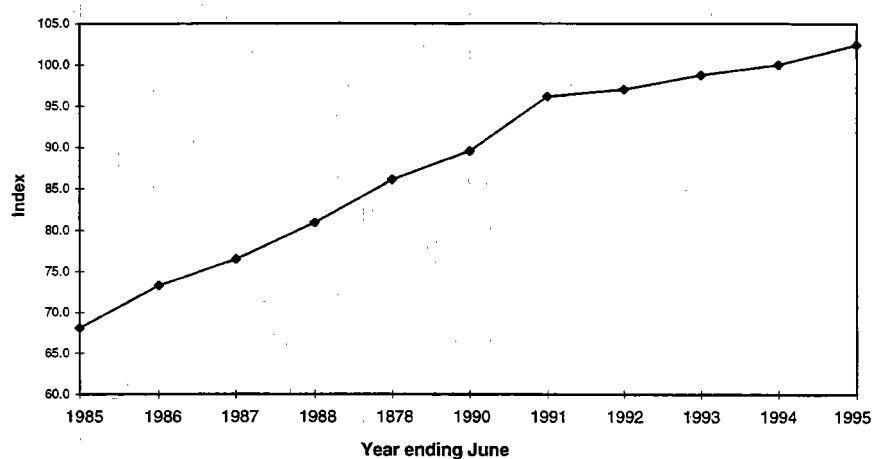
TABLE S.1 BTCE ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX
(1993-94 = 100)

Year ending June	Previous index	Current index
1985	68.1	
1986	73.3	
1987	76.4	
1988	80.9	
1989	86.1	
1990	89.5	
1991	96.2	
1992	97.0	
1993	98.8	
1994	100.0	100.0
1995		102.4*

* This figure revises the figure published for 1994-95 in *Transport and Communications Indicators*, March Quarter 1996.

Source BTCE.

FIGURE S.1 BTCE ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX
(1993-94 = 100)



Source BTCE estimates.

CHAPTER 1 INTRODUCTION

The BTCE road construction and maintenance price index (RCMPI) is an input-price index intended to reflect trends in prices of major input components of road construction and maintenance. It provides a means for calculating real changes in road expenditures and government road funding levels.

Road construction and maintenance price indexes have been developed in Australia by both federal and state road agencies. One of the earliest Commonwealth contributions in this area was by the Commonwealth Bureau of Roads (CBR). After the amalgamation of the CBR and the Bureau of Transport Economics (BTE) in 1976, the BTE continued to develop road construction price indexes (BTE 1978).

In 1981, the BTE substantially revised its index. The new index was an input-price index (with no adjustment for productivity) based on inputs actually purchased by the industry (for example, salaries, materials and plant). Since then, the basic methodology has remained the same with the same weightings used for inputs.

Significant changes have occurred since 1981 in the road construction and maintenance industry including:

- increased use of contractors for both road construction and maintenance;
- improved technology in road building; and
- greater use of capital equipment as a substitute for labour.

These industry changes have in turn led to changes in the relative proportions of input components used in road construction and maintenance. It was therefore considered timely to review and update the weightings used in the BTCE index.

The option of supplementing the BTCE index with an index used by one of the state road authorities (or some weighted average) was not attractive because a number of states have discontinued estimation of indexes (appendix I) and weightings used by the others would have needed updating. Reliance on an ABS index such as the consumer price index (CPI) or the implicit price deflator for materials used in building other than house building was also considered unsatisfactory because of differences in movement over time (table 3.15).

CHAPTER 2 THE PREVIOUS BTCE INDEX

A number of different types of cost and price indexes for road construction activity can be used to gauge changes in expenditure of input components, including:

- input-price indexes;
- input-cost indexes;
- output-cost indexes;
- implicit price deflators.

BTE (1982) presented a comprehensive review of indexes which had been compiled by the CBR, the BTE, and state road authorities. BTCE (1989) also reviewed early indexes. A summary of the current status of state road authority (SRA) road construction price indexes is presented in appendix I.

The previous BTCE road price index was an input-price index designed to reflect trends in prices of major input components of road construction using, where possible, nation-wide information.

The index was derived from three sub-indexes based on:

- road construction by state road authorities (based on information received from NSW and Queensland);
- road construction by local government authorities (LGAs) (based on information received from a survey of 250 authorities in 1981); and
- road maintenance activity (originally based on maintenance work undertaken by both SRAs and LGAs in 1981).

The relative weights of the three sub-indexes were based on table 6.3 of BTE (1979). This table provided estimates of road expenditure by road category for the period 1974–75 to 1978–79, on the simplifying assumption that all local roads were constructed by LGAs and all other roads by SRAs. The weights used were:

- SRA construction sub-index, 34 per cent;
- LGA construction sub-index, 35 per cent;
- maintenance sub-index, 31 per cent.

The three sub-indexes were compiled from the following six common input components:

- salaried labour;
- other labour;
- fuel;
- bitumen;
- other materials; and
- plant acquisition and replacement.

A potential seventh component of 'property acquisition' could not be included for lack of suitable data. The component weights for each of the sub-indexes and for the BTCE index are shown in table 2.1.

TABLE 2.1 COMPONENT WEIGHTS USED IN THE PREVIOUS BTCE INDEX
(per cent)

<i>Component</i>	<i>Maintenance</i>	<i>Construction</i>		<i>Total activity (BTCE index)</i>
		<i>SRAs</i>	<i>LGAs</i>	
<i>Labour</i>				
Salaried	15.9	22.8	20.4	19.7
Other	44.1	32.1	32.1	36.1
Total labour	60.0	54.9	52.5	55.8
<i>Materials</i>				
Fuel	11.7	9.1	10.3	10.4
Bitumen	6.2	9.3	9.4	8.3
Other	14.6	20.9	18.2	17.9
Total materials	32.5	39.3	37.9	36.6
<i>Plant acquisition and replacement</i>	7.5	5.8	9.6	7.6
<i>Total</i>	100.0	100.0	100.0	100.0

Source BTCE (1989, p.7).

