KAPITI RAIL PACKAGE EVALUATION

WELLINGTON REGIONAL COUNCIL

NOVEMBER 1998

BOOZ·ALLEN & HAMILTON (NEW ZEALAND) LTD

CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION

The Wellington Regional Council (WRC) is assessing the options available' for the development of rail-based public transport services in the Kapiti Coast District. Booz-Allen & Hamilton (NZ) Ltd (BAH) was engaged to undertake an evaluation of these options. This report sets out the results of the evaluation.

OPTIONS EVALUATED

The following rail improvement options were evaluated :

Wellington - Paraparaumu Services

A Interpeak Frequency increase - 30 min service

B1 Peak Frequency increase - 20 min service
B2 Peak Frequency increase - 15 min service
B3 Peak Frequency increase - 10 min service

C 1 Paraparaumu Station Upgrade
c 2 Paraparaumu Park and Ride

D Raumati Station (+parking & pedestrian overbridge)

Extension of Services to Waikanae

E1	Electrification -	Existing EMUs	- Existing frequency
E2	Electrification -	Existing EMUs	- 20 min peak service
E3	Wke to Ppm -	Loco hauled EMUs	- Existing frequency
E 4	Wke to Ppm -	Loco hauled EMUs	- 20 min peak service

F Lindale Station

EVALUATION FRAMEWORK

A social cost-benefit analysis was undertaken within the evaluation framework set down in the Transfund New Zealand (Interim) Evaluation Procedures For Alternatives to Roading (ATR) projects. Transfund's procedures involve determining an Efficiency Ratio (ER) for each option.

Several key evaluation assumptions have been made:

- All costs and revenues are in 1998 prices.
- All costs are indicative only. Although adequate for this evaluation, more detailed costings will be required when the project is submitted to Transfund. Many of these projects will require 'prices' from Tranz Rail.
- Operating resource requirements have been assessed treating the Western Line as a separate stand-alone operation. In practice, Tranz Rail operate the Western Line and the Hutt Line as a combined operation. This may mean that

some operational synergies are currently achieved by Tranz Rail which may be lost by separating the Western Line off. This would need further investigation in any subsequent work.

- No consideration has been given to the specific timing and phasing of projects. All projects are assumed to begin in the year 2000.

EVALUATION RESULTS

The evaluation results are set down in Table 1. These results are summarised below for each project group.

Paraparaumu - Wellington Service Freauency Increases

- All service frequency options have an ER above 1, and are therefore justifiable in economic terms.
- All three peak frequency increase options have an ER of 4 or higher, thereby meeting Transfund's current funding cut-off ratio.
- The interpeak frequency increase option does not meet the cut-off ratio.
- The peak options will achieve a substantial increase in patronage, ranging between 6.1% and 8.5% of total (daytime) patronage on the western line. They will also significantly reduce road traffic volumes and levels of congestion.
- Under Transfund's Incremental Analysis, the 15 min peak option is the 'preferred option' for funding.
- Only the 10 min option requires additional rolling stock.

Waikanae Electrification - Extension of EMU Service to Waikanae

- Electrification of the rail line between Paraparaumu and Waikanae, and extending the existing Paraparaumu services to Waikanae, has an ER below 1.
- Providing a higher level of service (20 min frequency) over the electrified line raises the ER above 3. However, the incremental ER of the 20 min Waikanae option relative to the Paraparaurnu 20 min option is only 0.7.
- Extending the rail service to Waikanae will have a small impact on total line patronage, in the order of 1.6% of daytime patronage; but the 20 min option will increase patronage by 6.6%..
- Neither of these options requires additional rolling stock.

Waikanae Loco Haul Extension to Waikanae

- Extending the existing rail service to Waikanae by using a Diesel Locomotive to pull the EMU units between Paraparaumu and Waikanae achieves an ER marginally over 1, which is slightly higher than the Electrification project.
- As for the Electrification project, providing a higher level of service (20 min frequency) raises the ER close to 4.
- The patronage impacts will be similar to those for the Electrification option.
- A dedicated Diesel Locomotive would be required for these options, but no additional EMU rolling stock.

- It has been assumed (on advice from Tranz Rail) that no additional rail infrastructure would be required. Further investigation by Tranz Rail of operational requirements would be necessary if this option was to be considered further.

Rail Station Options

- Both the Paraparaumu Station Upgrade option and the Raumati Station upgrade option, achieve ER values above 4.
- The Paraparaumu Park and Ride (P+R) option and the Lindale Station option achieve an ER of below 4, but well above 1.
- The station options will result in a small increase in total line patronage, ranging from 0.1% for the P+R option to 1.4% for the Raumati Station option.

CONCLUSIONS

- All of the project options evaluated (apart from the Waikanae Electrification existing service option) have an ER above 1, and are therefore justifiable in economic terms.

- The most cost-effective options, in terms of additional patronage relative to additional cost to Government, are the Paraparaumu-Wellington 20 min and 15 min peak service options

- Providing an increased frequency to Paraparaumu at peak times has the highest benefits relative to costs out of all projects evaluated, and should be funded first if funds are constrained. Following this would be the Paraparaumu Station Upgrade and Raumati Station.

- Electrification to Waikanae on its own is not justifiable in economic terms. However, if it is combined with an increased service frequency (20 mins peak) it achieves an ER close to the current Transfund cut-off ratio. Given the strategic benefits of extending the rail service to Waikanae this project may be able to secure Transfund funding.

- Extending the rail service to Waikanae using a Diesel Locomotive to pull the EMUs between Paraparaumu and Waikanae performs marginally better than the Electrification option under the analysis conducted here. However, it does have significant operating difficulties, and requires a dedicated locomotive, driver and support staff. Further analysis would be required by Tranz Rail to ascertain whether this option did in fact have cost advantages over Electrification.

- The projects evaluated could be implemented as several different rail improvement packages. In economic terms, the highest performing package will be :

  Peak period frequency increase to Paraparaumu (no capital exp)
  Paraparaumu Station Upgrade ($350,000 capital)

Raumati Station ($1.3M capital)
Paraparaumu Park and Ride ($405,000 capital).

TABLE 1 SUMMARY OF EVALUATION RESULTS (1st **Year Costs and Benefits)**

Option	Capital Cost ($000)	Additional Operating cost ($000)	Additional Fare Revenue ($000)	Funding Gap ($000)	Impact on Patronage (% Change W Line)	User Benefits ($000)	Road User Benefits: Travel Time Savings ($000)	Road User Benefits: Vehicle opg cost Savings ($000)	Road User Benefits: Accident cost Savings ($000)	Costs to Government: Road Maint cost Savings ($000)	Costs to Government: Lost Road User Payments ($000)	CO_2 Savings ($000)	Efficiency Ratio
Paraparaumu - Wellington Service Frequency Increases													
Peak - 20 mins	0	653	488	105	6.1	572	1,333	67	94	2	17	33	23.1
Peak - 15 mins	0	985	654	189	7.9	708	1,757	88	122	3	21	42	17.5
Peak - 10 mins	3,200	1,586	792	927	8.5	723	1,955	98	131	3	23	45	4.2
Interpeak - 30 mins	0	471	253	232	2.4	458	0	0	47	0.3	3	6	3.2
Peak-15 mins : 20 mins	0	332	166	84	1.8	136	424	21	28	1	4	9	9.6
Peak-10 mins : 15 mins	3,200	601	138	738	0.6	15	198	10	9	0	2	3	0.5
Waikanae Electrification - Extension of EMU Service to Waikanae													
1- Existing Service	5,000	614	222	1,048	1.6	62	380	19	26	0.4	3	7	0.8
2- 20 min service	5,000	1,224	522	1,122	6.6	788	1,481	74	288	3	18	35	3.1
20 min : Existmg	0	610	300	74	5	726	1,101	55	262	3	15	28	9.9
20 min Wke : 20 min Ppm	5,000	571	34	1,017	0.5	216	148	7	194	1	1	2	0.7
Waikanae Loco **Haul Extension to Waikanae**													
1- Existing Service	1,600	661	222	704	1.6	51	358	18	25	0.4	3	7	1.1
2- 20 min service	1,600	1,456	522	1,272	6.6	749	1,481	74	288	2.5	18	35	3.3
20 mm : Existing	0	795	300	568	5	698	1,123	56	263	2	15	28	6.0
Rail Station Options													
Ppm Station Upgrade	350	5	26	14	0.2	95	63	3	4	0.06	0.5	1	17.8
Ppm Station P+R	405	0	17	27	0.1	10	40	2	3	0.05	0.4	1	3.4
Raumati Station	1,300	68	84	106	1.1	154	176	9	12	0.2	1.6	3	4.4
Lindale Station	900	68	46	96	0.5	96	73	4	5	0.07	0.6	1	2.7

Note: Excludes 'Strategic Benefits'

1. INTRODUCTION

1.1. INTRODUCTION

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1.2. OPTIONS EVALUATED

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- No allowance has been made for timing and phasing of projects. All projects are assumed to begin in the year 2000.

