

Final Report

**ECONOMIC EVALUATION OF
DARWIN ALICE SPRINGS
RAILWAY**

**Northern Territory Department of
Transport and Works**

Melbourne
October 1999

*This report is confidential and intended solely for the use and
information of the Northern Territory Department of Transport and Works*

— BOOZ·ALLEN & HAMILTON —

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1. INTRODUCTION

The Northern Territory Department of Transport and Works (NT-DTW) has engaged Booz·Allen & Hamilton to undertake an economic evaluation of the proposed Alice Springs to Darwin Railway. Although an evaluation was previously undertaken by Travers Morgan in 1995, a considerable volume of work on the railway costs and projected demand has been undertaken since the original evaluation. This evaluation reflects the improved information and the change in economic conditions since the Travers Morgan report.

This report details the economic evaluation of the project undertaken by Booz·Allen & Hamilton.

2. EVALUATION COSTS AND BENEFITS

2.1 APPROACH

To ensure consistency with the approach used by Travers Morgan a conventional cost benefit analysis of the project has been undertaken which measures the difference between resource costs in the project and base case (without railway) to derive the benefits. The sources of resource cost savings in the transport of freight within the corridor were identified as:

- the difference in operating costs for traffic which is diverted from road to rail
- the reduced operating costs for existing rail traffic from the improved rail service
- the avoidance of handling charges at Alice Springs for rail/road traffic (eg rail from Adelaide to Alice Springs then road Alice Springs to Darwin) once it can travel by rail through to Darwin
- reduction in road infrastructure costs from the diversion of road traffic to rail
- the savings in accident costs generated from the diversion of road freight to rail
- the savings in externalities associated with the diversion of tonnage to rail

What has not been considered in this analysis is any tonnage generated or corridor shifted beyond that which is diverted as a result of the construction of the railway. For example CUB beer is currently brewed in Brisbane and trucked to Darwin, with a new rail link this beer would be likely to be transport from Melbourne.

Also not considered is any service benefits that customers gain from an improved service to/from Darwin. As most of the traffic is diverted traffic, and the transit time, service availability and reliability would be similar to existing operations, any non price customer benefits would be relatively small.

The NT-DTW estimates of the rail contestable domestic market in the Adelaide to Darwin transport corridor have been used in the evaluation. Domestic freight movements in transport corridors that feed into the Alice Springs to Darwin corridor have also been included.

The evaluation results are contained in section 3. Sensitivity test results are contained in section 3.1.

2.2 GENERAL ASSUMPTIONS

The following general assumptions have been made with regard to the economic evaluation:

- A 5% real discount rate based on the recent Access Economics report to the NT-DTW.
- The evaluation period is 50 years.
- All values are in 1999/2000 dollars.

2.3 PROJECT CONSTRUCTION COSTS

The total estimated construction costs are of \$1.02 billion (in 1999 dollars). This number has been estimated by scaling up the estimate of \$947 million by BHP Engineering in (1994 dollars) to 1999 dollars using the ABS construction index (an 8% increase in costs over the period). A three-year construction period is assumed as shown in Table 2.1.

Table 2.1 : Profile of Construction Spending

YEAR	DISTRIBUTION OF CONSTRUCTION SPENDING	
	(\$ MILLION)	%
2000	340	33
2001	340	33
2002	340	33

2.4 TASK, NTK AND GROWTH ESTIMATES

The total rail contestable domestic market in both the project and base case is 2.2 million net tonnes. Of this total market, 0.51 million tonnes are currently transported on the existing rail line between Tarcoola and Alice Springs and 1.3 million tonnes are projected to be transported by the proposed railway. The domestic task projection used in the evaluation is shown in Table 2.2.

Table 2.2 : Domestic Freight Task Inputs ('000)

TRANSPORT MODE	BASE CASE	PROJECT CASE
Rail	510 ⁺	1,251
Road		
within corridor	694	573
outside corridor	991	482
Total	2,195	2,195

⁺ This tonnage on the existing Tarcoola – Alice Springs line includes 150,000 tonnes which is transferred to road to deliver to destinations further north

NTK estimates in both the base and project case are derived from these task inputs multiplied by average haul lengths. The average haul lengths are calculated from the origin/destination matrix developed by NT-DTW and rail and road distances.