CHAPTER 3 REVISION OF THE BTCE INDEX

The previous BTCE index included six components to represent the inputs used in constructing and maintaining roads by state and local government authorities, but not contractors:

- salaried labour;
- other labour;
- bitumen;
- other materials;
- plant acquisition and replacement; and
- fuel.

Road construction and maintenance costs are affected by design standards such as horizontal and vertical alignment, pavement types and road cross-sections, the availability of road making materials, terrain and geological conditions, environmental factors such as climate, rainfall and drainage characteristics, as well as factors such as land acquisition and traffic control devices. Ideally, the composition of an index should encompass most of these factors. In practice, any new components or breakdown of existing items would depend on the availability and the timeliness of existing national price indexes needed to capture component price changes.

Input components which reflect the costs of property acquisition and traffic control devices have not been included because they are not universally applicable to both urban and rural roads. It is recognised, however, that in urban areas these costs may comprise a substantial portion of the total costs associated with road construction.

NEW INPUT COMPONENTS

After consultation with a number of SRAs and local councils and taking into consideration data availability, two additional input components have been added to the previous index:

- concrete; and
- quarry products.

Their addition provides a better representation of materials used in road construction and maintenance. Together they contribute about 52 per cent of the total materials component weighting in table 3.4.

DISAGGREGATION OF ROAD CONSTRUCTION AND MAINTENANCE ACTIVITIES

In BTE (1982), road construction and maintenance activities were disaggregated into three sectors:

- construction by the state road authorities (SRAs);
- construction by the local government authorities (LGAs); and
- total maintenance.

At the time, this level of disaggregation was considered feasible in terms of data availability. It was selected because it identified three major sectors of road construction activity which differed in terms of composition of inputs.

Although the proportion of LGA and SRA road construction and maintenance works undertaken by contractors varies widely, the incidence of contracting out is increasing. Road construction technology and road maintenance practices have also changed significantly in recent years. An example is the widespread use of geotextiles in conjunction with a sprayed bituminous film to create a bitumen impregnated interlayer between the existing pavement and the new surfacing treatment.

In order to reflect these changes, the level of disaggregation, together with the composition and the weighting for the price or cost of each of the input components, has been revised. Accordingly, road construction and maintenance activities have been disaggregated into three sub-indexes:

- road construction and maintenance by LGAs;
- road construction and maintenance by SRAs; and
- road construction and maintenance by contractors.

DEVELOPMENT OF THE REVISED BTCE INDEX

Revision of the BTCE index involved three steps:

- estimation of the proportion of road expenditure accounted for by SRAs, LGAs and contractors;
- determination of input component weightings; and
- derivation of movement in the revised BTCE index in 1994–95.

Proportions of road expenditure by SRAs, LGAs and contractors

Total expenditure levels for both construction and maintenance of roads are provided in ABS (1996). These expenditure levels are then used in conjunction

with the survey results to derive the breakdowns of total road expenditures for SRAs, LGAs and contractors for each state and territory.

Road construction and maintenance activities are carried out by LGAs, SRAs and contractors. LGAs undertake their own work as well as contracting some of the work out to private firms. SRAs undertake some of the work themselves and also contract out to LGAs and private contractors. Road construction and maintenance expenditures carried out by SRAs and LGAs can therefore be calculated by the following expressions:

Work carried out by SRAs = (State road expenditure from State sources) + (Federal funds for state and local roads) – (Contracts to LGAs) – (Work carried out by private contractors)

Work carried out by LGAs = (LGA road expenditure funded from SRA and LGA sources) – (Work carried out by private contractors) + (Contract work from SRAs)

These two expressions can be used to derive the weightings for the SRAs and the LGAs.

Actual road expenditure by contractors is estimated as the balance of total road expenditure.

State road authorities. Details on the expenditure of SRAs and that contracted out by SRAs for road construction and maintenance were obtained from the survey of SRAs. Because some of the contract work for SRAs is undertaken by LGAs it was necessary to obtain from the SRAs details on the proportions of state expenditure actually spent by the SRAs, LGAs and contractors. Table 3.1 shows these to be 38 per cent for SRAs, 24 per cent for LGAs, with the residual 38 per cent spent by contractors.

Local government. The LGA survey results indicate that of all road expenditure of LGAs in 1993–94, 70 per cent was carried out directly by LGAs with the remaining 30 per cent contracted out.

Aggregate weights. Using the ABS Government Finance Statistics and the results shown in table 3.1, the final weights for SRAs, LGAs and contractors to be used for the construction of the overall BTCE index can be derived. Tables 3.2 and 3.3 show these to be 26 per cent for SRAs, 34 per cent for LGAs and 40 per cent for private contractors.

Input component weightings

The surveys conducted by the BTCE provided the percentage shares of the input components (table 3.4). The input component shares were weighted by the expenditure weights of the three survey groups derived in tables 3.2 and 3.3, to produce an aggregate weighting shown in the last column of table 3.4.

TABLE 3.1 ESTIMATES OF STATE GOVERNMENT ROAD CONSTRUCTION AND MAINTENANCE EXPENDITURES 1993-94, SHOWING PROPORTION OF WORK CARRIED OUT BY SRAs, CONTRACTORS AND LGAs

State	Unit	Work performed by			Total
		SRAs	LGAs	Contractors	
NSW	\$ million	776.46	407.26	384.28	1 568.00
	%	(49.50)	(26.00)	(24.50)	(100.00)
Vic.	\$ million	150.80	138.40	326.80	616.00
	%	(24.48)	(22.47)	(53.05)	(100.00)
Qld	\$ million	284.89	314.26	231.85	831.00
	%	(34.28)	(37.82)	(27.90)	(100.00)
WA	\$ million	217.72	63.43	116.85	398.00
	%	(54.70)	(15.94)	(29.36)	(100.00)
SA	\$ million	47.19	4.81	156.00	208.00
	%	(22.69)	(2.31)	(75.00)	(100.00)
Tas.	\$ million	0.00	0.00	119.00	119.00
	%	(0.00)	(0.00)	(100.00)	(100.00)
NT	\$ million	0.00	31.60	93.40	125.00
	%	(0.00)	(25.28)	(74.72)	(100.00)
ACT	\$ million	15.00	0.00	67.00	82.00
	%	(18.29)	(0.00)	(81.71)	(100.00)
Australia	\$ million	1 492.10	959.76	1 495.18	3 947.00
	%	(37.80)	(24.32)	(37.88)	(100.00)

Sources ABS Government Finance Statistics (unpublished data); BTCE survey of SRAs.