1.4. REPORT STRUCTURE

This report has been set out basically in the format required by the Draft Alternatives to Roading Evaluation Procedures published by Transfund, with the projects grouped according to project type.

The projects are grouped together as follows:

Chapter	2	-	Wellington to Paraparaumu Service Frequency options (options A, B)
Chapter	3	-	Waikanae Electrification options (options E_1, E2)
Chapter	4	-	Waikanae Loco Haul (option E_3)
Chapter	5	-	Rail Station options (options C_1, C_2, D, F)

For each project the following is provided :

- Proposal Details
- Demand Estimation
- Service Provider Costs
- Service Provider Revenue
- Financial Viability
- Road User Benefits
- Costs to Government
- Calculation of the Efficiency Ratio
- Conclusions

The evaluation and technical spreadsheets are attached as Appendix A.

2. WELLINGTON TO PARAPARAUMU SERVICE FREQUENCY OPTIONS

2.1. PROPOSAL DETAILS

The proposal details for the Wellington to Paraparaumu rail service frequency options are summarised in Table 2.1.

TABLE 2.1 PARAPARAUMU FREQUENCY INCREASE PROPOSAL DETAILS

Proposal Name	Wellington to Paraparaumu Rail Service Frequency Options
Proposer	Wellington Regional Council
Evaluator	Booz-Allen & Hamilton (NZ) Ltd
Checker	
Date of Evaluation	November 1998
Proposed Start Date of Project	1 January 1999
Proposal Duration	25 years with residual value
Proposal Location	Wellington
Proposal Aims	This project will address the problem of peak period congestion on State Highway 1 between Paraparaumu and Wellington. It will aim to reduce the number of trips made by single-occupant vehicles by increasing the frequency of passenger rail services.
Relationship with RLTS	The Wellington RLTS seeks to encourage the use of public transport.
Needs of the Transport Disadvantaged	A key role of the Wellington public transport system is to provide transport services for people who are transport disadvantaged. This project will improve the transport options available to this group.
'Do Minimum'	Maintain the current service levels.
Proposal Options	1. Increase peak service frequencies from 30 minutes to 20 minutes (average). 2. Increase peak service frequencies from 30 minutes to 15 minutes. 3. Increase peak service frequencies from 30 minutes to 10 minutes. 4. Increase interpeak service frequencies from 60 minutes to 30 minutes.

2.1.1. Project Specification

The project essentially involves providing additional peak direction trips for passengers living in the Kapiti area. This can be done by extending several of the services presently originating from/terminating at Plimmerton to Paraparaumu. In addition, extra trips can be provided from/to Paraparaumu by making more efficient use of existing rolling stock. Providing more frequency to Paraparaumu also increases frequency at other stations on the line.

The project does not involve any construction : all of the options can be provided within the existing rail infrastructure.

The Base Case (Do Minimum)
The do minimum option is to continue providing services at the current level, with additional rolling stock provided as required to meet patronage growth.

A Roading Alternative
The roading project most suitable for comparative evaluation is the Transmission Gully project.

2.2. DEMAND ESTIMATES

2.2.1. Service Frequency Impact

The major impact of the proposed project will be to improve the frequency of the peak period rail service between Paraparaumu and Wellington. We are not aware of any Wellington specific analysis of actual patronage responses to service frequency changes. Analysis of the probable patronage impacts of this project on patronage using the Wellington Transport Model indicate an elasticity in the range of 0.25 - 0.3 for the peak period, and double that for the interpeak period. These are lower than standard elasticities used in other places (0.5 for the peak period), and are considered to be conservative values. Service frequency elasticities of 0.25 for the peak period and 0.5 for the interpeak, have been applied to existing patronage levels (using the Wellington Regional Council 1996 Census day station count as the main source for existing patronage) in determining the effect of future service frequency changes.

2.2.2. Patronage Growth

Tranz Rail have indicated that patronage on the Western Line grew by 6% in 1996/97, 2% in 1997/98, and has been static over the first 4 months of 1998/99. Taking these growth rates together gives an annual growth rate of 3.2%. This growth is largely occurring on the Kapiti Coast, and is fuelled by high population growth rates in this area. Given that high population growth is projected over the next 20-25 years in the Kapiti area, an annual (base case) growth rate of 1.5-2.5% over the whole line seems realistic. The levelling off of growth in 1998 most likely relates to the economic downturn experienced throughout New Zealand this year, and should be a minor blip in the long term. An annual patronage growth rate of 1.5% has been used in this evaluation.

2.2.3. Patronage Changes

The expected changes in patronage from the Paraparaumu service frequency project options, assuming they commence in the year 2000, are shown in Table 2.2.

TABLE 2.2 WESTERN LINE PATRONAGE (DAILY PASSENGERS)

	Year 2000 Base Case	Additional Passengers	Total With Project	% Change
Peak - 20 mins	9,226	655	9,881	7.1
Peak - 15 mins	9,226	844	10,070	9.1
Peak - 10 mins	9,226	910	10,136	9.9
Interpeak - 30 mins	1,488	252	1,740	17.0

2.3. SERVICE PROVIDER COSTS

2.3.1. Capital Cost

There are no construction costs associated with this project. An assessment of additional vehicles required over the evaluation period was carried out. The only option requiring additional vehicles is the 10 min peak period frequency option, which requires one additional EMU 2 car set in Year 1

The residual value of the rail vehicle has been calculated on a straight-line basis, assuming a 30 year life.

2.3.2. Operating Cost

A spreadsheet model of the existing rail service, and all of the proposed options, was created by BAH. This was used to determine the additional operating cost of providing each option.

The additional annual operating cost of each option is estimated to be:

Option	Additional Annual Operating Cost (1st Year)
Peak - 20 mins	653,000
Peak - 15 mins	985,000
Peak - 10 mins	1,586,000
Inter-peak - 30 mins	471,000

2.4. SERVICE PROVIDER REVENUE

The additional fare revenue from the estimated increase in patronage has been calculated for each option using the average fare matrix (with GST deducted) from the Wellington Transport Model.

The additional first year annual fare revenue of each option is estimated to be:

Option	Additional Annual Fare Revenue (1st Year)
Peak - 20 mins	488,000
Peak - 15 mins	654,000
Peak - 10 mins	792,000
Interpeak - 30 mins	253,000

2.5. FINANCIAL VIABILITY

The funding gap for this project has been estimated over 25 years using a 10% real discount rate.

The annual funding gap for each option is estimated to be:

Option	Annual Funding Gap
Peak - 20 mins	105,000
Peak - 15 mins	189,000
Peak - 10 mins	927,000
Interpeak - 30 mins	232,000

2.6. USER BENEFITS

The main user benefit from this project is a reduction in waiting time (actual waiting time at station, or inconvenience as a result of staggered departure times). The increase in frequency will reduce the average waiting time for users (and provide other smaller and less easily quantifiable benefits eg the increased choice of departure).

Headway functions have been developed to estimate the size of this waiting time reduction, with the following structure :

$$\text{Wait time} = F + G\,(\text{Headway})^{H}$$

Where

F = constant
G = constant
H = constant

We have used the following parameters apply for this evaluation: F = 0, G = 1, H = 0.65 (based on review of parameters by BAH). Applying this formula, wait times can be calculated for different headways with the following suggested values:

Headway	Wait Time
5	2.5
10	4.5
15	5.8
20	7.0
30	9.1

Thus, reducing the headway from 30 minutes to 15 minutes reduces effective waiting time from 9.1 minutes to 5.8 minutes. The benefit per user from the 15 min frequency option is therefore 3.3 minutes.

The estimated wait time saving per user has been calculated under each option on a station by station basis to determine. The current Transfund value of time for seated bus passengers, multiplied by a factor of two (given that users are considered to value wait time at twice that of seated in-vehicle time), has been used to determine the monetary value of this benefit for existing users.

New Users

The rule of a half has been applied for new users. However, the value of time which has been used for new users is the value of time for their previous mode.

Previous Mode

New rail passengers have been assumed to have come from either bus, car driver or car passenger as shown below. The 'diversion rates' used have been based on an analysis of expected patronage impacts using the Wellington Transport model : this found that around 60% of new rail passengers would be from car driver in the peak period, and around 30% in the interpeak period.

The peak period diversion rates used were :

- bus 10%
- car driver 60%
- car passenger 30%.