The volume diverted to rail in the first year of operation has been assumed at 50% of the total task to account for demand ramp up. The task has been grown at 3% per annum over the evaluation period based on the growth rate in the Travers Morgan report.

2.5 ROAD OPERATING COSTS

Truck operating costs have been derived from the Booz·Allen truck operating cost model. Average truck operating costs (resource costs) have been estimated for four vehicle types as shown in Table 2.3. The unit costs are derived from road user cost estimates supplied by ARRB (1997).

Table 2.3 : Truck Operating Cost Estimates

TRUCK TYPE	OPERATING COST (CENTS/NTK)
Articulated 6-Axle	4.17
B-Double	3.45
Double Road Train	2.92
Triple Road Train	2.49

The average truck operating cost within the corridor is estimated at 3.26 cents/ntk based on the fleet mix derived from truck counts supplied by NT-DTW. The average truck operating cost for operations outside of the corridor has been estimated at 3.70 cents/ntk.

To account for changes in the fleet mix, increased capacity and improvements in fuel efficiency and maintenance of the road vehicles, the operating costs are assumed to decline by 1.5% per annum for 30 years.

2.6 RAIL OPERATING COSTS

The rail operating costs for the current Adelaide to Alice Springs rail operations have been estimated by Booz·Allen at 3.0 cents/NTK including all direct trains operations (train running, terminal costs, track maintenance, direct operating overhead and rollingstock capital). After removing full excise the cost per ntk reduces to 2.75 cents/ntk. These costs have been reduced by 1.5% per annum for 30 years to account for future efficiency gains.

The project case rail operating costs are estimated using the Booz·Allen rail cost model at 1.82 cents/NTK for the operations within the corridor and at 2.75 cents/ntk for operations outside of the corridor. The operating costs are projected to decline by 1.5% per annum for 30 years due to improvements related to economies of scale and future productivity gains.

2.7 INTERMODAL TRANSFER COSTS

Around 30% of the freight (150,000 tonnes) currently on the railway between Tarcoola and Alice Springs is transferred to road. This intermodal transfer of freight at Alice Springs would be eliminated if the railway were extended to Darwin. The Travers Morgan estimate of freight handling cost at \$3 per tonne is used to calculate this benefit in the analysis.

Similar costs are incurred for freight that is transferred from one mode to another within the project case. (rail freight totaling 28,000 tonnes via Barkley Hwy and Victoria Hwy)

2.8 EXTERNALITIES

The savings in externalities are assumed as follows:

- Savings in road infrastructure costs is 0.770 cents/NTK for trucks operating within the Adelaide to Alice Springs corridor and 0.901 cents/NTK for trucks operating outside the corridor. The estimates are based on the previous Travers Morgan report.
- Savings in road accidents are estimated to be 0.183 cents/NTK for trucks operating within the corridor and 0.319 cents /NTK for trucks

operating outside the corridor. The above values have been derived from the latest ARRB Accident costs for articulated vehicles.

- Savings from the reduction in greenhouse gas emissions is based on work by VTES (1994) on CO₂ vehicle emissions and Moffet (1991) cost estimates. The costs related to green house gases for this analysis are 0.05 cents /NTK for rail and 0.10 cents /NTK for road.

3. EVALUATION RESULTS

The results of the 50-year economic evaluation with a discount rate of 5% are summarised in Table 3.1. Appendix A contains the detailed economic evaluation spreadsheets.

Table 3.1 : Economic Evaluation Results

PROJECT CASE INCREMENTAL TO BASE CASE	
PRESENT VALUE	PROJECT CASE (\$ MILLION)
Capital Costs (Present Value)	926
Benefits (Present Value)	1,737
Net Present Value	811
NPV/Capital Costs	0.88
Internal Rate of Return %	9.2
Benefit / Cost	1.88

With an initial capital cost of \$926 million (PV), the project produces a net benefit of \$811 million giving a benefit cost ratio of 1.88 and an internal rate of return of 9.2%

Table 3.2 provides a breakdown of the various sources of the project benefits.