TABLE 3.2 DERIVATION OF WEIGHTS—SRAs

	\$ million
Total road expenditure 1993-94	5 725.60
Expenditure by State and Federal governments	3 947.00
Less expenditure contracted to LGAs	<u>959.76</u>
	2 987.24
Less expenditure by private contractors	<u>1 495.18</u>
Work carried out by SRAs	1 492.06
SRAs work as % of total expenditure	26.06%

Sources ABS Government Finance Statistics (unpublished data); BTCE estimates.

TABLE 3.3 DERIVATION OF WEIGHTS—LGAs AND CONTRACTORS

	<i>\$ million</i>
Total road expenditure 1993–94	5 725.60
Expenditure by LGAs	1 778.60
Add expenditure as State government contractors	<u>959.76</u>
	2 738.36
Less expenditure by private contractors	<u>815.72</u>
Work carried out by LGAs	1 922.64
LGAs work as % of total expenditure	33.58%
<i>Residual weighting of contractors</i>	<i>40.36%</i>

Sources ABS Government Finance Statistics (unpublished data); BTCE estimates.

Movement in the revised BTCE index in 1994–95

The movement in the index from 1993–94 to 1994–95 was calculated by applying the new component weights shown in table 3.4 to changes in the prices of inputs. To determine these changes in prices, separate indexes were used for each input. These are described below.

TABLE 3.4 INPUT COMPONENT WEIGHTS USED IN THE BTCE INDEX

<i>Component</i>	<i>LGAs</i>	<i>SRAs</i>	<i>Contractors</i>	<i>Weighted average</i>
<i>Expenditure weights</i>	<i>0.336</i>	<i>0.261</i>	<i>0.404</i>	<i>1.000</i>
Salaried labour	0.109	0.113	0.056	0.089
Other labour	0.175	0.212	0.138	0.170
Total labour	0.284	0.325	0.194	0.258
Bitumen	0.180	0.027	0.130	0.120
Concrete	0.049	0.214	0.062	0.097
Quarry products	0.137	0.066	0.222	0.153
Other materials	0.092	0.099	0.127	0.108
Total materials	0.458	0.405	0.540	0.477
Plant hire/depreciation	0.204	0.200	0.188	0.196
Fuel	0.055	0.070	0.078	0.068
Total plant	0.259	0.270	0.266	0.265
Total all components	1.000	1.000	1.000	1.000

Note Owing to rounding, figures may not add to totals.

Source BTCE estimates.

Salaried and other labour. Changes in the price of labour are given by changes in average weekly earnings across Australia for all males. Salaried and other labour are grouped together because of the difficulty of obtaining a suitable series that shows changes for these categories separately. This overall series is given in ABS (1995a). Increases from 1993–94 to 1994–95 are shown in table 3.5.

Bitumen. Prices of road making bitumen in Melbourne in 1993–94 and 1994–95 are given in table 3.6.

Concrete. Price changes for concrete used in road construction are given by the changes in price indexes for ready mixed concrete, provided in ABS (1995b). The price change in 1994–95, obtained by converting the 1993–94 index figure to a base of 100, is shown in table 3.7.

Quarry products. Price changes for quarry products are represented by changes in the costs of sand and gravel, provided in ABS (1995b). Table 3.8 shows the change in the price index from 1993–94 to 1994–95.

Other materials. Price changes for other materials are given by the 'all groups index', provided in ABS (1995b). Table 3.9 shows the change in the price index from 1993–94 to 1994–95.

Plant hire. Changes in the price indexes of plant and equipment were obtained from changes in the hire rates of a group of plant and equipment items used in road construction and maintenance, provided by the Australian Earthmovers and Road Contractors Federation (1995). Changes in hire rates (\$ per hour) from 1993–94 to 1994–95 are shown in tables 3.10 and 3.11.

Fuel. Diesel is the predominant fuel used in road construction and maintenance. Changes in the price of diesel fuel were obtained from the Australian Competition and Consumer Commission. Table 3.12 shows the change in the price of diesel fuel over 1993–94 to 1994–95.

THE REVISED BTCE INDEX

The revised BTCE index for 1994–95, given in table 3.13, was derived by using the input component weights shown in table 3.4, and the price indexes for the input components shown in tables 3.5 to 3.9, 3.11 and 3.12. The index values shown for the years 1984–85 to 1992–93 were obtained by re-basing the existing index to the common year 1993–94.

Chaining indexes in this way is a common procedure following changes to the regimen of weights of a price index. However, Karmel (1957, p. 310) points out that, strictly speaking, no valid comparisons can be made between the values in the two indexes because both prices and quantities will differ.

TABLE 3.5 AVERAGE WEEKLY EARNINGS, ALL MALES

<i>Year ending June</i>	<i>Aug (\$)</i>	<i>Nov (\$)</i>	<i>Feb (\$)</i>	<i>May (\$)</i>	<i>Average^a (\$)</i>	<i>Index</i>
1994	618.1	619	625.6	625.1	622.0	100.0
1995	634.5	643.1	650.1	652.7	645.1	103.7

a. Financial year average of quarterly figures.

Source ABS (1995a).

TABLE 3.6 BITUMEN PRICE

<i>Year ending June</i>	<i>Price per tonne (\$)</i>	<i>Index</i>
1994	370	100.0
1995	370	100.0

Source Shell Australia Pty Ltd, personal communication, August 1995.

TABLE 3.7 CONCRETE PRICE

<i>Year ending June</i>	<i>Price index</i>	<i>Index</i>
1994	106.7	100.0
1995	112.4	105.3

Source ABS (1995b).

TABLE 3.8 PRICE OF QUARRY PRODUCTS (GRAVEL AND SAND)

<i>Year ending June</i>	<i>Price index</i>	<i>Index</i>
1994	118.7	100.0
1995	121.6	102.4

Source ABS (1995b).