The annual user benefits of each option is estimated to be:

Option	Annual User Benefits (1st Year)
Peak - 20 mins	572,000
Peak - 15 mins	708,000
Peak - 10 mins	723,000
Interpeak - 30 mins	458,000

2.7. ROAD USER BENEFITS

2.7.1. Travel Time Benefits

Congestion benefits (travel time benefits) have been modelled using the Wellington Transport Model based on an AM two hour peak period of 7:00 am to 9:00 am. A

travel time saving was determined for each area on the Western Line in terms of number of minutes per vehicle removed in the am peak period. An average travel time saving per peak vehicle removed was then calculated for each option. The recently released Transfund values of time were used to estimate the road congestion cost saving. This was done for 1996 and 2016. Comparing these two results derived an average congestion growth rate of 1.5% per annum.

The average travel time savings for each option, and the congestion cost saving per peak vehicle removed are shown below:

Option	1996 Average Travel Time Saving (mins per vehicle)	1996 Average Congestion Cost Saving ($ per vehicle)
Peak - 20 mins	51	15.94
Peak - 15 mins	59	18.18
Peak - 10 mins	53	16.52

The annual road user travel time benefits of each option are estimated to be:

Option	Annual Travel Time Benefits (1st Year)
Peak - 20 mins	1,348,000
Peak - 15 mins	1,757,000
Peak - 10 mins	1,955,000
Interpeak - 30 mins	0

2.7.2. Vehicle Operating Costs

As set down in the ATR Manual, vehicle operating cost savings for road users have been estimated as 5% of travel time benefits.

The annual vehicle operating cost savings of each option are estimated to be:

Option	Annual Vehicle Operating Cost Savings (1st Year)
Peak - 20 mins	67,000
Peak - 15 mins	88,000
Peak - 10 mins	98,000
Interpeak - 30 mins	0

2.7.3. Accident Cost Savings

The accident cost savings have been calculated by determining the total reduction in vehicle kilometres under each option, and applying the following accident cost rates : peak period - $0.06 / veh km, interpeak - $0.14 / veh km (a region-wide all-day figure of $0.10 / veh km was obtained from the Wellington Transport Model. Peak accident costs are typically substantially lower than interpeak costs: recent analysis of Auckland accident costs has derived the values used here).

The annual accident cost savings of each option are estimated to be:

Option	Annual Accident Cost Savings (1st Year)
Peak - 20 mins	94,000
Peak - 15 mins	122,000
Peak - 10 mins	131,000
Interpeak - 30 mins	47,000

2.8. COSTS TO GOVERNMENT

2.8.1. Road Maintenance Cost Savings

One effect of this project will be to reduce vehicle kilometres travelled within Wellington region. This will have some effect on road maintenance costs. The Australian National Road Transport Commission has developed a unit value for this effect of 0.106 c/vehicle km removed.

The following annual road maintenance cost reductions have been determined:

Option	Annual Road Maintenance Cost Reduction (1st Year)
Peak - 20 mins	2,000
Peak - 15 mins	3,000
Peak - 10 mins	3,000
Inter-peak - 30 mins	300

2.8.2. Lost Road User Payments

The fuel tax "lost" is calculated using the rate recommended by the Transfund ATR Manual of 88 cents per 100 vehicle-km.

The annual lost road user payments are estimated to be :

Option	Annual Lost Road User Payments (1st Year)
Peak - 20 mins	17,000
Peak - 15 mins	21,000
Peak - 10 mins	23,000
Interpeak - 30 mins	3,000

2.9. ENVIRONMENTAL BENEFITS

2.9.1. Air Pollution and CO,

Air Pollution

A formula is given in the Draft Evaluation Manual for air pollution which is:
0.001 * ΔPM_{10} concentration" population exposed * normal death rate * value for life.

Also given in the draft evaluation manual is a rate of $0.01 per car km. This is quoted as being appropriate for use in an urban area, but the underlying assumptions are not given. We have taken this figure for our calculations.

Carbon dioxide

A value of $30/tonne is quoted in the ATR evaluation manual. Alternatively a value of 9c/litre of fuel is proposed. We have assumed an average car uses 8 litres/100 km. The CO, cost is thus $0.72 per 100 kilometres.

The estimated annual benefit for air pollution and carbon dioxide for each option is :

Option	Annual Air Pollution Savings (1st Year)
Peak - 20 mins	33,000
Peak - 15 mins	42,000
Peak - 10 mins	45,000
Interpeak - 30 mins	6,000

2.9.2. Noise

The impact of the number of cars avoided on the dB level will be negligible, and no benefits have been assessed for this factor.

2.10. CALCULATION OF THE EFFICIENCY RATIO

2.10.1. Unadjusted ER

Table 2.3 sets out the calculation of the unadjusted Efficiency Ratio for each option.

TABLE 2.3 EFFICIENCY RATIO				
	BENEFITS ($ PV)			
	Peak - 20 min	Peak - 15 min	Peak - 10 min	Intpk - 30 min
ATR User Benefits	6,557,093	8,119,415	8,289,309	5,102,793
ATR User Disruption Disbenefits				
Demand Change Impact				
Travel Time Benefits	17,431,458	22,971,813	25,561,118	
VOC Benefits	871,573	1,148,591	1,278,056	
Accident Reduction Benefits	215,700	922,317	993,885	349,577
Road User Construction Disbenefits				
CO2	372,032	479,435	516,637	64,898
Total PV Benefits for ER	25,947,858	33,641,571	36,639,006	5,517,268
	COSTS ($ PV)			
Funding Gap	956,308	1,710,685	8,411,514	1,699,742
Lost Road User Payments	190,342	245,292	264,326	33,204
Government Cost Savings	22,062	28,432	30,638	3,849
Total PV (Net Costs to Govt)	1,124,588	1,927,545	8,645,203	1,729,097
Unadjusted Efficiency Ratio	23.1	17.5	4.2	3.2

2.10.2. Strategic Factors

The Wellington Regional Land Transport Strategy (WRLTS), sets the strategic framework for meeting land transport needs within the Wellington region.

Strategy A is to *'Enhance and expand urban public passenger transport facilities' The* key objective for this strategy . . . is to promote increased passenger transport patronage. The use of passenger transport will be encouraged through making it an attractive alternative to the private car, particularly at peak periods.'

Making significant improvements to particular elements of the public transport service (in this case, to the Western Line rail service) will have a wider impact than just on the users of that particular service. As the level of public transport service provided improves relative to the private car (particularly at times of high road congestion) people's perception of it will change. Over time the combined impact on road traffic of the individual improvements should be greater than the sum of their individually assessed effects. This additional effect can also be classified as a strategic factor, which will have strategic benefits (ie contribute to achieving strategic goals).

In addition, high population growth is predicted in the Kapiti Coast District over the evaluation life of this project. The workforce is predicted to grow by 46% over the period 1996-2021. Improving the rail service at this time will have the 'strategic benefit' of making rail a more attractive transport option relative to private car, prior to commuters making a decision to purchase a vehicle for commuting. This will help overcome the 'marginal cost factor' whereby motor vehicle owners reason that

they have already bought the vehicle and consider only marginal costs (fuel and parking) when comparing with alternative modes.

Strategic benefits have not been calculated for this project given that all of the peak frequency increase options are above Transfund's cut-off ratio. The interpeak option, on its own, would have a relatively small strategic benefit.

2.11. INCREMENTAL ANALYSIS

Transfund's ATR Manual states that 'Where the options being evaluated, including the do minimum , are mutually exclusive . . . , an incremental analysis of the options shall be used to determine the best option'. In this project, the three peak service frequency increase options fall into this category, and an incremental analysis has been undertaken for these options. The results are shown below.

	A Peak - 20 mins	B Peak - 15 mins	C Peak - 10 mins
ATR Benefits (PV)	$25,947,858	$33,641,571	$36,639,006
cost to Govt (Iv)	$1,124,588	$1,927,545	$8,645,203
Incremental over A		9.6	
Incremental over B			0.5

On the basis of this analysis, the Peak - 15 mins option is the preferred option.

2.12. SENSITIVITY ANALYSIS

A sensitivity analysis of key variables was undertaken. The results are shown below. The values used in this analysis, and resultant ER, are shown *in italics.*

		ER			
Variable		20 mins	15 mins	10 mins	Intpk 30 min
Patronage Growth Rate	2.5%	23.1	17.5	4.2	3.2
	1.0%	19.0	14.8	3.9	2.9
	3.0%	60.0	35.6	5.5	3.2
Car Diversion Rate	60%	23.1	17.5	4.2	3.2
	50%	20.7	15.5	3.7	3.2
	70%	25.4	19.3	4.8	3.2
Congestion Growth Rate	2.5%	23.1	17.5	4.2	3.2
	1.0%	22.4	16.9	4.1	3.2
	2.5%	24.7	18.7	4.5	3.2

2.13. FUNDING PROPOSAL

The funding share of each of the potential funding parties has been determined using Transfund's formula as set down in its Programme and Funding Manual. Transfund currently funds 100% of state highway benefits and 43% of local road

benefits. The Wellington Transport Model was used to provide an assessment of the percentage of the traffic diverted from the state highway system as a result of upgrading the Western Line rail system. This found that around 80% of traffic diverted was from state highways. However, because of the way in which the Model categorises road types this is considered to be on the high side. It has therefore been assumed that 65% of traffic diverted as a result of this project is from the state highway network. On this basis, Transfund will fund 80% of road user benefits.