Table 3.2 : Source of Project Benefits

BENEFIT (PV)	PROJECT CASE (\$ MILLION)	%
Operating Costs Improvements	913	53
Accident Costs Avoided	181	10
Avoided Intermodal Transfer Costs	15	1
Road Infrastructure Cost Savings	574	33
Green House Gas Savings	54	3
Total	1,737	100

The primary source of benefit is operational cost savings for tonnage diverted to the new rail link. The reduction in road infrastructure costs due to the diversion of freight from to rail is the next major source of benefit.

3.1 SENSITIVITY ANALYSES

A number of sensitivity tests have been conducted and are shown in Table 3.2 below.

Table 3.3 : Sensitivity Tests

SENSITIVITY TEST	NPV (\$ MILLION)	NPV/C	BCR	IRR
Base Evaluation	811	0.88	1.88	9.2%
1. Project Rail Operating Costs: +10%	713	0.77	1.77	8.8%
2. Project Rail Operating Costs: - 10%	910	0.98	1.98	9.7%
3. Rail Task: +10%	908	0.98	1.98	9.7%
4. Rail Task: - 10%	598	0.65	1.65	8.3%
5. Rail Task : -20%	432	0.47	1.47	7.5%
6. Project Construction Costs: + 10%	718	0.71	1.71	8.5%
7. Project Construction Costs: - 10%	903	1.08	2.08	10.1%
8. Road Operating Costs: 0% annual decline	1425	1.54	2.54	11.2%
9. Road Operating Costs: - 3% annual decline	396	0.43	1.43	7.5%
10. 7% Discount Rate	310	0.35	1.35	9.2%
11. 3% Discount Rate	1714	1.78	2.78	9.2%

The sensitivity tests show that the NPV ranges from \$310 million to \$1,714 million with BCR's ranging from 1.35 to 2.78. The internal rate of return ranges from 7.5% to 11.2%. This indicates that under all of the sensitivity tests the project returns a positive NPV at the selected discount rate.