TABLE 3.9 PRICE OF OTHER MATERIALS^a

<i>Year ending June</i>	<i>Price index</i>	<i>Index</i>
1994	107.5	100.0
1995	110.4	102.7

a. The ABS 'all groups index' is used as the price index for construction materials other than bitumen, concrete, and quarry products.

Source ABS (1995b).

TABLE 3.10 ROAD CONSTRUCTION EQUIPMENT HIRE RATES

Plant and equipment	ERG ^a Class/category	Hire rate (\$ per hour)	
		1993-94	1994-95
Backhoe/loader	3	62	64
Bulldozer	5	120	128
Compactor	3	125	130
Vibratory roller—self propelled, smooth drum	4	100	105
Crawler mounted backhoe excavator	8	99	97
Grader	8	103	103
Wheel loader	9	110	110
Trencher	Class 80	110	100
Dump truck—articulated	2	140	140
<i>Total</i>		969	977

a. Melbourne based Equipment Research Group, which runs a national sales reporting program for suppliers of construction equipment.

Source Australian Earthmovers and Road Contractors Federation (1995).

TABLE 3.11 ROAD CONSTRUCTION EQUIPMENT HIRE RATE

Year ending June	Hire rate (\$ per hour)	Index
1994	969	100.0
1995	977	100.8

Source Australian Earthmovers and Road Contractors Federation (1995).

TABLE 3.12 DIESEL FUEL PRICE

Year ending June	Price (cents/litre)	Index
1994	70.19	100.0
1995	71.05	101.2

Source Australian Competition and Consumer Commission, personal communication, December 1995.

TABLE 3.13 BTCE ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX
(1993–94 = 100)

<i>Year ending June</i>	<i>Previous index</i>	<i>Current index</i>
1985	68.1	
1986	73.3	
1987	76.4	
1988	80.9	
1989	86.1	
1990	89.5	
1991	96.2	
1992	97.0	
1993	98.8	
1994	100.0	100.0
1995		102.4*

* This figure revises the figure for 1994–95 published in *Transport and Communications Indicators*, March quarter 1996.

Source BTCE estimates.

Users of the BTCE index should also bear in mind that no adjustment has been made for any change in the quality of the inputs. While this problem is common to many price indexes, it may be particularly important in the case of road construction and maintenance because of the significant degree of technological change over the last decade. It is possible to splice indexes by using weights based on relative prices of a regimen of goods whose quality has changed. Lack of precise information about prices and quality of the regimen used in the BTCE indexes over the whole period precluded the use of splicing in this paper.

COMPARISON WITH OTHER INDEXES

Table 3.14 and the corresponding figure 3.1 provide a comparison of the BTCE road construction and maintenance price index (RCMPI) with indexes produced by the state authorities in New South Wales, Queensland and South Australia from 1984–85 to 1994–95. All the indexes have been converted to a common base, 1993–94.

Over the decade to 1994–95 the four road indexes followed a broadly similar pattern. One exception is the decline of the New South Wales index between 1991–92 and 1994–95, against the upward trend of the other three indexes. In 1994–95, the BTCE road index showed a rise of 2.4 per cent, which falls within the range of rises that occurred with the other three indexes, ranging from 1.8 to 2.9 per cent.

Table 3.15 and the associated figure 3.2 present a comparison between the RCMPI, the consumer price index (CPI) and the ABS implicit price deflator (IPD) for gross non-farm product. The three indexes follow a similar upward trend, particularly between 1990–91 and 1993–94.

TABLE 3.14 COMPARISON OF BTCE ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX WITH SRA INDEXES

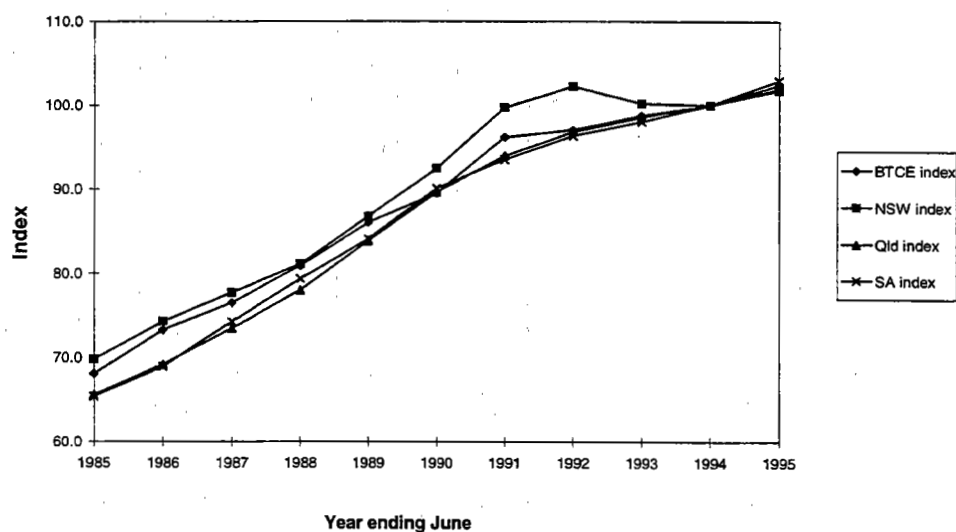
(1993-94 = 100)

Year ending June	Previous BTCE road construction and maintenance price index	Current BTCE road construction and maintenance price index	New South Wales road index	Queensland road index	South Australia road index
1985	68.1		69.8	65.6	65.4
1986	73.3		74.3	69.2	68.9
1987	76.4		77.7	73.4	74.2
1988	80.9		81.1	78.0	79.3
1989	86.1		86.8	83.9	84.1
1990	89.5		92.4	89.6	90.1
1991	96.2		99.7	93.9	93.5
1992	97.0		102.2	96.8	96.3
1993	98.8		100.2	98.6	98.0
1994	100.0	100.0	100.0	100.0	100.0
1995		102.4	101.9	101.8	102.9

Sources BTCE estimates, RTA (1995); Queensland Transport (1995); Department of Transport, South Australia, Corporate Financial Services, personal communications June 1995.

FIGURE 3.1 COMPARISON OF BTCE INDEX WITH SRA INDEXES

(1993-94 = 100)



Sources BTCE estimates, RTA (1995); Queensland Transport (1995); Department of Transport, South Australia, Corporate Financial Services, personal communications June 1995.