The funding apportionment for this project is shown in Table 2.4.

Table 2.4 Funding Apportionment (PV of Funding Gap)

	Transfund	Local Authority	Regional Council	Total
Peak - 20 mins	569,403	143,666	243,239	956,308
Peak - 15 mins	1,034,248	260,883	415,554	1,710,685
Peak - 10 mins	5,188,068	1,308,187	1,915,260	8,411,514
Interpeak - 30 mins	93,433	25,848	1,580,461	1,699,742

3. WAIKANAE ELECTRIFICATION

3.1. PROPOSAL DETAILS

The proposal details for the Wellington to Paraparaumu rail service frequency options are summarised in Table 2.1.

TABLE 2.1 WAIKANAE ELECTRIFICATION PROPOSAL DETAILS	
Proposal Name	Waikanae Electrification
Proposer	Wellington Regional Council
Evaluator	Booz-Allen & Hamilton (NZ) Ltd
Checker	
Date of Evaluation	November 1998
Proposed Start Date of Project	1 January 1999
Proposal Duration	25 years with residual value
Proposal Location	Wellington
Proposal Aims	This project will improve access to the rail service for Waikanae residents, with the aim of attracting present car drivers on to the rail service. This will help reduce congestion on State Highway 1 between Waikanae and Wellington.
Relationship with RLTS	The Wellington RLTS seeks to encourage the use of public transport.
Needs of the Transport Disadvantaged	A key role of the Wellington public transport system is to provide transport services for people who are transport disadvantaged. This project will improve the transport options available to this group.
'Do Minimum'	Maintain the current service levels.
Proposal Options	1. Extension of Existing EMU service to Waikanae. 2. Extension of EMU service to Waikanae and increase in frequency to 20 min peak period service.

3.1.1. Project Specification

At present the Western Rail Line is electrified as far as Paraparaumu. The suburban rail service is operated using EMUs, and thus services cannot be provided to Waikanae. Demand for the rail service has been increasing in Waikanae, with increasing numbers of people travelling by car or bus from Waikanae to Paraparaumu to take the train to Wellington or Porirua. This project involves electrification of the Paraparaumu to Waikanae section of the rail line, and extension of the suburban rail service to Waikanae.

Two options have been evaluated:

(1) Extension of the existing service - this involves operating the existing level of service, but having trips terminate/originate at Waikanae instead of Paraparaumu. This is the 'base option'.

(2) Extension to Waikanae with a higher level of service - this involves increasing the frequency to 20 mins at peak times for the Kapiti area, and extending the service to Waikanae.

The Base Case (Do Minimum)

The do minimum option is to continue providing services to Paraparaumu at the current level, with additional rolling stock provided as required to meet patronage growth.

A Roadine Alternative

We are not aware of any roading projects which are close substitutes to this project for comparative purposes. The Transmission Gully project, and the proposed 'Sandhills Route', both only cover a portion of the route covered by this project.

3.2. DEMAND ESTIMATES

3.2.1. Improved Rail Access

The main impact of the 'base option' is to reduce the rail access distance, and travelling time, for Waikanae passengers. This will reduce the generalised cost of travel for Waikanae residents, and will therefore increase rail patronage from Waikanae.

An analysis of the 1996 Census Journey to Work (JTW) data was carried. This found that a lower proportion of total JTW trips from Waikanae were by rail, than from Paraparaumu. This will be a result of two factors:

- The proportion of JTW trips to the Wellington CBD decreases with distance from the CBD - more JTW trips are to local employment. The rail service is most competitive with the car over long distances and for trips to the CBD where parking is restricted - it will therefore achieve a higher modal share in areas with higher proportions of trips to the CBD.
- The proportion of JTW trips by rail decrease with distance from the rail station. Areas close to the rail station have a higher proportion of JTW trips by rail than areas further away because of the increased cost of rail access both in terms of time and vehicle operating costs. Waikanae is around 7 km from the nearest rail station (for the suburban service), whereas most areas of Paraparaumu are within 3 km of the station.

The Census JTW analysis has been used to estimate the expected number of new period rail trips from Waikanae as follows:

- The Waikanae proportion of total JTW trips by rail has been assumed to increase to the Paraparaumu level with extension of the rail service to Waikanae, subject to this proportion being adjusted down to reflect the lower proportion of JTW trips to Wellington and Porirua in Waikanae than in Paraparaumu.
- In estimating the number of new JTW trips, those trips presently made by company car have been excluded - these people have been assumed to be 'captive' to car.
- JTW trips are assumed to be 80% of all peak period trips.

- Expected new interpeak trips have been estimated based upon the present ratio of interpeak to peak trips for Paraparaumu.

3.2.2. Service Frequency Impact

Option (2) involves extending the suburban rail service to Waikanae, but with a higher service frequency. This option will bring the rail access related demand impact outlined in chapter 2, and will also provide reduced waiting time benefits for users and increase patronage, as for the Paraparaumu service frequency options detailed in chapter 2. As for the Paraparaumu options, standard service frequency elasticities (+0.2 for the peak period and +0.4 for the interpeak period) have been applied to the to existing patronage levels.

3.2.3. Patronage Growth

As indicated earlier, an annual patronage growth rate of 1.5% for the Western Rail Line has been assumed.

3.2.4. Patronage Changes

The expected changes in patronage from the Waikanae Electrification options, assuming they commence in the year 2000, are shown in Table 3.2.

TABLE 3.2. WESTERN LINE PATRONAGE (DAILY PASSENGERS)

	Year 2000 Base Case	Additional Passengers	Total With Project	% Change
l-Extension of Existing Service	10,714	167	10,880	1.6
2-Extension of 20 min service	9,226	702	9,928	7.6

3.3. SERVICE PROVIDER COSTS

3.3.1. Capital Cost

The capital cost for this project is estimated at $5M. This cost covers :

- Electrification of the rail line between Paraparaumu and Waikanae
- Provision of a new passing bay and platform at Waikanae.

No additional EMUs are required to extend the suburban rail service to Waikanae. Given the relatively small patronage increases resulting from these options, it has been assumed that no additional EMUs, above those which will be needed to meet the projected patronage growth trends, will be required over the life of the project.

The residual value of the rail infrastructure has been calculated on a straight-line basis assuming a 40 year life for the infrastructure.

3.3.2. Operating Cost

A spreadsheet model of the existing rail service, and all of the proposed options, was created by BAH. This was used to determine the additional rail operating cost of providing each option. In addition, the Waikanae rail station to Paraparaumu rail station portion of the existing bus service between the two areas will no longer be required - this will be an operating cost saving.

The additional net annual operating cost of each option is estimated to be:

Option	Additional Annual Operating Cost (1st Year)
l-Extension of Existing Service	614,000
2-Extension of 20 min service	1,224,000

3.4. SERVICE PROVIDER REVENUE

The additional fare revenue from the estimated increase in patronage has been calculated for each option using the average fare matrix (with GST deducted) from the Wellington Transport Model.

The additional first year annual fare revenue of each option is estimated to be:

Option	Additional Annual Fare Revenue (1st Year)
l-Extension of Existing Service	222,000
2-Extension of 20 min service	522,000

3.5. FINANCIAL VIABILITY

The funding gap for this project has been estimated over 25 years using a 10% real discount rate.

The annual funding gap for each option is estimated to be:

Option	Annual Funding Gap
l-Extension of Existing Service	1,048,000
2-Extension of 20 min service	1,122,000

3.6. USER BENEFITS

The main benefits for users from the Waikanae service extension is a reduction in rail access time and vehicle operating costs. However, against that will be an increase in rail journey time and rail fare. We have determined the net impact of these to provide an estimate of the net user benefit for existing users.

In addition, Option 2, extending a higher frequency service, will result in a reduction in waiting time. This benefit has been estimated using the approach outlined earlier in the Paraparaumu options section of the report.

New Users
The rule of a half has been applied for new users. However, the value of time which has been used for new users is the value of time for their previous mode.

Previous Mode
The diversion rates used in chapter 2 have been applied :

- bus 10%
- car driver 60%
- car passenger 30%.

The annual user benefits of each option is estimated to be:

Option	Annual User Benefits (1st Year)
l-Extension of Existing Service	62,000
2-Extension of 20 min service	788,000

3.7. ROAD USER BENEFITS

3.7.1. Travel Time Benefits

The approach set down in Chapter 2 to determine congestion cost savings has been used here.