APPENDIX A
EVALUATION SPREADSHEETS

PROJECT CASE		CAPITAL COSTS		ROAD COST	EXISTING RAIL COSTS		DIVERTED RAIL COSTS			EXTERNAL COSTS					TOTAL COSTS	TOTAL NET BENEFITS
Disc. Rate	5%	Initial	Residual	Operating	Tarcoola - Alice Springs		Alice Springs - Darwin			Road	Accident Costs		Green Hse	Total	(BENEFITS)	(COSTS)
Year	Year No.	Capital	Value	Costs	Oper. Costs	Handling Costs	Operating Costs	Handling Costs	Total	Damage	Road	Rail	Gases	Total		
1999	0	-	-	175,632	24,250	908	-	-	-	41,583	13,562	194	5,478	60,817	261,608	-
2000	1	340,000	-	178,188	24,603	935	-	-	-	42,830	13,969	200	5,642	62,641	606,368	(340,000)
2001	2	340,000	-	180,780	24,961	963	-	-	-	44,115	14,388	206	5,812	64,521	611,225	(340,000)
2002	3	340,000	-	183,411	25,324	992	-	-	-	45,439	14,820	212	5,986	66,456	616,184	(340,000)
2003	4	-	-	149,416	-	-	37,741	405	38,146	38,070	11,291	342	3,688	53,391	240,952	40,292
2004	5	-	-	88,032	-	-	76,580	417	76,997	22,902	7,290	704	3,798	34,694	199,723	124,074
2005	6	-	-	89,313	-	-	77,694	429	78,124	23,589	7,508	725	3,912	35,735	203,172	126,459
2006	7	-	-	90,612	-	-	78,825	442	79,267	24,296	7,734	747	4,030	36,807	206,686	86,099
2007	8	-	-	91,931	-	-	79,972	456	80,427	25,025	7,966	770	5,357	39,118	211,476	86,738
2008	9	-	-	93,268	-	-	81,135	469	81,604	25,776	8,205	793	4,275	39,049	213,921	89,835
2009	10	-	-	94,625	-	-	82,316	483	82,799	26,549	8,451	816	4,404	40,220	217,644	91,771
2010	11	-	-	96,002	-	-	83,513	498	84,011	27,346	8,704	841	4,536	41,427	221,440	93,754
2011	12	-	-	97,399	-	-	84,729	513	85,241	28,166	8,965	866	4,672	42,670	225,310	95,785
2012	13	-	-	98,816	-	-	85,961	528	86,489	29,011	9,234	892	4,812	43,950	229,255	97,867
2013	14	-	-	100,254	-	-	87,212	544	87,756	29,882	9,511	919	4,956	45,268	233,278	99,998
2014	15	-	-	101,713	-	-	88,481	560	89,041	30,778	9,797	946	5,105	46,626	237,380	102,183
2015	16	-	-	103,192	-	-	89,768	577	90,346	31,701	10,091	975	5,258	48,025	241,563	104,421
2016	17	-	-	104,694	-	-	91,075	594	91,669	32,652	10,393	1,004	5,416	49,466	245,829	106,713
2017	18	-	-	106,217	-	-	92,400	612	93,012	33,632	10,705	1,034	5,578	50,950	250,179	109,063
2018	19	-	-	107,763	-	-	93,744	631	94,375	34,641	11,026	1,065	5,746	52,478	254,616	111,471
2019	20	-	-	109,331	-	-	95,108	650	95,758	35,680	11,357	1,097	5,918	54,052	259,141	113,938
2020	21	-	-	110,921	-	-	96,492	669	97,161	36,751	11,698	1,130	6,095	55,674	263,756	116,466
2021	22	-	-	112,535	-	-	97,896	689	98,585	37,853	12,049	1,164	6,278	57,344	268,465	119,058
2022	23	-	-	114,173	-	-	99,320	710	100,030	38,989	12,410	1,199	6,467	59,065	273,272	121,714
2023	24	-	-	115,834	-	-	100,765	731	101,496	40,158	12,783	1,235	6,661	60,837	278,167	124,436
2024	25	-	-	117,519	-	-	102,232	753	102,984	41,363	13,166	1,272	6,861	62,662	283,165	127,227
2025	26	-	-	119,229	-	-	103,719	776	104,495	42,604	13,561	1,310	7,066	64,541	288,265	130,087
2026	27	-	-	120,964	-	-	105,228	799	106,027	43,882	13,968	1,349	7,278	66,478	293,469	133,020
2027	28	-	-	122,724	-	-	106,759	823	107,582	45,199	14,387	1,390	7,497	68,472	298,778	136,026
2028	29	-	-	124,510	-	-	108,313	847	109,160	46,555	14,818	1,432	7,722	70,526	304,196	139,108
2029	30	-	-	126,321	-	-	109,888	873	110,761	47,951	15,263	1,475	7,953	72,642	309,725	142,268
2030	31	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2031	32	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2032	33	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2033	34	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2034	35	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2035	36	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2036	37	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2037	38	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2038	39	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2039	40	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2040	41	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2041	42	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2042	43	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2043	44	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2044	45	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2045	46	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2046	47	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2047	48	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2048	49	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
2049	50	-	-	128,159	-	-	111,487	899	112,386	49,390	15,721	1,519	8,192	74,821	315,367	145,509
Present Value		925,904	-	2,366,727	92,199	3,530	1,402,082	9,673	1,411,755	706,057	225,327	16,814	110,248	1,058,445	5,858,559	810,932
		(925,904)	-	1,826,618	487,706	24,425	(1,402,082)	(9,673)	(1,411,755)	574,103	192,190	(10,843)	54,391	809,842	810,932	
															NPV/C	0.88
															IRR	9.2%
															Benefit/Cost	1.88