TABLE 3.15 COMPARISON OF BTCE ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX AND GENERAL PRICE INDEXES

(1993-94 = 100)

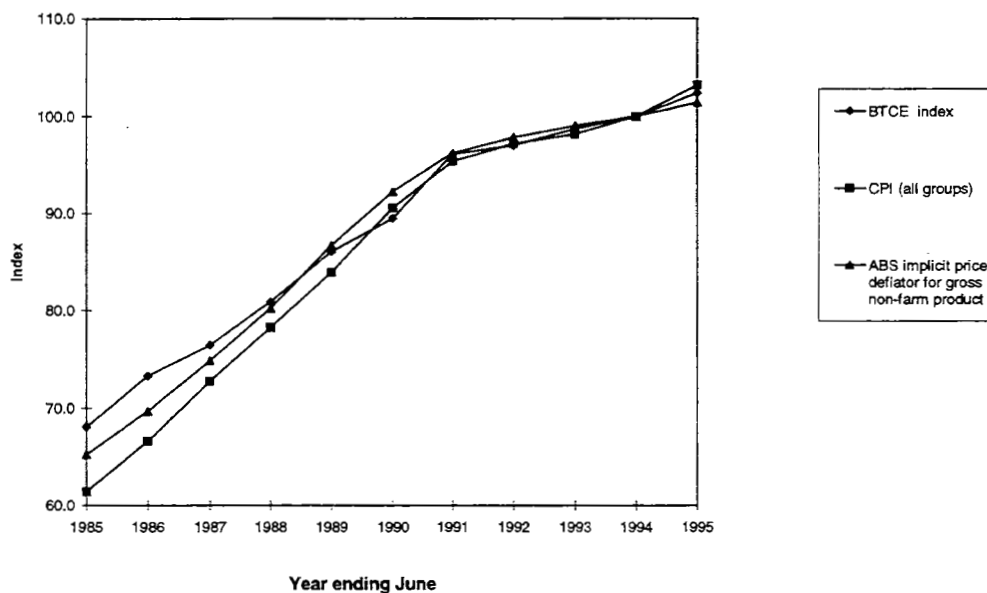
Year ending June	Previous BTCE road construction and maintenance price index	Current BTCE road construction and maintenance price index	CPI (all groups)	ABS implicit price deflator ^a
1985	68.1		61.4	65.2
1986	73.3		66.6	69.6
1987	76.4		72.7	74.8
1988	80.9		78.2	80.2
1989	86.1		83.9	86.7
1990	89.5		90.6	92.3
1991	96.2		95.4	96.2
1992	97.0		97.2	97.9
1993	98.8		98.2	99.1
1994	100.0	100.0	100.0	100.0
1995		102.4	103.2	101.5

a. ABS implicit price deflator for gross non-farm product.

Sources ABS (1995b); ABS (1995c); BTCE estimates.

FIGURE 3.2 COMPARISON OF BTCE INDEX WITH OTHER GENERAL PRICE INDEXES

(1993-94 = 100)



Sources ABS (1995b, 1995c); BTCE estimates.

APPENDIX I STATE ROAD AND TRAFFIC AUTHORITY INDEXES

Road construction price indexes continue to be produced by state road authorities in New South Wales, Queensland and South Australia. However, Victoria, Western Australia and Tasmania no longer produce road construction indexes. The indexes produced are mostly input-price or input-cost indexes, but different methodologies have been employed reflecting differences in the level of aggregation applied to road construction activity and the choice of price or cost series for the various inputs. The current position of the state road authority indexes is summarised as follows.

New South Wales

The former NSW Department of Main Roads (now the Roads and Traffic Authority) has produced an input-cost index since 1939. The input components are drawn from a detailed cost breakdown of road construction and maintenance activities, and are aggregated into a maintenance index, a road construction index, and a bridge construction index. These three indexes are produced for the Sydney region and the rest of the state. Using these individual indexes, an overall Road Cost Index (RCI) for New South Wales is derived. The Roads and Traffic Authority (RTA) reviewed the RCI framework in 1990 and 1993. The 1993 revised version, which is published quarterly, incorporates a new RCI series with base year 1992–93, and includes a breakdown of the RCI quarterly movements in wages, stores, plant, haulage overheads, administration, property acquisition and financing costs.

Victoria

VicRoads (formerly the Victorian Roads Construction Authority, and the Country Roads Board of Victoria) produced a quarterly publication titled *Quarterly Price Indexes for Road and Bridge Works* up until June 1990. These indexes were compiled for VicRoads internal use. As they were based on weightings applicable to the VicRoads direct labour force, they may not be appropriate to any other organisation. Production of this publication ceased after a user review was conducted in 1990. The review found that the number of

users did not justify the time and effort needed to produce the indexes. VicRoads now produces the National Cost Adjustment Provision 1 (NCAP1) Contract Price Adjustment Schedule of indexes, which consists of three separate groups of indexes:

- labour indexes, which are calculated in accordance with the NCAP1 (as agreed by the National Building and Construction Council and the National Public Works Conference, March 1982);
- material indexes, which are taken out of ABS Catalogue no. 6407.0, *Price Index of Materials Used in Building other than House Building*; and
- fuel indexes, which are calculated using data from the Australian Competition and Consumer Commission.

Queensland

A Roadworks Input-Cost Index is produced by the Queensland Department of Main Roads (formerly Queensland Transport). Despite the title, this index is an input-price index, in terms of the definitions used in this paper. The index uses ABS figures to represent movements in the price of labour, materials and plant hire. The roadworks index is a weighted combination of these three individual indexes and is produced quarterly.

South Australia

The South Australian Department of Transport has produced an overall roadworks input-cost index since 1970. This index is a weighted average of input-cost indexes for several groups of activity including road construction, maintenance, bridge construction, land acquisition, land and buildings, and administration and other.

Western Australia

Main Roads Western Australia (MRWA) produced an input-price index until 1993. The index is similar to the Queensland index, using external price sources to measure price movements. MRWA now uses other published price deflators for cost escalations.