The average travel time savings for each option, and the congestion cost saving per peak vehicle removed are shown below:

Option	1996 Average Travel Time Saving (mins per vehicle)	1996 Average Congestion Cost Saving ($ per vehicle)
l-Extension of Existing Service	70	21.68
2-Extension of 20 min service	53	16.47

The annual travel time benefits of each option are estimated to be:

Option	Annual Travel Time Benefits (1st Year)
l-Extension of Existing Service	380,000
2-Extension of 20 min service	1,481,000

3.7.2. Vehicle Operating Costs

As set down in the ATR Manual, vehicle operating cost savings for road users have been estimated as 5% of travel time benefits.

The annual vehicle operating cost savings of each option are estimated to be:

Option	Annual Vehicle Operating Cost Savings (1st Year)
l-Extension of Existing Service	19,000
2-Extension of 20 min service	74,000

3.7.3. Accident Cost Savings

The accident cost savings have been calculated by determining the total reduction in vehicle kilometres under each option, and applying the following accident cost rates : peak period - $0.06 / km, interpeak - $0.14 / km.

The annual accident cost savings of each option are estimated to be:

Option	Annual Accident Cost Savings (1st Year)
l-Extension of Existing Service	26,000
2-Extension of 20 min service	288,000

3.8. COSTS TO GOVERNMENT

3.8.1. Road Maintenance Cost Savings

As detailed in Chapter 2, the road maintenance cost saving has been assumed to be 0.106 c/vehicle km removed.

The following annual road maintenance cost reductions have been determined:

Option	Annual Road Maintenance Cost Reduction (1st Year)
l-Extension of Existing Service	400
IL-Extension of 20 min service	3,000

3.8.2. Lost Road User Payments

The fuel tax "lost" is calculated using the rate recommended by the Transfund ATR Manual of 88 cents per 100 vehicle-km.

The annual lost road user payments are estimated to be :

Option	Annual Lost Road User Payments (1st Year)
l-Extension of Existing Service	3,000
2-Extension of 20 min service	18,000

3.9. ENVIRONMENTAL BENEFITS

3.9.1. Air Pollution and CO,

Air Pollution

The draft evaluation manual rate of $0.01 per car km has been used for air pollution..

Carbon dioxide

As detailed in Chapter 2, a CO2 cost saving of $0.72 per 100 kilometres has been applied.

The estimated annual benefit for air pollution and carbon dioxide for each option is :

Option	Annual Air Pollution Savings (1st Year)
l-Extension of Existing Service	7,000
2-Extension of 20 rnin service	35,000

3.9.2. Noise

The impact of the number of cars avoided on the dB level will be negligible, and no benefits have been assessed for this factor.

3.101 CALCULATION OF THE EFFICIENCY RATIO

3.10.1. Unadjusted ER

Table 3.3 sets out the calculation of the unadjusted Efficiency Ratio for each option.

TABLE 3.3 EFFICIENCY RATIO		
BENEFITS ($ PV)		
	Extension of Existing Service	Extension of 20 min service
Net ATR User Benefits	684,816	9,031,476
ATR User Disruption Disbenefits		
Demand Change Impact		
Travel Time Benefits	4,678,187	19,652,659
VOC Benefits	233,909	982,633
Accident Reduction Benefits	188,534	2,187,437
Road User Construction Disbenefits		
c o 2	74,193	406,094
Total PV Benefits for ER	5,859,639	32,260,299
COSTS (PV)		
Funding Gap	7,692,278	10,182,979
Lost Road User Payments	37,959	207,769
Government Cost Savings	4,400	28,899
Total PV (Net Costs to **Govt)**	7,725,838	10,361,850
Unadjusted Efficiency Ratio	0.8	3.11

3.10.2. Strategic Factors

The strategic benefits outlined for the Paraparaumu service frequency projects also apply to this project. However, given that both the project options are well below the Transfund cut-off ratio, strategic benefits have not been done for this project.

3.11. INCREMENTAL ANALYSIS

Transfund's ATR Manual states that 'Where the options being evaluated, including the do minimum , are mutually exclusive . . . , an incremental analysis of the options shall be used to determine the best option'. The options in this project fall into this category, and an incremental analysis has been undertaken. The results are shown below.

	A Existing Service	B Peak - 20 mins
ATR Benefits (PV)	$5,859,639	$31,964,150
Cost to Govt (PV)	$7,725,838	$10,361,850
Incremental over A		9.9

On the basis of this analysis, the Electrification : Peak - 20 mins option is the preferred option.

3.12. SENSITIVITY ANALYSIS

A sensitivity analysis of key variables was undertaken. The results are shown below. The values used in this analysis, and resultant ER, are shown in italics.

Variable		ER Existing peak service	ER 20 min peak
Patronage Growth Rate	1.5%	0.8	3.1
	1.0%	0.7	2.9
	3.0%	0.9	3.8
Car Diversion Rate	60%	0.8	3.1
	50%	0.6	2.7
	70%	0.9	3.4
Congestion Growth Rate	1.5%	0.8	3.1
	1.0%	0.7	3.0
	3.0%	0.8	3.3

3.13. FUNDING PROPOSAL

The funding share of each of the potential funding parties has been determined using Transfund's formula as set down in its Programme and Funding Manual. Transfund currently funds 100% of state highway benefits and 43% of local road benefits. The Wellington Transport Model was used to provide an assessment of the percentage of the traffic diverted from the state highway system as a result of upgrading the Western Line rail system. This found that around 80% of traffic diverted was from state highways. However, because of the way in which the Model categorises road types this is considered to be on the high side. It has therefore been assumed that 65% of traffic diverted as a result of this project is from the state highway network. On this basis, Transfund will fund 80% of road user benefits.

The funding apportionment for this project is shown in Table 3.4.

Table 3.4 Funding Apportionment ($ PV of Funding Gap)

	Transfund	Local Authority	Regional Council	Total
l-Extension of Existing Service	5,423,878	1,364,225	904,175	7,692,278
2-Extension of 20 min service	5,822,034	1,467,552	2,893,394	10,182,979

4. WAIKANAE LOCO HAUL OPTIONS

4.1. PROPOSAL DETAILS

The proposal details for the Wellington 'to Paraparaumu rail service frequency options are summarised in Table 4.1.

TABLE 2.1 WAIKANAE LOCO HAUL PROPOSAL DETAILS	
Proposal Name	Waikanae Extension Loco Haul
Proposer	Wellington Regional Council
Evaluator	Booz-Allen & Hamilton (NZ) Ltd
Checker	
Date of Evaluation	November 1998
Proposed Start Date of Project	1 January 1999
Proposal Duration	25 years with residual value
Proposal Location	Wellington
Proposal Aims	This project will improve access to the rail service for Waikanae residents, with the aim of attracting present car drivers on to the rail service. This will help reduce congestion on State Highway 1 between Waikanae and Wellington.
Relationship with RLTS	The Wellington RLTS seeks to encourage the use of public transport.
Needs of the Transport Disadvantaged	A key role of the Wellington public transport system is to provide transport services for people who are transport disadvantaged. This project will improve the transport options available to this group.
'Do Minimum'	Maintain the current service levels.
Proposal Options	1. Extend existing peak service to Waikanae - Loco EMU. 2. Extend 20 min peak service to Waikanae - Loco EMU

4.1.1. Project Specification

At present the Western Rail Line is electrified as far as Paraparaumu. The suburban rail service is operated using EMUs, and thus services cannot be provided to Waikanae. Demand for the rail service has been increasing in Waikanae, with increasing numbers of people travelling by car or bus from Waikanae to Paraparaumu to take the train to Wellington or Porirua. This project involves extension of the suburban rail service to Waikanae using a Diesel Locomotive (Loco) to pull the EMUs over the un-electrified portion of the track (base option). Under this project the Waikanae-Paraparaumu portion of the rail line would not need to be electrified.

Two options have been evaluated:

1) Existing Peak Loco-EMU Extension - this involves a Loco pulling the existing EMUs between Waikanae and Paraparaumu - peak period only. This is the 'base option'. This type of arrangement has operated previously : at one time

the rail line was only electrified as far as Paekakariki and a Loco was used to pull the EMUs between Paekakariki and Paraparaumu.

2) 20 min Peak Loco-EMU Extension - as for option 1), but a 20 min peak service to Waikanae.

Another possible option is 'Peak Loco-Carriages Extension'. This would involve Locos and carriages providing the rail services between Waikanae and Wellington. Given that the costing of this option is dependent on the availability of Locos and ability to make use of EMUs released within the Wellington rail network, this option should be developed in conjunction with Tranz Rail.

The Base Case (Do Minimum)
The do minimum option is to continue providing services at the current level, with additional rolling stock provided as required to meet patronage growth.

A Roading Alternative
We are not aware of any roading projects which are close substitutes to this project for comparative purposes. The Transmission Gully project only covers a portion of the route covered by this project.

4.2. DEMAND ESTIMATES

4.2.1. Improved Rail Access

The main impact of the 'base option' is to reduce the rail access distance, and travelling time, for Waikanae passengers. This will reduce the generalised cost of travel for Waikanae residents, and will therefore increase rail patronage from Waikanae. The approach set out above for the Waikanae electrification options has been used to estimate demand.

4.2.2. Service Frequency Impact

Option (2) involves extending the suburban rail service to Waikanae, but with a higher service frequency. This option will bring the rail access related demand impact outlined above; and will also provide reduced waiting time benefits for users and increase patronage, as for the Waikanae Electrification 20 min Peak Service option detailed in chapter 3.

4.2.3. Patronage Growth

As indicated earlier, an annual patronage growth rate of 1.5% for the Western Rail Line has been used.

4.2.4. Patronage Changes

The expected changes in patronage from the Waikanae Loco options, assuming they commence in the year 2000, are shown in Table 4.2.

TABLE 4.2 WESTERN LINE PATRONAGE (DAILY PASSENGERS)

	Year 2000 Base Case	Additional Passengers	Total With Project	% Change
Exis Peak Loco- Ext	10,714	167	10,880	1.6
20 min Peak Loco Ext	10,714	702	11,416	6.6

4.3. SERVICE PROVIDER COSTS

4.3.1. Capital Cost

The capital cost for this project involves the cost of the Diesel Locomotive required to operate the Waikanae extension. Both options can be operated with one Locomotive. Providing a higher frequency service would require additional locomotives. An indicative cost of $1.6M has been used for the Diesel Locomotive (assuming it is purchased half life expired).

The residual value of the rail vehicles has been calculated on a straight-line basis assuming a 30 year life.

4.3.2. Operating Cost

A spreadsheet model of the existing rail service, and the proposed option, was created by BAH. This was used to determine the additional operating cost of providing each option. An additional cost incurred for the Loco-EMU Extension project is an additional staff person required to couple/uncouple the EMUs from the Loco. This has been assumed to require 0.5 of a person year.

The additional annual operating cost of each option is estimated to be:

Option	Additional Annual Operating Cost (1st Year)
1. Existing Peak Service	661,000
2.20 min Peak Service	1,456,000

4.4. SERVICE PROVIDER REVENUE

The additional fare revenue' from the estimated increase in patronage has been calculated for each option using the average fare matrix (with GST deducted) from the Wellington Transport Model.

The additional first year annual fare revenue of each option is estimated to be:

Option	Additional Annual Fare Revenue (1st Year)
1. Existing Peak Service	205,000
2.20 min Peak Service	522,000

4.5. FINANCIAL VIABILITY

The funding gap for this project has been estimated over 25 years using a 10% real discount rate.
The annual funding gap for each option is estimated to be:

Option	Annual Funding Gap (1st Year)
1. Existing Peak Service	704,000
2.20 min Peak Service	1,272,000

4.6. USER BENEFITS

The main user benefits for users from the Waikanae service extension is a reduction in rail access time and vehicle operating costs. However, against that will be an increase in rail journey time and rail fare. We have determined the net impact of these to provide an estimate of the net user benefit for existing users.

New Users
The rule of a half has been applied for new users. However, the value of time which has been used for new users is the value of time for their previous mode.

Previous Mode
As detailed in Chapter 2, the following peak period diversion rates were applied :

- bus 10%
- car driver 60%
- car passenger 30%.

The annual user benefits of each option is estimated to be:

Option	Annual User Benefits (1st Year)
1. Existing Peak Service	51,000
2.20 min Peak Service	749,000

4.7. ROAD USER BENEFITS

4.7.1. Travel Time Benefits

The approach set down in Chapter 2 to determine congestion cost savings has been used here.

The average travel time savings for each option, and the congestion cost saving per peak vehicle removed are shown below:

option	1996 Average Travel Time Saving (mins per vehicle)	1996 Average Congestion Cost Saving ($ per vehicle)
1. Existing Peak Service	70	21.68
2.20 mm Peak Service	53	16.47

The annual travel time benefits of each option are estimated to be:

Option	Annual Travel Time Benefits (1st Year)
1. Existing Peak Service	358,000
2.20 min Peak Service	1,481,000

4.7.2. Vehicle Operating Costs

As set down in the ATR Manual, vehicle operating cost savings for road users have been estimated as 5% of travel time benefits.

The annual vehicle operating cost savings of each option are estimated to be:

Option	Annual Vehicle Operating Cost Savings
1. Existing Peak Service	18,000
2.20 mm Peak Service	75,000

4.7.3. Accident Cost Savings

The accident cost savings have been calculated by determining the total reduction in vehicle kilometres under each option, and applying the following accident cost rates : peak period - $0.06 / km, interpeak - $0.14 / km.

The annual accident cost savings of each option are estimated to be:

Option	Annual Accident Cost Savings
1. Existing Peak Service	25,000
2.20 min Peak Service	288,000

4.8. COSTS TO GOVERNMENT

4.8.1. Road Maintenance Cost Savings

As detailed in Chapter 2, a unit value for road maintenance costs savings of 0.106 c/vehicle km removed has been applied.

The following annual road maintenance cost reductions have been determined:

Option	Annual Road Maintenance Cost Reduction
1. Existing Peak Service	400
2.20 min Peak Service	2,500

4.8.2. Lost Road User Payments

The fuel tax "lost" is calculated using the rate recommended by the Transfund ATR Manual of 88 cents per 100 vehicle-km.

The annual lost road user payments are estimated to be :

Option	Annual Lost Road User Payments (1st Year)
1. Existing Peak Service	3,000
2.20 min Peak Service	18,000

4.9. ENVIRONMENTAL BENEFITS

4.9.1. Air Pollution and CO,

Air Pollution

The draft evaluation manual unit value of $0.01 per reduced car km has been applied.

Carbon dioxide

As detailed in Chapter 2, a unit value of $0.72 per 100 kilometres of reduced travel has been applied.

The estimated annual benefit for air pollution and carbon dioxide for each option is :

Option	Annual Air Pollution Savings (1st Year)
1. Existing Peak Service	7,000
2.20 min Peak Service	35,000

4.9.2. Noise

The impact of the number of cars avoided on the dB level will be negligible, and no benefits have been assessed for this factor.

4.10. CALCULATION OF THE EFFICIENCY RATIO

4.10.1. Unadjusted ER

Table 4.3 sets out the calculation of the unadjusted Efficiency Ratio for each option.

TABLE 4.3 EFFICIENCY RATIO

	BENEFITS (PV $)	
	1. Existing Peak Service	20 min Peak Service
Net ATR User Benefits ATR User Disruption Disbenefits	580,152	8,591,409
Demand Change Impact		
Travel Time Benefits	4,678,187	19,370,612
VOC Benefits	233,909	968,531
Accident Reduction Benefits	188,534	2,187,437
Road User Construction Disbenefits		
c o 2	74,193	406,094
Total PV Benefits for ER	5,754,976	31,524,083
	COSTS (PV $)	
Funding Gap	5,167,762	9,337,910
Lost Road User Payments	37,959	207,769
Government Cost Savings	4,400	28,899
Total PV (Net Costs to Govt)	**5,201,321**	**9,516,780**
Unadjusted Efficiency Ratio	1.1	3.3

4.10.2. Strategic Factors

The strategic benefits outlined for the Paraparaumu service frequency projects also apply to this project. However, given that both the project options are well below the Transfund cut-off ratio, strategic benefits have not been calculated for this project.

4.11. INCREMENTAL ANALYSIS

Transfund's ATR Manual states that 'Where the options being evaluated, including the do minimum , are mutually exclusive . . . , an incremental analysis of the options shall be used to determine the best option'. The options in this project fall into this category, and an incremental analysis has been undertaken. The results are shown below.

	A Existing Service	B Peak - 20 mins
ATR Benefits (PV)	$5,754,976	$31,524,083
Cost to Govt (PV)	$5,201,312	$9,516,780
Incremental over A		6.0

On the basis of this analysis, the Electrification : Peak - 20 mins option is the preferred option.

4.12. SENSITIVITY ANALYSIS

A sensitivity analysis of key variables was undertaken. The results are shown below. The values used in this analysis, and resultant ER, are shown *in italics.*

Variable		ER Existing peak service	ER 20 min peak
Patronage Growth Rate	1.5%	1.1	3.3
	1.0%	1.0	3.1
	3.0%	1.3	4.1
Car Diversion Rate	60%	1.1	3.3
	50%	0.9	2.9
	70%	1.3	3.7
Congestion Growth Rate	1.5%	1.1	3.3
	1.0%	1.1	3.2
	3.0%	1.2	3.5

4.13. FUNDING PROPOSAL

The funding share of each of the potential funding parties has been determined using Transfund's formula as set down in its Programme and Funding Manual. Transfund currently funds 100% of state highway benefits and 43% of local road benefits. The Wellington Transport Model was used to provide an assessment of the percentage of the traffic diverted from the state highway system as a result of upgrading the Western Line rail system. This found that around 80% of traffic diverted was from state highways. However, because of the way in which the Model categorises road types this is considered to be on the high side. It has therefore been assumed that 65% of traffic diverted as a result of this project is from the state highway network. On this basis, Transfund will fund 80% of road user benefits.

The funding apportionment for this project is shown in Table 4.4.

Table 4.4 Funding Apportionment (PV of Funding Gap)

	Transfund	Local Authority	Regional Council	Total
1. Existing Peak	3,710,482	933,268	524,012	5,167,762
2.20 min Peak	5,413,827	1,364,655	2,559,428	9,337,910

5. RAIL STATION OPTIONS

5.1. PROPOSAL DETAILS

The proposal details for the Rail Station options are summarised in Table 5.1.

TABLE 5.1 RAIL STATION OPTIONS PROPOSAL DETAILS	
Proposal Name	Rail Station Options
Proposer	Wellington Regional Council
Evaluator	Booz-Allen & Hamilton (NZ) Ltd
Checker	
Date of Evaluation	November 1998
Proposed Start Date of Project	1 January 1999
Proposal Duration	25 years with residual value
Proposal Location	Wellington
Proposal Aims	This project will provide new rail stations, and upgrade facilities at an existing station. This with the aim of attracting present car drivers on to the rail service. This will help reduce congestion on State Highway 1 between Waikanae and Wellington.
Relationship with RLTS	The Wellington RLTS seeks to encourage the use of public transport.
Needs of the Transport Disadvantaged	A key role of the Wellington public transport system is to provide transport services for people who are transport disadvantaged. This project will improve the transport options available to this group.
'Do Minimum'	Maintain the current service levels.
Proposal Options	1. Upgrade Paraparaumu Rail Station 2. Provide more Park and Ride carparks at Paraparaumu. 3. Provide new rail station at Raumati. 4. Provide a new rail station at Lindale.

5.1.1. Project Specification

This project involves 4 options:

(1) Paraparaumu Station Upgrade : this option involves a complete refurbishment of the Paraparaumu rail station building, and provision of new/upgrade facilities, for example, security cameras, new seats, toilets etc.

(2) Paraparaumu Station - New P+R Carparks : this option involves purchase of land adjacent to the existing Paraparaumu P+R carpark to (a) ensure that 40 existing carparks are retained; and, (b) to facilitate construction of 114 new carparks. The option evaluated assumes that the new carparks will be built.

(3) Raumati Station - this option involves construction of a new rail station at Raumati, along with a new P+R facility opposite the new rail station. A new pedestrian bridge will be required across State Highway 1.

(4) Lindale Station - this option involves construction of a new rail station at Lindale. In addition to the station itself, a road/pedestrian access will need to be provided. This option has been evaluated assuming the existing road network. Although implementation of the proposed new Kapiti north-south urban road could result in some Waikanae Beach commuters using a Lindale station, benefits from this group have already been counted in the Waikanae extension options. The approach adopted will enable the incremental benefit/cost of a Lindale station to be determined.

The Base Case (Do Minimum)

The do minimum option is to continue the present situation:

(1) Existing Station building at Paraparaumu
(2) Existing number of carparks in Paraparaumu P+R carpark, less the 40 carparks which will be lost if the land is not purchased.
(3) No station at Raumati.
(4) No station at Lindale.

A Roading Alternative

We are not aware of any roading projects which are suitable for comparative evaluation.

5.2. DEMAND ESTIMATES

5.2.1. Paraparaumu Station Upgrade

Upgrading the Paraparaumu rail station will result in amenity benefits for users. This will reduce the generalised cost (GC) of travel by train, which will result in a patronage gain. The GC elasticity of -1.0 has been used to estimate the number of new passengers generated by the station upgrade.

5.2.2. Paraparaumu Station P+R

The existing carparks in the Paraparaumu P+R carpark are presently full. Providing additional carparks will reduce the access time for passengers who are forced to park on the street and walk further to the station. This will reduce the generalised cost (GC) of travel by train, which will result in a patronage gain. The GC elasticity of -1.0 has been used to estimate the number of new passengers generated by the station upgrade.

5.2.3. Raumati Station

The main impact of providing a new rail station at Raumati is to reduce the rail access distance, and travelling time, for people living in this area. This will reduce the generalised cost of travel for Raumati residents, and will therefore increase rail patronage from this area.

An analysis of the 1996 Census Journey to Work (JTW) data was carried out. This found that a lower proportion of total JTW trips from Raumati were by rail, than from Paraparaumu. This is despite Raumati having a higher proportion of JTW trips to l?orirua/ Wellington than Paraparaumu. The main cause of the lower train modal

share for Raumati than Paraparaumu will thus be the greater distance from the rail station, allied with the need for Raumati commuters to 'backtrack' to get to the station.

The Census JTW analysis has been used to estimate the expected number of new period rail trips from Raumati as follows:

- The Raumati proportion of total JTW trips by rail has been assumed to increase to the Paraparaumu level with extension of the rail service to Waikanae, subject to this proportion being adjusted upwards to reflect the higher proportion of JTW trips to Wellington and Porirua from Raumati than from Paraparaumu.
- In estimating the number of new JTW trips, those trips presently made by company car have been excluded - these people have been assumed to be 'captive' to car.
- JTW trips are assumed to be 80% of all peak period trips.
- Expected new interpeak trips have been estimated based upon the present ratio of interpeak to peak trips for Paraparaumu.

5.2.4. Lindale Station

Users of a new rail station at Lindale would comprise two main groups:

- Residents of the Otaihanga and North Paraparaumu areas - mostly commuters
- Students and staff attending the Whitireia Polytechnic's Lindale campus.

The estimated demand from Otaihanga and North Paraparaumu has been calculated using the approach outlined above for the Raumati Station.

The expected demand by Whitireia Polytechnic students and staff has been estimated as follows:

- The estimated number of students per day travelling to/from the Polytechnic each day was provided by the Polytechnic.
- It has been assumed that 5% of trips to the Polytechnic would be made by train if a station was provided. This is based on work undertaken for UNITEC Polytechnic where it was found 3-5% of trips to the Polytech at peak times were made by public transport.

5.2.5. Patronage Growth

As indicated earlier an annual patronage growth rate of 1.5% has been used.

5.2.6. Patronage Changes

The expected changes in patronage from the rail station options, assuming they commence in the year 2000, are shown in Table 5.2.

TABLE 5.2 WESTERN LINE PATRONAGE (DAILY PASSENGERS)

	Year 2000 Base Case	Additional Passengers	Total With Project	% Change
Ppm Station Upgrade	10,714	24	10,738	0.2
Ppm Station P+R	10,714	15	10,728	0.1
Raumati Station	10,714	146	10,860	1.4
Lindale Station	10,714	76	10,790	0.7

5.3. SERVICE PROVIDER COSTS

5.3.1. Paraparaumu Station Upgrade

The estimated capital cost of this project, provided by Tranz Rail, is $450,000.

This covers the cost of:

- Refurbishment of the existing station building - inside and outside
- Security cameras
- New toilets
- . New seats
- New waiting area
- New ticket office
- Information Boards.

An additional operating cost of $5,000 per annum to cover operation of the security cameras has been assumed for this project.

5.3.2. Paraparaumu Station P+R

The estimated capital cost of this project is $405,000.

This covers the cost of:

- purchase of land covering 40 existing car spaces, and space for approximately 114 new spaces
- grading and preparation of new car spaces.

No additional operating costs have been assumed for this project.

5.3.3. Raumati Station

The estimated capital cost of this project is $1.3M.

This covers the cost of:

- rail station
- P+R carpark
- pedestrian bridge from P+R carpark to station.

In addition to these capital costs, additional operating costs of $67,800 per annum will be incurred. This is the result of an additional 3 minutes which would be added to each trip to/from Paraparaumu (stopping time plus reduction in average speed for Paraparaumu to Paekakariki leg).

5.3.4. Lindale Station

The estimated capital cost of this project is $900,000.

This covers the cost of:

- Rail station
- Road access to station
- Park and Ride site.

In addition to these capital costs, additional operating costs of $68,000 per annum will be incurred. This is the result of an additional 3 minutes which would be added to each trip to/from Waikanae (stopping time plus reduction in average speed for Paraparaumu to Waikanae leg).

5.4. SERVICE PROVIDER REVENUE

The additional fare revenue from the estimated increase in patronage has been calculated for each option using the average fare matrix (with GST deducted) from the Wellington Transport Model.

The additional first year annual fare revenue of each option is estimated to be:

Option	Additional Annual Fare Revenue (1st Year)
Ppm Station Upgrade	26,000
Ppm Station P+R	17,000
Raumati Station	84,000
Lindale Station	46,000

5.5. FINANCIAL VIABILITY

The funding gap for this project has been estimated over 25 years using a 10% real discount rate.

The annual funding gap for each option is estimated to be:

Option	Annual Funding Gap
Ppm Station Upgrade	13,900
Ppm Station P+R	32,700
Raumati Station	106,000
Lindale Station	96,000

5.6. USER BENEFITS

5.6.1. Paraparaumu Station Upgrade

All passengers using the upgraded station benefit from an improved terminal environment. Willingness to Pay studies for improved terminal facilities suggest that passengers value improved waiting conditions, toilets, lighting, security and convenience of transfer. Based on previous studies, we have included a benefit per trip of $0.44.

The rule of a half has been applied for new users.

5.6.2. Paraparaumu P+R Carparks

Users of the new P+R carparks will no longer have to park on the road and walk to the station. The benefit for users is thus the reduced walk time/distance. This benefit has been valued at twice the Transfund value of time for seated bus passengers (studies have found that public transport users value walking time at twice in-vehicle time).

The rule of a half has been applied for new users. However, the value of time which has been used for new users is the value of time for their previous mode.

5.6.3. Raumati Station

The main benefits for users of a new Raumati Station will be :

- reduced rail access distance/time
- reduced vehicle operating costs (rail access)
- reduced m-train journey time.

These have been calculated using Transfund's values of time and vehicle operating costs.

5.6.4. Lindale Station

The main benefits for users of a new Lindale Station will be :

- reduced rail access distance/time
- reduced vehicle operating costs (rail access).

Offsetting this to some extent will be:

- increased rail fare
- increased m-train journey time.

The net benefit has been calculated using Transfund's values of time and vehicle operating costs.

The rule of a half has been applied for new users. However, the value of time which has been used for new users is the value of time for their previous mode.

Previous Mode

As detailed in Chapter 2, the following peak period diversion rates have been applied :

- bus 10%
- car driver 60%
- car passenger 30%.

The annual user benefits of each option is estimated to be:

Option	Annual User Benefits (1st Year)
Ppm Station Upgrade	94,700
Ppm Station P+R	10,200
Raumati Station	154,000
Lindale Station	96,000

5.7. ROAD USER BENEFITS

5.7.1. Travel Time Benefits

The approach set down in Chapter 2 to determine congestion cost savings has been used here.

The average travel time savings for each option was estimated at 70m mins per peak vehicle removed, with a resultant congestion cost saving per peak vehicle removed of $21.68.

The annual travel time benefits of each option are estimated to be:

Option	Annual Travel Time Benefits (1st Year)
Ppm Station Upgrade	63,300
Ppm Station P+R	40,400
Raumati Station	176,000
Lindale Station	73,000

5.7.2. Vehicle Operating Costs

As set down in the ATR Manual, vehicle operating cost savings for road users have been estimated as 5% of travel time benefits.

The annual vehicle operating cost savings of each option are estimated to be:

Option	Annual Vehicle Operating Cost Savings (1st Year)
Ppm Station Upgrade	3,000
Ppm Station P+R	2,000
Raumati Station	9,000
Lindale Station	4,000

5.7.3. Accident Cost Savings

The accident cost savings have been calculated by determining the total reduction in vehicle kilometres under each option, and applying the following accident cost rates : peak period - $0.06 / km, interpeak - $0.14 / km.

The annual accident cost savings of each option are estimated to be:

Option	Annual Accident Cost Savings (1st Year)
Ppm Station Upgrade	4,000
Ppm Station P+R	3,000
Raumati Station	12,000
Lindale Station	5,000

5.8. COSTS TO GOVERNMENT

5.8.1. Road Maintenance Cost Savings

As detailed in Chapter 2, a unit value of 0.106 c/vehicle km removed has been used for road maintenance costs.

The following annual road maintenance cost reductions have been determined:

Option	Annual Road Maintenance Cost Reduction (1st Year)
Ppm Station Upgrade	60
Ppm Station P+R	50
Raumati Station	200
Lindale Station	70

5.8.2. Lost Road User Payments

The fuel tax "lost" is calculated using the rate recommended by the Transfund ATR Manual of 88 cents per 100 vehicle-km.

The annual lost road user payments are estimated to be :

Option	Annual Lost Road User Payments (1st Year)
Ppm Station Upgrade	500
Ppm Station P+R	400
Raumati Station	1,600
Lindale Station	600

5.9. ENVIRONMENTAL BENEFITS

5.9.1. Air Pollution and CO,

Air Pollution

The draft evaluation manual unit rate of $0.01 per car km reduction has been applied.

Carbon dioxide

As detailed in Chapter 2, a unit value $0.72 per 100 kilometres travel reduction has been applied .

The estimated annual benefit for air pollution and carbon dioxide for each option is :

Option	Annual Air Pollution Savings (1st Year)
Ppm Station Upgrade	1,000
Ppm Station P+R	1,000
Raumati Station	3,000
Lindale Station	1,000

5.9.2. Noise

The impact of the number of cars avoided on the dB level will be negligible, and no benefitshave been assessed for this factor.

5.10. CALCULATION OF THE EFFICIENCY RATIO

5.10.1. Unadjusted ER

Table 5.3 sets out the calculation of the unadjusted Efficiency Ratio for each option.

TABLE 5.3 EFFICIENCY RATIO

	Ppm Stn Upgrade	Ppm Stn P+R	Raumati Stn	Lindale Stn
BENEFITS ($ PV)				
ATR User Benefits ATR User Disruption Disbenefits	1,053,733	113,402	1,761,712	1,350,109
Demand Change Impact				
Travel Time Benefits	779,429	528,484	2,294,860	952.455
VOC Benefits	38,971	26,424	114,743	47,623
Accident Reduction Benefits	27,002	22,632	94,017	39,021
Road User Construction co2	11,158	9,804	36,680	17,536
Total PV Benefits for ER	1,910,293	700,746	4,302,012	2,406,745
COSTS ($ PV)				
Funding Gap	102,293	199,338	963,411	879,766
Lost Road User Payments	5,709	5,016	18,766	8,972
Government Cost Savings	662	581	2,175	1,040
Total PV (Net Costs to Govt)	107,340	203,772	980,002	879,766
Unadjusted Efficiency Ratio	17.8	3.4	4.4	2.7

5.10.2. Strategic Factors : Back-Calculation

The strategic benefits outlined for the Paraparaumu service frequency projects also apply to this project. However, given that the two projects not meeting the Transfund cut-off ratio are well below the required level, their strategic benefits have not been calculated.

5.11. SENSITIVITY ANALYSIS

A sensitivity analysis of key variables was undertaken. The results are shown below. The values used in this analysis, and resultant ER, are shown *in italics.*

		ER			
Variable		Ppm Stn	Ppm P+R	Raumati	Lindale
Patronage Growth Rate	2.5%	17.8	3.4	4.4	2.7
	1.0%	15.6	3.2	4.1	2.7
	3.0%	29.9	4.4	5.7	2.9
Car Diversion Rate	60%	17.8	3.4	4.4	2.7
	50%	16.6	3.0	4.0	2.5
	70%	18.5	3.7	4.6	2.8
Congestion Growth Rate	2.5%	17.8	3.4	4.4	2.7
	1.0%	17.5	3.3	4.3	2.7
	2.5%	18.5	3.7	4.6	2.8

5.12. FUNDING PROPOSAL

The funding share of each of the potential funding parties has been determined using Transfund's formula as set down in its Programme and Funding Manual. Transfund currently funds 100% of state highway benefits and 43% of local road benefits. The Wellington Transport Model was used to provide an assessment of the percentage of the traffic diverted from the state highway system as a result of upgrading the Western Line rail system. This found that around 80% of traffic diverted was from state highways. However, because of the way in which the Model categorises road types this is considered to be on the high side. It has therefore been assumed that 65% of traffic diverted as a result of this project is from the state highway network. On this basis, Transfund will fund 80% of road user benefits.

The funding apportionment for this project is shown in Table 5.4.

Table 5.4 Funding Apportionment ($ PV of Funding Gap)

	Transfund	Local Authority	Regional Council	Total
Ppm Station Upgrade	36,536	9,182	56,575	102,293
Ppm Station P+R	133,296	33,578	32,464	199,338
Raumati Station	453,328	114,030	396,053	963,411
Lindale Station	304,456	76,689	490,689	871,835