BASE CASE		CAPITAL COSTS		ROAD COST	EXISTING RAIL COSTS Tarcoola - Alice Springs		DIVERTED RAIL COSTS Alice Springs - Darwin			EXTERNAL COSTS					TOTAL COSTS (BENEFITS)
Disc. Rate	5%	Initial Capital	Residual Value	Operating Costs	Oper. Costs	Handling Costs	Operating Costs	Handling Costs	Total	Road Damage	Accident Costs Road Rail		Green Hse Gases	Total	
Year	Year No.														
1999	0	-	-	175,632	24,250	908	-	-	-	41,583	13,562	194	5,478	60,817	261,608
2000	1	-	-	178,188	24,603	935	-	-	-	42,830	13,969	200	5,642	62,641	266,368
2001	2	-	-	180,780	24,961	963	-	-	-	44,115	14,388	206	5,812	64,521	271,225
2002	3	-	-	183,411	25,324	992	-	-	-	45,439	14,820	212	5,986	66,456	276,184
2003	4	-	-	186,079	25,693	1,022	-	-	-	46,802	15,264	218	6,166	68,450	281,244
2004	5	-	-	225,116	26,067	1,053	-	-	-	48,206	15,722	225	7,410	71,562	323,797
2005	6	-	-	228,391	26,446	1,084	-	-	-	49,652	16,194	232	7,632	73,709	329,631
2006	7	-	-	190,335	26,824	1,117	-	-	-	51,142	16,680	239	6,450	74,509	292,785
2007	8	-	-	193,104	27,214	1,150	-	-	-	52,676	17,180	246	6,643	76,745	298,214
2008	9	-	-	195,914	27,610	1,185	-	-	-	54,256	17,695	253	6,843	79,047	303,756
2009	10	-	-	198,765	28,012	1,220	-	-	-	55,884	18,226	261	7,048	81,418	309,415
2010	11	-	-	201,657	28,419	1,257	-	-	-	57,560	18,773	268	7,259	83,861	315,194
2011	12	-	-	204,591	28,833	1,295	-	-	-	59,287	19,336	277	7,477	86,377	321,095
2012	13	-	-	207,568	29,252	1,334	-	-	-	61,066	19,916	285	7,701	88,968	327,122
2013	14	-	-	210,588	29,678	1,374	-	-	-	62,898	20,514	293	7,932	91,637	333,276
2014	15	-	-	213,652	30,110	1,415	-	-	-	64,785	21,129	302	8,170	94,386	339,563
2015	16	-	-	216,760	30,548	1,457	-	-	-	66,728	21,763	311	8,415	97,218	345,983
2016	17	-	-	219,914	30,992	1,501	-	-	-	68,730	22,416	321	8,668	100,134	352,542
2017	18	-	-	223,114	31,443	1,546	-	-	-	70,792	23,088	330	8,928	103,138	359,242
2018	19	-	-	226,360	31,901	1,592	-	-	-	72,916	23,781	340	9,196	106,233	366,086
2019	20	-	-	229,654	32,365	1,640	-	-	-	75,103	24,494	350	9,472	109,420	373,079
2020	21	-	-	232,995	32,836	1,689	-	-	-	77,356	25,229	361	9,756	112,702	380,223
2021	22	-	-	236,385	33,314	1,740	-	-	-	79,677	25,986	372	10,049	116,083	387,522
2022	23	-	-	239,825	33,798	1,792	-	-	-	82,067	26,766	383	10,350	119,566	394,981
2023	24	-	-	243,314	34,290	1,846	-	-	-	84,529	27,569	394	10,660	123,153	402,603
2024	25	-	-	246,854	34,789	1,901	-	-	-	87,065	28,396	406	10,980	126,847	410,392
2025	26	-	-	250,446	35,295	1,958	-	-	-	89,677	29,248	418	11,310	130,653	418,353
2026	27	-	-	254,090	35,809	2,017	-	-	-	92,367	30,125	431	11,649	134,572	426,488
2027	28	-	-	257,787	36,330	2,078	-	-	-	95,138	31,029	444	11,998	138,610	434,804
2028	29	-	-	261,538	36,858	2,140	-	-	-	97,993	31,960	457	12,358	142,768	443,304
2029	30	-	-	265,343	37,395	2,204	-	-	-	100,932	32,919	471	12,729	147,051	451,993
2030	31	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2031	32	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2032	33	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2033	34	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2034	35	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2035	36	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2036	37	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2037	38	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2038	39	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2039	40	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2040	41	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2041	42	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2042	43	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2043	44	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2044	45	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2045	46	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2046	47	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2047	48	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2048	49	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
2049	50	-	-	269,204	37,939	2,270	-	-	-	103,960	33,906	485	13,111	151,462	460,876
Present Value		-	-	4,193,344	579,905	27,955	-	-	-	1,280,160	417,517	5,971	164,639	1,868,287	6,669,491