Tasmania

The Tasmanian Department of Roads and Transport produced an input-cost index until 1990. This index was a weighted average of three sub-indexes of road construction, maintenance, and bridge construction. These three aggregate indexes were derived from cost movements for input components of labour, materials, plant, property acquisition and sundries.

APPENDIX II SURVEY OF LGAS, SRAS AND CONTRACTORS

The BTCE conducted three postal surveys of LGAs, SRAs and contractors to collect data to determine the weightings for each of the input components.

Questionnaire design

The questionnaires sought information on the breakdown of the prices of input components used in construction and maintenance of the National Highway system, state highways and arterial roads, and local roads. During the survey design process, the BTCE conducted a small pilot survey of local government authorities and sought advice from the Australian Bureau of Statistics, the Australian Local Government Association, the Civil Contractors Federation, the Queanbeyan City Council, the Yass City Council and the Roads and Traffic Authority of New South Wales.

The final questionnaires (appendixes III, IV and V) were mailed to a sample of local government authorities, state road authorities and private road contractors throughout Australia.

Local government

Sampling approach. LGAs are responsible mainly for the construction and maintenance of local roads and some arterial roads, and, to a lesser extent, state highways. Their involvement in different types of road varies between states and even within states.

The main purpose of the survey of LGAs was to obtain the percentage breakdown of input components used for the construction and maintenance of local roads as well as arterial roads and state highways. The questionnaire also sought information on the percentage of construction and maintenance works performed by LGAs and that contracted by them to private firms.

To select a sample size from the population of approximately 700 LGAs, two sampling approaches were considered. The first was a simple random sampling approach. The second possible approach was to use a stratified random sample which would take into account regional variations in factors such as the types of road, terrain, climatic conditions and the availability of labour and materials.

A stratified sampling approach would have involved separation of LGAs into a number of sub-population regions, followed by selection of a random sample from each group: for example, urban LGAs, coastal LGAs, remote LGAs and mountainous LGAs. However, unless a relationship exists between the weightings of target variables (input components) and the stratification variables (regional characteristics of LGAs), stratification would not produce more accurate results than simple random sampling.

In this case, there was little information of sufficient quality to establish relationships between target variables and stratification variables. After consultation with the ABS, it was concluded that a simple random sampling would suffice.

Determining the sample size. The formula for calculating the required sample size is:

$$n = 1 / \{1/N + [RSE(Y')/CV(Y)]^2\}$$

where n is the required sample size, N is the population size, $RSE(Y')$ is the required relative standard error of the estimate, and $CV(Y)$ is the coefficient of variation in the population. The coefficient of variation measures the variability of an item relative to the average value of the item in the population. The accuracy of the estimates is represented by the relative standard error (RSE), which expresses the variability of the estimate as a proportion of the value of the estimate. The formula was taken from ABS unpublished statistics course notes, 1996.

For populations of small, moderate and high variabilities (corresponding to $CV(Y)$ values of 0.01, 0.5 and 1.0), table II.1 gives the sample size required from a population size of 700, for different values of $RSE(Y')$.

The table shows that for a moderate amount of variability in road construction and maintenance inputs among the LGAs, a sample of about 90 would provide the survey with a level of confidence of 95 per cent (that is, $RSE(Y') = 0.05$), which was considered acceptable. Assuming a response rate of around 40 per cent, a simple random sample of 219 LGAs was selected.

TABLE II.1 SAMPLE SIZE FOR THE SURVEY OF LGAS

$RSE(Y')$	$CV(Y)$		
	0.01	0.5	1.0
0.01	90	540	699
0.05	5	90	255
0.10	1	25	90

TABLE II.2 SURVEY RESPONSES FROM LGAs

<i>State</i>	<i>Number of LGAs</i>	<i>LGAs surveyed</i>	<i>Forms returned</i>	<i>Overall survey response rate</i>
NSW	177	55	25	45.5
Vic.	81	24	5	20.8
Qld	124	44	9	20.5
WA	142	44	19	43.2
SA	117	34	9	26.5
Tas.	28	13	10	76.9
NT	7	5	3	60.0
<i>Total</i>	676	219	80	36.5

Source BTCE.

A total of 80 responses were received from the 219 LGAs surveyed — a response rate of 37 per cent, slightly lower than the anticipated level of 40 per cent. Despite the lower response rate, an investigation of the LGAs that responded indicated that there was a satisfactory spread of representation from each of the states, as well as across the different terrain groups within each of the states and a good representation of urban and rural LGAs.

The number of survey responses from each state and territory are shown in table II.2.

Survey of SRAs

The survey of SRAs collected data on the percentage breakdown of input components used in the construction and maintenance of the National Highway system, state highways and arterial roads. The questionnaire also sought information on the percentage shares of construction and maintenance work performed by SRAs' day labour and by private contractors. The questionnaire was sent to the six state and two territory road authorities.

All state and territory road authorities responded to the survey although some states were unable to offer much information as most or all of their road works in recent years had been done by private contractors.

The survey of private contractors

The purpose of the survey of contractors was to obtain the percentage breakdown of input components used in the construction and maintenance of the National Highway system, state highways, arterial roads and local roads.

A list of private contractors specialising in road construction and maintenance in the ACT, Queensland, South Australia and Victoria was supplied by the Civil Contractors Federation, and survey questionnaires were sent to all these

contractors. For New South Wales, Tasmania and Western Australia, the Civil Contractor Federation could not identify road work contractors from the list of general contractors, so questionnaires were sent to all listed civil engineering contractors in these states. A total of 171 questionnaires were sent to all states and the ACT.

Survey responses from contractors in each state and territory are shown in table II.3. The response rate varied from 18.2 per cent for South Australia to 33.3 per cent for ACT. The national average was 24 per cent.

TABLE II.3 SURVEY RESPONSES FROM PRIVATE CONTRACTORS

<i>State</i>	<i>Number of forms sent to private road contractors</i>	<i>Forms returned</i>	<i>Overall survey response rate</i>
NSW	62	14	22.6
Vic.	38	10	26.3
Qld	17	4	23.5
WA	24	7	29.2
SA	11	2	18.2
Tas.	16	3	18.8
NT	0	0	0
ACT	3	1	33.3
<i>Australia</i>	171	41	24.0

Source BTCE.

APPENDIX III LOCAL GOVERNMENT AUTHORITIES QUESTIONNAIRE



ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX SURVEY

Purpose of the survey

The purpose of this survey is to provide information to assist the Bureau of Transport and Communications Economics (BTCE), to revise the weightings of input components used in the construction of its Road Construction and Maintenance Price Index.

The Road Price Index is updated annually and published in the BTCE's quarterly publication *Transport and Communications Indicators*. The main purpose of the index is to provide a measure of price movements in road construction and maintenance. No other measure of price movements is available nationally and your input will play a valuable role in assisting the BTCE with this work.

.....

I M P O R T A N T I N F O R M A T I O N**➔ Filling out the questionnaire**

Please provide details as requested on pages 2 and 3 of this questionnaire.

If you are unable to provide a breakdown of the costs of input components for arterial (State and locally owned) roads and local roads for Question 6, it would be appreciated if sub-total estimates could be provided. If cost levels are unavailable please provide percentage estimates. Definitions of road construction, maintenance and labour are provided in the glossary on the back page.

➔ Confidentiality

All individual responses will be treated as confidential and will only be used in determining the aggregate weightings of input components used in road construction and maintenance. Individual responses will be destroyed after data has been compiled in aggregate form.

➔ Due Date

Please complete this form and return it in the reply paid envelope to the Bureau of Transport and Communications Economics by Friday 29 September 1995.

➔ Help Available

If you have any questions regarding the completion of this questionnaire or would like more information on this project please contact:

Mr Kay Loong Telephone: (06) 274 6740, or,

Mr Peter Sydney Telephone (06) 274 6858

Facsimile: (06) 274 6816.

.....

Contact Person in Your Organisation

(We may need to contact someone in your organisation about the questionnaire:
please supply contact details below)

Name		Position	
Phone Number		Facsimile Number	

3 Road Construction and Maintenance Price Index Survey

Road Construction and Maintenance Costs Breakdown (see glossary over page)

- 1 Local Government Area Name
- 2 Length of road system
Arterial (State and locally owned) Roads kms Local Roads kms
- 3 Time Period: 1993-94 (Please specify if other time provided)
- 4 Expenditure on road construction carried out
by Local Government % by contractors %
- 5 Expenditure on road maintenance carried out
by Local Government % by contractors %
- 6 Breakdown of the costs of input components used in construction and maintenance of arterial (State and locally owned) and local roads, 1993-94

Input Components	Construction (\$'000)			Maintenance (\$'000)			Total (\$'000)
	Arterial (State and locally owned) roads	Local roads	Sub total	Arterial (State and locally owned) roads	Local roads	Sub total	
Labour							
Salaried labour							
Other labour							
Sub-total							
Construction Materials							
Bitumen/Bituminous products							
Concrete							
Quarry products							
Other materials							
Sub-total							
Plant							
Plant hire/depreciation							
Fuel							
Sub-total							
TOTAL COSTS							

Thank you for completing this form

GLOSSARY

Road Construction

Road construction includes:

- ▶ construction of a new road, bridge, tunnel, traffic signs and signals where none previously existed;
- ▶ major widening or replacement, eg. replacement of two-lane road with a four-lane road;
- ▶ large-scale heavy patching, pavement rehabilitation, and minor improvements in alignment.
- ▶ replacement of a gravel road by a sealed road.

Road Maintenance

Road maintenance includes:

- ▶ restoring edge wear, repairing potholes and small-scale pavement rehabilitation;
- ▶ resheeting of gravel roads and resealing of bitumen surfaced roads;
- ▶ linemarking;
- ▶ minor bridge and tunnel repairs;
- ▶ repairs to guardrail, traffic signs and signals;
- ▶ clearing of road drains and culverts;
- ▶ road side landscaping.

Salaried Labour

Salaried labour refers to persons engaged mainly in non-manual occupations such as managers, engineers, surveyors and clerical staff.

Other Labour

Other labour refers to persons engaged in manual occupations such as labourers and trade persons (eg. motor mechanics, electricians and carpenters).

**APPENDIX IV STATE ROAD AUTHORITIES
QUESTIONNAIRE**



BUREAU OF TRANSPORT AND COMMUNICATIONS
ECONOMICS

ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX SURVEY

Purpose of the survey

The purpose of this survey is to provide information to assist the Bureau of Transport and Communications Economics (BTCE), to revise the weightings of input components used in the construction of its Road Construction and Maintenance Price Index.

This Index is updated annually and published in the BTCE's quarterly publication *Transport and Communications Indicators*. The main purpose of the index is to provide a measure of price movements in road construction and maintenance. No other measure of price movements is available nationally and your input will play a valuable role in assisting the BTCE with this work.

I M P O R T A N T I N F O R M A T I O N

➡ **Filling out the questionnaire**

Please provide details as requested on pages 2 and 3 of this questionnaire.

If you are unable to provide a breakdown of the costs of input components for the National Highway, State highways and arterial roads for Question 6, it would be appreciated if sub-total estimates could be provided. If cost levels are unavailable please provide percentage estimates. Definitions of road construction, maintenance and labour are provided in the glossary on the back page.

➡ **Confidentiality**

All individual responses will be treated as confidential and will only be used in determining the aggregate weightings of input components used in road construction and maintenance.

➡ **Due Date**

Please complete this form and return it in the reply paid envelope to the Bureau of Transport and Communications Economics by Friday 29 September 1995.

➡ **Help Available**

If you have any questions regarding the completion of this questionnaire or would like more information on this project please contact:

Mr Kay Loong Telephone: (06) 274 6740, or,

Mr Peter Sydney Telephone (06) 274 6858

Facsimile: (06) 274 6816.

Contact Person in Your Organisation

(We may need to contact someone in your organisation about the questionnaire:
please supply contact details below)

Name		Position	
Phone Number		Facsimile Number	

3 Road Construction and Maintenance Price Index Survey

1 State or Territory name

2 Length of road system
National Highway kms State highways and arterial roads kms

3 Time Period: 1993-94 (Please specify if other time provided)

4 Expenditure on road construction carried out
by State or Territory % by contractors %

5 Expenditure on road maintenance carried out
by State or Territory % by contractors %

6 Breakdown of the costs of input components used in construction and maintenance of the National Highway, State highways and arterial roads, 1993-94.

Input Components	Construction (\$'000)			Maintenance (\$'000)			Total (\$'000)
	National Highway	State highways and arterial roads	Sub total	National Highway	State highways and arterial roads	Sub total	
Labour							
Salaried labour							
Other labour							
Sub-total							
Construction Materials							
Bitumen/Bituminous products							
Concrete							
Quarry products							
Other materials							
Sub-total							
Plant							
Plant hire/depreciation							
Fuel							
Sub-total							
TOTAL COSTS							

Thank you for completing this form

GLOSSARY

Road Construction

Road construction includes:

- ▶ construction of a new road, bridge, tunnel, traffic signs and signals where none previously existed;
- ▶ major widening or replacement, eg. replacement of two-lane road with a four-lane road;
- ▶ large-scale heavy patching, pavement rehabilitation, and minor improvements in alignment.
- ▶ replacement of a gravel road by a sealed road.

Road Maintenance

Road maintenance includes:

- ▶ restoring edge wear, repairing potholes and small-scale pavement rehabilitation;
- ▶ resheeting of gravel roads and resealing of bitumen surfaced roads;
- ▶ linemarking;
- ▶ minor bridge and tunnel repairs;
- ▶ repairs to guardrail, traffic signs and signals;
- ▶ clearing of road drains and culverts;
- ▶ road side landscaping.

Salaried Labour

Salaried labour refers to persons engaged mainly in non-manual occupations such as managers, engineers, surveyors and clerical staff.

Other Labour

Other labour refers to persons engaged in manual occupations such as labourers and trade persons (eg. motor mechanics, electricians and carpenters).

APPENDIX V PRIVATE CONTRACTORS QUESTIONNAIRE



BUREAU OF TRANSPORT AND COMMUNICATIONS
ECONOMICS

ROAD CONSTRUCTION AND MAINTENANCE PRICE INDEX SURVEY

Purpose of the survey

The purpose of this survey is to provide information to assist the Bureau of Transport and Communications Economics (BTCE), to revise the weightings of input components used in the construction of its Road Construction and Maintenance Price Index.

The Road Construction and Maintenance Price Index is updated annually and published in the BTCE's quarterly publication *Transport and Communications Indicators*. The main purpose of the index is to provide a measure of price movements in road construction and maintenance. No other measure of price movements is available nationally and your input will play a valuable role in assisting the BTCE with this work.

I M P O R T A N T I N F O R M A T I O N

➔ **Filling out the questionnaire**

Please provide details as requested on pages 2 and 3 of this questionnaire.

If you are unable to provide a breakdown of the costs of input components for the various road types it would be appreciated if sub-total estimates could be provided. If cost levels are unavailable please provide percentage estimates. Definitions of road construction, maintenance and labour are provided in the glossary on the back page.

➔ **Confidentiality**

All individual responses will be treated as confidential and will only be used in determining the aggregate weightings of input components used in road construction and maintenance. Individual responses will be destroyed after data has been compiled in aggregate form.

➔ **Due Date**

Please complete this form and return it in the reply paid envelope to the Bureau of Transport and Communications Economics by Friday 27 October 1995.

➔ **Help Available**

If you have any questions regarding the completion of this questionnaire or would like more information on this project please contact:

Mr Kay Loong Telephone: (06) 274 6740, or,

Mr Peter Sydney Telephone: (06) 274 6858

Facsimile: (06) 274 6816.

.....

Contact Person in Your Organisation

(We may need to contact someone in your organisation about the questionnaire: please supply contact details below)

Name		Position	
Phone Number		Facsimile Number	
Organisation			
Address			

3 Road Construction and Maintenance Price Index Survey

Breakdown of the costs of input components used in construction and maintenance of roads, 1993–94 (Please specify if other time provided)

Input Components	Construction (\$'000)				Maintenance (\$'000)				Total (\$'000)
	National Highway	State highways and arterial roads	Local roads	Sub total	National Highway	State highways and arterial roads	Local roads	Sub total	
Labour									
Salaried labour									
Other labour									
Sub-total									
Construction Materials									
Bitumen/ Bituminous products									
Concrete									
Quarry products									
Other materials									
Sub-total									
Plant									
Plant hire/ depreciation									
Fuel									
Sub-total									
TOTAL COSTS									

Thank you for completing this form

GLOSSARY

Road Construction

Road construction includes:

- ▶ construction of a new road, bridge, tunnel, traffic signs and signals where none previously existed;
- ▶ major widening or replacement, eg. replacement of two-lane road with a four-lane road;
- ▶ large-scale heavy patching, pavement rehabilitation, and minor improvements in alignment.
- ▶ replacement of a gravel road by a sealed road.

Road Maintenance

Road maintenance includes:

- ▶ restoring edge wear, repairing potholes and small-scale pavement rehabilitation;
- ▶ resheeting of gravel roads and resealing of bitumen surfaced roads;
- ▶ linemarking;
- ▶ minor bridge and tunnel repairs;
- ▶ repairs to guardrail, traffic signs and signals;
- ▶ clearing of road drains and culverts;
- ▶ road side landscaping.

Salaried Labour

Salaried labour refers to persons engaged mainly in non-manual occupations such as managers, engineers, surveyors and clerical staff.

Other Labour

Other labour refers to persons engaged in manual occupations such as labourers and trade persons (eg. motor mechanics, electricians and carpenters).

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AGPS	Australian Government Publishing Service
BTCE	Bureau of Transport and Communications Economics
BTE	Bureau of Transport Economics
CBR	Commonwealth Bureau of Roads
CPI	consumer price index
IPD	implicit price deflator
LGA	local government authority
MRWA	Main Roads Department Western Australia
NCAP1	National Cost Adjustment Provision 1
NSW	New South Wales
NT	Northern Territory
Qld	Queensland
RCI	Road Cost Index
RCMPI	road construction and maintenance price index
RTA	Road and Traffic Authority, NSW
SA	South Australia
SRA	state road authority
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia