



Wellington Region Road Pricing Study - Stage 2



WELLINGTON REGION ROAD PRICING STUDY - STAGE 2 - TECHNICAL REPORT

Technical Report

Issue 2

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Sinclair Knight Merz
Level 12, Mayfair House
54 The Terrace
PO Box 10-283
Wellington New Zealand
Tel: +64 4 473 4265
Fax: +64 4 473 3369
Web: www.skmconsulting.com

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Executive Summary

Road pricing in the greater Wellington region has the ability to reduce network congestion, and be economically and fiscally viable, while at the same time having marginal social and regional economic impacts. Moreover, reduced congestion in the greater Wellington region would improve accessibility and may well improve the regional economy by allowing greater mobility for traffic with a higher value of time (including commercial traffic).

Background

Congestion and its associated social, economic and environmental problems are acknowledged as some of the largest issues facing the world's cities. More and more, road pricing is seen as an innovative and effective measure to reduce congestion and the greater Wellington region has been considering the implementation of road pricing to address congestion for some time.

Wellington has a linear structure to its strategic highway network. This means that there are few alternative routes to avoid the consequences of incidents on the highway system. Further, the linear structure accentuates the effect of congestion induced travel time variability and again does not allow alternative routes to avoid these congestion related consequences. This can be frustrating for road users, particularly annoying for those who have absolute deadlines for arrival times such as airport bound travellers, and costly for trips with a high value of time such as commercial vehicles.

Over the last decade there has been a growing realisation that in the greater Wellington region that continuing major road capacity increases are unlikely to address Wellington's transportation needs. This is because major road construction, particularly in Wellington's constrained and difficult topography is very expensive and a comprehensive programme of construction is likely to be unaffordable.

Further, the linear structure of the strategic highway network and the adjacent passenger rail corridors means that road capacity increases, unless carefully managed, are likely to significantly reduce rail patronage and increase pressure downstream on the road network. This would require further expensive road construction to address the induced problems of road construction.

Another realisation over the last decade is that conventional measures, such as promoting public transport, walking and cycling and various non-pricing based Travel Demand Management can only have marginal if any impact on the choice to travel by car. Only road pricing appears to have the potential to significantly influence the choice between car use or an alternative means of travel. This balance between car use and alternative transport forms is important in the greater Wellington region where there is a linear strategic highway network with adjacent passenger rail.



Because carbon emissions from transport are a significant proportion of New Zealand's total carbon emissions there is growing interest in approaches that might reduce carbon emissions from transport. As carbon emission from transport are directly related to fuel consumption and therefore car use, the inability of conventional transport measures to influence car use is a problem. Road pricing appears to be one of the few measures that can influence transport base carbon emissions if high enough charges are imposed. This would however need to be balance with the other adverse impacts of higher charging levels.

In this context, successive Wellington Regional Land Transport Strategies since 1993 have signalled the need to investigate Road Pricing as one measure within a wider package of measures. In response to a commission by Greater Wellington Regional Council, SKM produced a report titled *Wellington Road Pricing Study – Stage 1 – Initial Road Pricing Viability Study* in 2005. This report showed that it was possible to develop a road pricing proposal for the greater Wellington region that is both economically and financially viable.

Road Pricing Objectives and Performance Measures

The brief for this study stated that the "...main purpose of road pricing in the Wellington region is network efficiency. However, revenue generation is considered a useful secondary benefit", and that road pricing options should be evaluated against the objectives of the Draft Regional Land Transport Strategy (RLTS), which are as follows:

- assist economic and regional development;
- assist safety and personal security;
- improve access mobility and network reliability;
- protect and promote public health;
- ensure environmental sustainability; and
- consider economic efficiency and affordability.

Specific performance measures were developed to enable different pricing options to be evaluated against the objectives, and compared. A Planning Balance Sheet approach was used to undertake the evaluation.

Option Development and Definition

A number of generic road pricing concepts were considered along with the cordon and screenline charging options developed as part of the Stage 1 work. These included:

- Toll Lanes / High Occupancy Toll (HOT) Lanes
- New Toll Roads



- Area Charges – where all trips into, out of, or within a particular area are charged
- Full Network Charges – where all trips on the whole road network are charged
- Strategic Network Charges – where all trips on the strategic road network (e.g. State Highways and arterial roads) are charged
- Parking Charges – where additional charges (above those already charged commercially) are levied for parking in specific areas such as the CBD

A large number of tests were carried out to identify the potential the concepts had to provide an effective efficient road pricing option for the greater Wellington region. Through a screening process using key performance measures and assessments of the technology and cost implications, some of the options above were found to be deficient and were removed from further consideration. The remaining options were either retained as they were or refined to make them more useful.

Option Testing

The following options were taken forward for detailed evaluation, with final option labels in brackets. The “Y” nomenclature refers to the resemblance the State Highway network has to the letter Y. Given that the prime objective of road pricing is to reduce congestion (which occurs predominantly during peak periods) it was assumed that charges would be imposed in the periods between 7 to 9am and 4 to 6pm and in the peak travel direction (the exception to this are the YM and YMS options which have an element of counter peak charging on State Highway 2 near Petone).

For the purposes of this study all vehicles were charged on the same basis. Commercial and private vehicles were assumed to pay the same charge to simplify modelling.

The options tested included:

- CBD Cordon (CC) – Charges are paid on all trips that cross a cordon around the Wellington CBD. The cordon encompasses the central city, Thorndon, and Mt Victoria and is bounded in the south west by the Basin Reserve. Importantly, this option includes charges on the new Inner City Bypass (ICB) and the Mt Victoria Tunnel.
- Ngauranga Screenline (NS) – Charges are paid on all trips that cross a screenline immediately north of the Wellington central city. This screenline is located on SH1 immediately south of the SH1 / SH2 merge at Ngauranga.
- Y Screenlines - Inner Emphasis (YI) – Charges are paid on the Ngauranga Screenline and at screenlines across SH2 at Petone and across SH1 (and parallel local roads) immediately south of the Tawa Interchange.



- Y Screenlines - Medium Emphasis (YM) – Charges are paid at the same locations as YI but also includes charges at screenlines at Pukerua Bay and between Hutt City and Upper Hutt. Additionally a counterpeak charge was imposed at Petone.
- CBD + Y Screenlines (CY) – Charges are paid at the same locations as YM but also includes charges on the CBD cordon.
- Y + South of CBD Screenline (YMS) – Charges are paid at the same locations as YM but includes charges on a southern screenline. This southern screenline is essentially the same as the southern part of the Wellington CBD cordon and runs from Oriental Bay imposing charges on the Mt Victoria Tunnel, Adelaide Road, Taranaki Street and Brooklyn Rd.

Each option was tested, using the Wellington Transport Strategy Model (WTSM) model. All the options performed well against the objectives of the RLTS using the performance measures developed for the planning balance sheet approach. The results are set out in Table 0-1 and discussed below.

Table 0-1 : Planning Balance Sheet Scores (Equal Weights)

Summary - Equal Weights	No Pricing	CC	NS	YI	YM	YMS	CY
1 ECONOMIC DEVELOPMENT	0	X	0	0	0	0	0
2 SAFETY & PERSONAL SECURITY	0	√+	0+	0+	0+	√+	√+
3 ACCESS, MOBILITY & NETWORK RELIABILITY	0	√	√	√	√	√+	√+
4 PUBLIC HEALTH	0	0+	0+	0+	0+	0+	0+
5 ENVIRONMENTAL SUSTAINABILITY	0	0+	0+	0+	0+	0+	0+
6 EFFICIENCY & AFFORDABILITY	0	√√+	√+	√+	√+	√√	√+

CBD Cordon - The Wellington CBD cordon option tested in Stage 1 performed poorly because it did not apply charges on the ICB, which resulted in rerouting through the Terrace Tunnel from the Quays routes to avoid the charge. Notably, this option charges trips from the south and east and achieves a reduction in congestion through the Mt Victoria Tunnel, but at the same time results in significant modal shift to public transport from this area.

A high charge is applied to all trips that cross the single cordon and so does not differentiate between short and long distance trips. This results in a high average cost of travel, high average charge and therefore performs poorly against the economic development objective. This option has a relatively large impact on travel, reducing person kilometres travelled by almost 8% which improves its' safety performance.



Ngauranga Screenline - This option applies a high charge to all charged trips and so does not differentiate between short and long distance trips. This option performs similarly to the other options under all objectives.

Y – inner emphasis - This concept imposes higher charges on trips closer to Wellington City. This option performs well for all objectives, generally reducing congestion at all key bottlenecks except Mt Victoria Tunnel.

Y – medium emphasis - This option imposes tolls at more regular intervals across the Y network, with modest tolls at several screenline points with counter-peak charges included on SH2 near Petone. This option performs similarly to the Y – inner option, but spreads the charges across the network more evenly.

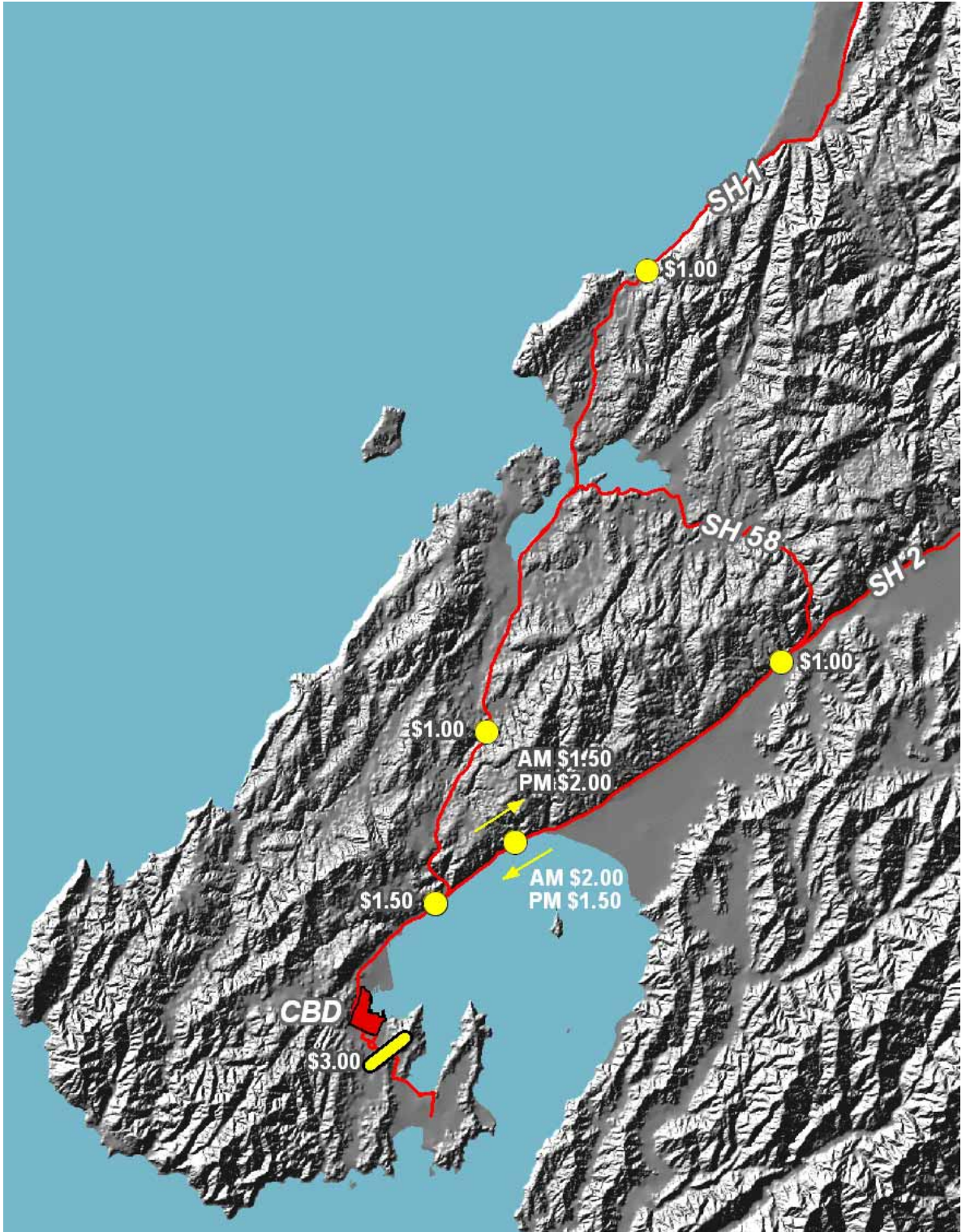
Y – medium + southern screenline - This option results in reduced congestion through the Mt Victoria Tunnel but at the same time induces a large modal shift towards public transport in that corridor. Overall this option performs the best for the access objective, having the greatest average reduction in volume to capacity (V/C) ratios at key bottlenecks and travel times on key routes, while having the greatest average speed increase. This option has a relatively high impact on travel by reducing the person-kilometres of travel and hence improves safety. The economic efficiency of this option is the best of the options tested.

CBD + Y screenline - This option performs similarly to the Y-medium emphasis option as charges are paid on the Y but also for trips from the south and east. The efficiency of this option is slightly worse than the Y-medium emphasis option.

The Y – medium + southern screenline (YMS) is one of the better performing options and charging levels and locations are shown diagrammatically in Figure 0-1. A summary of some key performance measures for that option is included in Table 0-2.



Figure 0-1 YMS Option Charging Locations



**Table 0-2 Y – medium + southern screenline Key Performance Measures**

Key Performance Measure	Compared to No Pricing
Congested VKT (VKT with V/C ratio >0.8) (AM peak)	-39%
Average vehicle speed on the network (AM peak)	+10%
Average travel time on key routes inbound Wellington CBD (AM peak)	-10%
Annual injury accidents	-6%
Average charge paid per trip (AM peak private vehicle)	\$0.32
Average generalised cost of travel per kilometre (AM peak private vehicle)	+2%
Person-kilometres of travel (AM peak)	-4%
User Benefits (25 year NPV)	\$119M
Scheme costs (25 year NPV)	\$57 – \$105M
User Charges (25 year NPV)	\$221M
Excess revenues (annual)	\$28 – \$38M

The primary purpose of road pricing in the greater Wellington region is to reduce congestion. Clearly, in reducing congestion, road pricing will assist in managing the balance between road use and other means of travel and will generate environmental and public health benefits as a consequence.

The best performing options tested could reduce congested motorised vehicle kilometres travelled (VKT) on links with a traffic V/C ratios of 0.8 or higher by up to 43%. This could increase average speeds on the whole road network by up to 10% during the AM peak period. This impact on links with a high V/C ratio will lead to significant improvement in congestion related travel time reliability. AM peak travel times on selected key routes into Wellington City could reduce on average by 15% with up to a 36% reduction between Ngauranga and the CBD. At the same time annual injury crashes could reduce by up to 6% with average charges per trip in the AM peak as low as \$0.60 for all options.

The average generalised cost of travel per kilometre in the AM peak could increase by up to 15% for private vehicles which would imply negative economic impacts. The generalised cost is a measure of real costs paid plus the monetised value of the economic costs such as delay, crashes and others. Total person kilometres of travel could reduce by up to 4.5% in the AM peak, which indicates a reduction in personal mobility.



The YMS option is expected to have user benefits in the order of \$119M, scheme costs of \$57M with user charges in the order of \$221M (these are 25 year Net Present Values). Using the ratio of user benefits / scheme costs as a measure of economic performance, the benefits outweigh the costs by a factor of 2. Using the ratio of revenues / scheme costs as a measure of financial performance, the revenues outweigh the costs by a factor of almost 4.

This shows that a road pricing scheme could provide economic benefits, while at the same time be financially viable. If the repayment of capital and financing costs is ignored, road pricing has the potential to provide annual excess revenues in the order of \$17M to \$41M which could be re-invested into improving transport infrastructure and services.

Regional Economic and Land Use Impact

The scheme based economic efficiency assessment above considers user benefits and shows that there will be clear economic benefits to the schemes evaluated from a national perspective. The charges paid will, however, impact on regional economic activity if they are additional to current taxes. A review of the possible wider economic impacts of the road pricing schemes developed was undertaken to identify any potential adverse impacts on the regional economy and land use from the imposition of charges.

The maximum estimated capital cost to implement a scheme is less than 0.24% of regional GDP, while the maximum annual operating cost is less than 0.1%. The maximum annual charge revenue is less than 0.27% of regional GDP.

This review concluded that the direct regional economic and land use effects of road pricing at the levels proposed here will be at most marginal. If the surplus revenues generated by road pricing are reinvested within the region, then any adverse impacts on the regional economy of road pricing would be negligible.

If the surplus revenues from a road pricing scheme are spent on efficient transport projects, the road pricing schemes plus the supplementary investments could generate a positive regional economic impact. These infrastructure and service improvements would generate additional user benefits and an increased regional economic benefit.

It was noted that a number of characteristics of the regional economy offer scope to complement road pricing in supporting further regional economic growth. The relatively high self-containment of much of the region's employment in the individual local authority areas means that employment is already located near to the contributing population centres. Road pricing would provide further incentive to build on this local employment reducing the need for travel across the region for employment.



The regional workforce is relatively highly qualified. A qualified professional workforce is more compatible with flexi-hours which avoid the worst of peak period travel.

The greater Wellington regional economy is strong in some of the faster growing industry sectors such as business and other services, transport and communications. The transport sector will benefit directly from reduced congestion. While some parts of the business services sector will have a competitive advantage from location in the Wellington CBD, much of the services and the communications sectors will have more flexibility in terms of location decisions, again potentially reducing the need for peak travel to and from the Wellington CBD.

The proposed road pricing options are unlikely to have a significant impact on land use at the charging levels proposed. Nonetheless, there may be some limited opportunities for more intensive land use and development in specific areas of the region within charging cordons to reflect changes in road use related to road pricing charges.

Social Impacts

Because of the modest charges proposed, social impacts are likely to fall on particular segments of the community who are more vulnerable because of their socio economic status and lack of flexibility in their trip making. Lower socioeconomic groups will be less able to afford a charge as it would make up a larger proportion of their household income. These groups may have to travel by car in the peak times because there is limited flexibility in their working hours e.g. shift workers or because no viable public transport is available.

Our investigations into the social impacts of road pricing has therefore focused on identifying socially deprived groups which would be unfairly impacted by road pricing and on investigating trips from these areas to key employment and community facilities.

The number of trips from socially deprived areas which would face a charge is in most cases small, with the exception of trips into Wellington CBD where employment is more likely to be in higher paying “white collar” jobs. Good public transport links are provided from most locations into central Wellington and therefore a viable alternative to the charges is provided.

Schemes which impose high charges near the Wellington CBD have the greatest potential to have adverse social impacts because of the high level of charge for a single cordon crossing. Even short local trips which cross the cordon would experience a relatively high charge but would not gain a large improvement in their journey times.

Road pricing schemes need to be designed to ensure that they have minimal adverse social impacts. Mitigation measures should be investigated to ensure minimal adverse social impacts, and could potentially include:



- Exempting people travelling from particular areas or to particular destinations from paying the toll-this would have to be by way of a form of concession card or tag. Exemptions can prove difficult to implement fairly
- Reimbursing socially deprived groups through reductions in rates (funded by road pricing revenues)
- Diverting excess revenues into improved public transport
- Improving opportunities for walking and cycling especially from areas close to the Wellington CBD. This could target those living close to the CBD or those who could drive to a point and then walk or cycle
- Obtaining community ‘buy in’ and acceptance of the scheme and its rationale – involve the community in discussing how the revenue raised should be spent. Work to ensure the political acceptability of the proposal and towards overcoming public scepticism about the outcomes

If road pricing is to be considered further in the greater Wellington region, detailed investigations into the social impacts of particular road pricing schemes would need to be undertaken and involve detailed public consultation. This study has concluded that road pricing would have an adverse social impact on relatively small numbers of individuals. Through more detailed design and development of mitigation measures, it should be possible to reduce these impacts.

Passenger Transport Impacts

There are unlikely to be any fundamental constraints to introducing a road pricing scheme due to additional demand for passenger transport.

Increases in rail patronage are generally small in the AM peak (in the order of 7%). As the current rail services can be near capacity at present these small increases could exacerbate the problem. The improvements that are required to upgrade current services to cater for future demand are substantially planned for in the GWRC Rail Business Case and the Western Corridor Plan. It is unlikely that the additional demand (maximum 700 trips in 2 hour peak) forecast as a result of introducing road pricing, would trigger the need for significant further investment in the rail network by itself but could lend further weight to the need for these improvements to take place.

The options which involve charges to the south of the CBD would result in significant increases in bus patronage from the south and east of the CBD. Because the majority of bus services use the existing roading infrastructure, the provision of additional capacity could be catered for through the procurement of additional bus services using more or larger capacity buses. These improvements could be funded from the surplus revenues generated by a pricing scheme. As road pricing is intended to reduce congestion, buses would experience reduced travel times after implementation, improving service performance. As part of a package of complementary measures, bus priority improvements such as bus lanes and signal pre-emption could be provided to improve services.

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Technology and Costs

The technologies identified as appropriate for cordon or screenline road pricing schemes in Wellington are:

- Vehicle mounted electronic tags (majority of users)
- Offline payment options available via Short Message Service (SMS), internet, call centre, on-street meters and retail shops (for infrequent users etc.)
- Enforcement using Automatic Number Plate Reader (ANPR) and colour context cameras

These technologies have been chosen for a number of reasons. They have been used extensively in tolling systems around the world and are therefore proven. They have reduced costs in processing transactions because they are handled electronically and do not require costly manual interaction with staff. Importantly, the technologies are consistent with the technologies proposed in the Transit NZ Toll Systems Project and the Auckland Road Pricing Evaluation Study.

This means that there is potential for the same onboard units to be utilised nationally and significant cost savings to be made by combining the systems set up and operations. A stand alone 'back office' management system which stores and process the information collected has been assumed for this evaluation, but could potentially be combined with these other schemes.

The capital costs could range from \$37M for the Ngauranga Screenline option through to \$42M for the CBD + Y option. Annual operating costs could range from \$3M to \$18M. This large range is due to variations between the schemes in the number of transactions processed and uncertainty over the scalability of costs with additional transactions.

Legislative and Privacy Issues

There is currently no legislative mandate that would allow for road pricing of existing infrastructure. New or modified legislation would be required before any road pricing scheme could be implemented. Legislation would be required that provides the ability to implement a charge and the ability to enforce the charge.

Assuming that the legislative framework would be similar to that set out for road tolling in the Land Transport management Act (LTMA), even with legislative provisions in place, direct approval for a road pricing scheme would still be required from the Minister of Transport. It is likely that each road pricing scheme would need to be established by the Governor-General by Order in Council (OIC), on recommendation by the Minister.

The 'back office' management system would need to be secure, and meet the requirements of the Privacy Act. Any use of the data collected must be in compliance with the Act, which would require the drafting a well considered privacy policy. Processes, similar to those required under the



LTMA for road tolling, would be required to enable people to use the system without personal data being collected. Provision of anonymous prepaid accounts would allow people to make payments without having personal data recorded.

Risks

A qualitative risk assessment has been undertaken which considered the risks to implementing a road pricing scheme in the greater Wellington region. The following broad categories of risk were identified:

- Legislative – There are risks associated with obtaining Government support the scheme and getting legislation through the House of Parliament in an effective and workable form
- Technological – There are risks associated with cost of the technology, ensuring it meets its functional requirements, the technology becoming outdated and the creation of a single supplier monopoly on future upgrades
- Implementation and Enforcement – There are risks associated with obtaining infrastructure consents
- Financing, Funding and Revenues – There are risks associated with finding a source of initial capital investment, Land Transport New Zealand reducing the regional funding contributions because of the revenues of the scheme, interest rate or currency fluctuations and how Government will treat the revenues
- Forecasting – There are risks associated with forecasting traffic growth and revenues collected, and differences between assumed and revealed elasticities to price
- Public and Political Acceptability – There are risks associated with how easily people will accept being charged to drive in Wellington, especially if no alternative road is provided (compared to the case for tolling proposals)

The majority of the high and extreme risks identified related to public and political uncertainties particularly legislative issues and political and public acceptability. This indicates that one of the key tasks in the future will be to develop an action plan to address public and political acceptance.

Acceptability

Where road pricing has been implemented, a key factor in the successful introduction of road pricing is the level of public acceptability.

Local and international studies have consistently concluded that the following factors are a major influence on the level of public acceptability of road pricing schemes:



- Alternatives to the car and their perceived effectiveness
- Use of the revenues generated
- Scale of the congestion problem
- Understanding the purpose of road pricing
- Considerations of equity and fairness of the pricing
- Form, technology, complexity and privacy
- Political leadership and public trust

A number of recent studies and strategies have investigated the issue of road pricing in New Zealand. These include the GWRC Regional Travel Demand Management Strategy and the Auckland Road Pricing Evaluation Study.

Any form of road pricing is unlikely to gain widespread public support in Wellington initially. A clear strategy would need to be developed to build public and political support for a road pricing scheme before, during and after implementation. This would need to address the factors listed above and could include:

- Well-articulated vision and strategy which sets out the purpose of road pricing, and identifies the congestion problems it is intended to address
- Strong political leadership which will build public trust in the scheme
- Re-investment of revenues to publicly and politically supported transport infrastructure projects and services, clearly identifying where the revenues would be used
- Transparency of the operation, costs and revenues, and clear identification of accountabilities for managing the scheme in order to build public trust
- The scheme developed should clearly be seen as fair and equitable
- An education and information campaign which would advise people of the above.

Conclusion

The analysis shows that road pricing in the greater Wellington context is economically and fiscally viable. Excess revenues, in the order of \$20 to \$40M per annum, would provide a funding stream for investment in transport infrastructure and services.

Further, road pricing at the relatively low charging levels proposed is likely to generate useful travel benefits through reducing congestion and travel time. These travel benefits are likely to lead to improved regional economic performance through enhanced accessibility, particularly for vehicles which have a high value of time such as commercial vehicles. This evaluation concludes that the social impacts of road pricing are likely to be able to be managed so that they are small.



While the Y-medium emphasis + southern screenline (YMS) option appears to provide the best overall performance, all the options tested perform similarly under the objectives of the RLTS. This indicates that a simple road pricing system could be implemented in greater Wellington which would attract a large proportion of the benefits that a more comprehensive scheme would generate and could be expanded in the future, as acceptability and available technology improved. The options do however perform differently under some specific measures and a decision on a preferred scheme would be dependant on which particular issues were considered the most important by decision makers.

It is important to see road pricing as one component of the overall regional transport strategy, rather than a stand-alone initiative. The next stage of developing a road pricing scheme for the greater Wellington region will need to involve consideration of road pricing as part of the mix of future transport investment projects in the RLTS. In parallel a detailed strategy for developing public and political acceptability would need to be produced.



1. Introduction

1.1 Background

Congestion and its associated social, economic and environmental problems are acknowledged as some of the largest issues facing the world's cities. More and more, road pricing is seen as an innovative and effective measure to reduce congestion and the greater Wellington region has been considering the implementation of road pricing to address congestion for some time. While Wellington does not currently have congestion problems in the same scale as those experienced in cities like London, planning for interventions to address the issue in the future needs to be considered now.

Since 1993, the Wellington Regional Land Transport Strategy (RLTS) has referred to the need for road pricing in the future and the RLTS 1999-2004 gives clear direction as to the need to consider road pricing.

The Land Transport Management Act (LTMA) 2003 requires the consideration of travel demand management (TDM) as part of a package of measures designed to achieve national and regional objectives for transport. Greater Wellington Regional Council (GWRC) developed a TDM Strategy in 2005 which clearly signals the need for road pricing to be considered in more detail as part of a package of TDM measures. Although the Land Transport Management Act 2003 (LTMA) does not permit the introduction of road pricing for the purposes of TDM, the Government has signalled an interest in investigating road pricing in special cases. It is envisaged that if a good case can be demonstrated then this may lead legislative changes to permit road pricing on existing roads.

It had not been clear whether such a scheme would have benefits for the regional transport network, nor had the form and timing of introducing such a system been identified. In 2004, GWRC, in association with Transit New Zealand (Transit), Land Transport New Zealand (LTNZ) and the region's territorial authorities, developed terms of reference for a road pricing study to answer these questions. The study was also to examine what specific transport issues road pricing might address, the pricing level appropriate for Wellington and what the impacts would be.

In October 2004, GWRC appointed Sinclair Knight Merz (SKM) to commence the Wellington Region Road Pricing Study - Stage 1. This work indicated that it may be possible to implement a road pricing scheme that is both financially and economically viable and would deliver substantial transportation benefits. Subsequently, in August 2005, GWRC developed a Request for Proposal (RFP) for Stage 2 of the Wellington Region Road Pricing Study, to develop a road pricing strategy for the region's strategic road network that best meets national and regional objectives for



transport. In September 2005, SKM were commissioned to undertake the Stage 2 work which is detailed in this report.

1.2 Report Structure

This report sets out the investigations and findings of Stage 2 of the Wellington Region Road Pricing Study. This stage has involved reviewing potential concepts for road pricing, selecting and developing indicative scenarios and evaluating these in detail against the objectives of the RLTS.

The report is structured as follows:

Chapter 1	Introduction
Chapter 2	Option Development and Definition
Chapter 3	Evaluation
Chapter 4	Regional Economic and Land Use Impact Review
Chapter 5	Social Impacts
Chapter 6	Other Considerations
Chapter 7	Conclusions and Recommendations

1.3 Study Governance

This study was commissioned by GWRC. However, a Technical Group, comprising officials from the Ministry of Transport (MOT), Transit New Zealand (Transit), the region's territorial authorities and GWRC, was convened to provide direction and context for the project. The Group was Chaired by Tony Brennand until February 2006 and then by Joe Hewitt of GWRC and their role was to ensure that the study is based on sound processes and information.

Technical Group meetings were held on 6 December 2005 and 15 June 2006. At these meetings, study progress and interim findings were presented to the Technical Group and the scope and methodology of subsequent work was agreed with the consultant team.

1.4 Study Objectives

The overall objective of the Wellington Road Pricing Study is to develop a road pricing strategy for the region's strategic road network that best meets national and regional objectives for transport. Road pricing must then be seen as part of the wider RLTS that underpins the strategic direction that the region seeks to develop. This direction is described by the objectives of the RLTS.

The Study brief identified that the "...main purpose of road pricing in the Wellington region is network efficiency. However, revenue generation is considered a useful secondary benefit."

The specific objectives of the Stage 2 work have therefore been to:



- 1) Define scenarios which have the most potential to improve network efficiency
- 2) Confirm the evaluation framework and performance criteria
- 3) Identify the financial and economic potential of the chosen scenarios
- 4) Review the regional economic and land use impacts of the chosen scenarios
- 5) Review the social impacts of the chosen scenarios
- 6) Review the environmental impacts of the chosen scenarios
- 7) Review the public acceptability of road pricing in the greater Wellington region
- 8) Identify the system operation and technology requirements of the chosen scenarios
- 9) Identify the legislative and privacy issues associated with road pricing
- 10) Recommend a strategy for progressing road pricing in the greater Wellington region

1.5 Related Studies

As noted above, the *Wellington Region Road Pricing Study – Stage 1 – Initial Road Pricing Viability Study* was completed by SKM in 2005. This study investigated whether a pricing scheme could be found which would address congestion, would be economically and financially viable, and would contribute towards all the objectives of the RLTS. The study concluded that road pricing in Wellington merited further investigation and recommended a number of options to be taken forward for further consideration as part of Stage 2.

The MoT has recently undertaken the Auckland Road Pricing Evaluation Study culminating in a report *Tackling Congestion in Auckland – Auckland Road Pricing Evaluation Study*, March 2006. The report presents potential road pricing options for Auckland and evaluates the different schemes. However, the document does not make any recommendations as to a preferred solution, but provides analysis and data for public consultation. This Study signals the Government's interest in considering road pricing for specific applications in the future.

The electronic Road User Charging (eRUC) and National Toll Administration Project (NTAP) are other studies that are related to road pricing through potential infrastructure and technology compatibility. These are discussed further in the Technology section.

1.6 Road Pricing Overseas Experience

Road pricing has been implemented in a number of locations overseas. Most recognisably in:

- London – London Congestion Charging Scheme (2003)
- Singapore – Electronic Road Pricing Scheme (1999)
- Oslo (and other Norwegian cities)– “Toll Ring” (1990)



The London and Singapore schemes have been hailed as successes and focus on management of congestion rather than generation of revenues. They involve access charges for entry into, or trips on a network within specific areas as opposed to variable, distance based charging. The Oslo scheme was implemented with the express purpose of generating revenue to fund transport infrastructure.

Road pricing was recently considered in Edinburgh, but it was abandoned due to adverse public opinion. Work is currently underway in the UK under the direction of the Department for Transport (DfT), to investigate road pricing concepts in seven, mainly urban areas.

1.7 Study Process

The initial work undertaken by SKM in Stage 1 of this study suggested that some form of road pricing scheme could be designed which would have benefits for the region and would be financially self-sustaining. This initial work focussed on cordon and screenline charges as they are the most practical option available with currently proven technology, and provided a good indication of how a number of different pricing concepts would perform.

Road pricing is a generic term for a wide number of pricing concepts and Stage 2 of the study focused on identifying the concepts with the most potential and evaluating their performance in more detail. The Stage 2 work was undertaken in three phases as described in the following sections:

- **Phase 1: Option Development and Definition**– This phase involved a review of the different forms of road pricing, followed by a range of tests to identify the potential of different concepts in the Wellington context. Following the identification of the road pricing concepts which were likely to perform best in Wellington, these options were developed and optimised further so they could be evaluated in detail.
- **Phase 2: Detailed evaluation of the indicative options** – The indicative options developed were evaluated against the full set of objectives and performance measures detailed in Section 2.2.
- **Phase 3: Review of wider issues** – The wider social and regional economic impacts of the option were reviewed alongside the risks associated with road pricing and consideration of how road pricing and associated mitigation measures could form part of the future transport strategies in the region.



2. Option Development and Definition

2.1 Congestion Review

With road pricing being intended to reduce congestion in Wellington, a brief review of the distribution of peak period congestion currently and forecast in the future was undertaken as part of the Stage 1 investigations. Wellington Transport Strategy Model (WTSM) and the central Wellington SATURN model were used for this purpose. Significant congestion also occurs on Saturdays (late morning to mid-afternoon); however this was not considered as part of this study.

2.1.1 Model Congestion Levels: 2003

The following figures are plots from the 2003 base year SATURN model and show the road network links that have a volume to capacity ratio (V/C) ratio which exceeds 1.0, indicating those links over capacity.



Figure 2-1: V/C >1.00 for the 2003 Base Year AM Peak

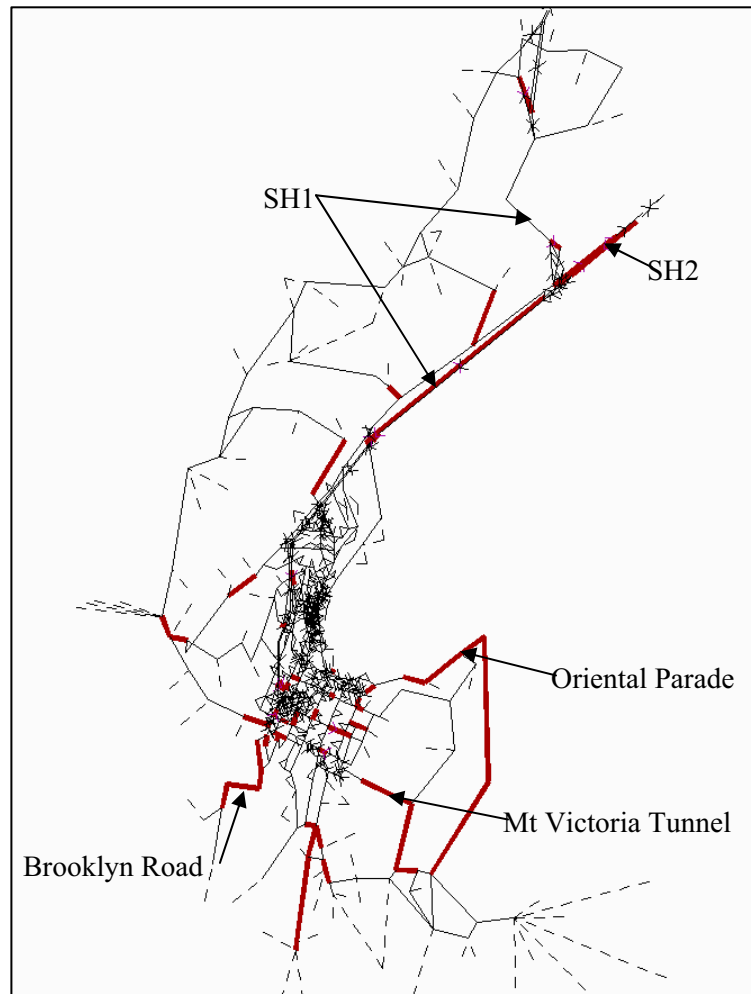


Figure 2-1 shows that the following links into central Wellington are over capacity.

From the north:

- Johnsonville Road
- SH2 north of Ngauranga
- SH1 north of Ngauranga and on the approach to the Wellington CBD
- Kaiwharawhara Road
- Grant Road



From the south:

- Brooklyn Road
- Adelaide Road
- Riddiford Street
- Mt Victoria Tunnel
- Oriental Parade

This indicates that most routes into the city from the north and the southeast experience significant congestion. It should be noted that these plots only show the links which are over capacity, however the queuing effects resulting from this extend much further than indicated on the plots.

Figure 2-2: V/C > 1.00 for the 2003 Base Year AM Peak: Wellington CBD

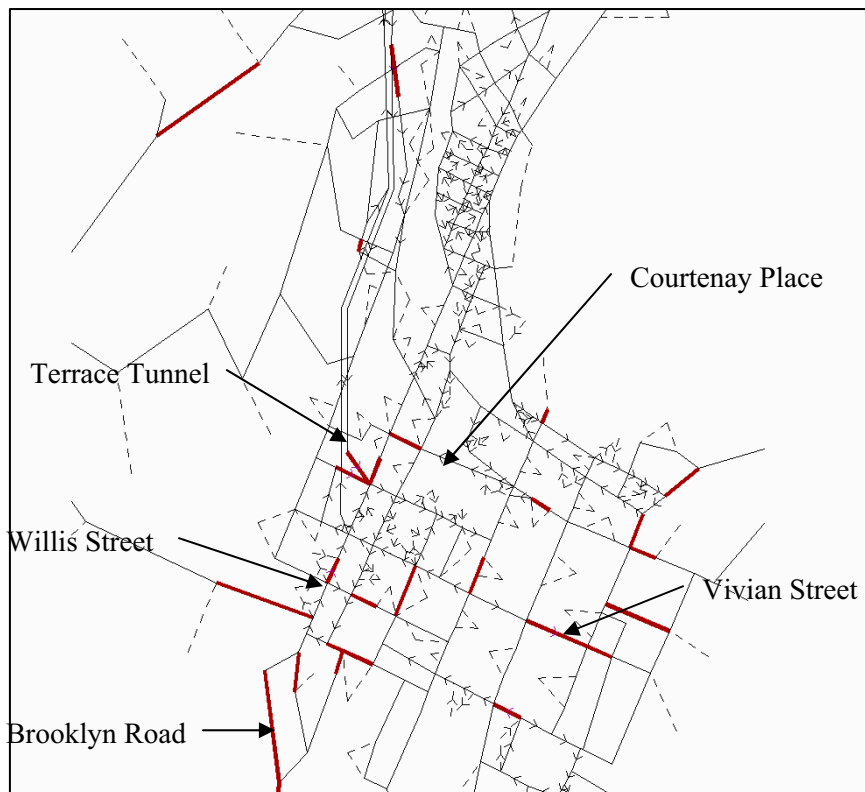


Figure 2-2 indicates that the bottlenecks in the CBD are limited to a relatively small number of links. These include:



- The Terrace Tunnel
- Ghuznee Street
- Willis Street
- Webb Street
- Aro Street
- Vivian Street
- Buckle Street
- Elizabeth Street
- Cable Street
- Courtenay Street / Dixon Street

It should be noted that enhancing the capacity at these bottlenecks will not necessarily reduce the level of congestion in the CBD, as it may simply transfer congestion downstream to the next intersection.

Table 2-1 below shows the V/C ratios at a number of selected bottlenecks taken from the 2016 WTSM model. This indicates these links are forecast to be over capacity in the future.

Table 2-1: V/C Ratios for Selected Bottlenecks

Location	V/C Ratio
Mount Victoria Tunnel	1.08
Terrace Tunnel off-ramp	1.04
SH1 south of the Ngauranga Merge	1.01
SH1 north of the Ngauranga Merge	1.03
SH2 north of the Ngauranga Merge	1.04
SH2 Western Hutt Road (by Petone)	1.00
SH2 Western Hutt Road (north of Buchannans Rd)	1.04
SH1 north of Mana Bridge	1.03

The Draft RLTS 2007-2016 notes that “Sever congestion occurs particularly at peak times, on the main routes in and out of Wellington City CBD. Severe ‘bottlenecks’ on the strategic network include Paekakariki to Pukerua Bay, SH1 Ngauranga interchange, SH2 Dowse to Ngauranga and around the terrace and Mt Victoria Tunnels.



Congestion is a significant issue during the peak period due to its impact on journey time reliability. A 2006 GWRC transport perceptions survey¹ indicated that 49% of respondents felt traffic congestion was worse than it was two years previously. Modelling of the network suggests that peak period congestion will continue to increase on many parts of the region's road network".

2.1.2 Congestion Summary

Observations of the network indicate that congestion is predominantly limited to the weekday AM and PM peak times associated with commuter travel and Saturday in the late morning and early afternoon. Congestion also occurs at some locations outside the peaks including weekend (Friday evening/Sunday afternoon) bottlenecks at Mana as people leave and re-enter the city for the weekend.

The areas identified as particular congestion bottlenecks are predominantly on the main radial approaches to the city.

2.2 Evaluation Framework and Performance Measures

2.2.1 Road Pricing Objectives

Internationally, road pricing is advocated as a means of addressing one or more of the following objectives:

- increasing the extent of costs recovered (internalising externalities) (particularly environmental and congestion costs);
- changing the pricing signals to road users, and hence influencing travel demand;
- providing additional funds for transport infrastructure investment (to supplement or replace existing funding sources).

The Study brief identified that the "...main purpose of road pricing in the Wellington region is network efficiency. However, revenue generation is considered a useful secondary benefit." The primary objective of road pricing in greater Wellington is therefore to manage demand, thus ensuring balanced use of infrastructure and reducing congestion at peak times. This would be achieved through the second objective above (changing pricing signals).

2.2.2 Development of Performance Measures

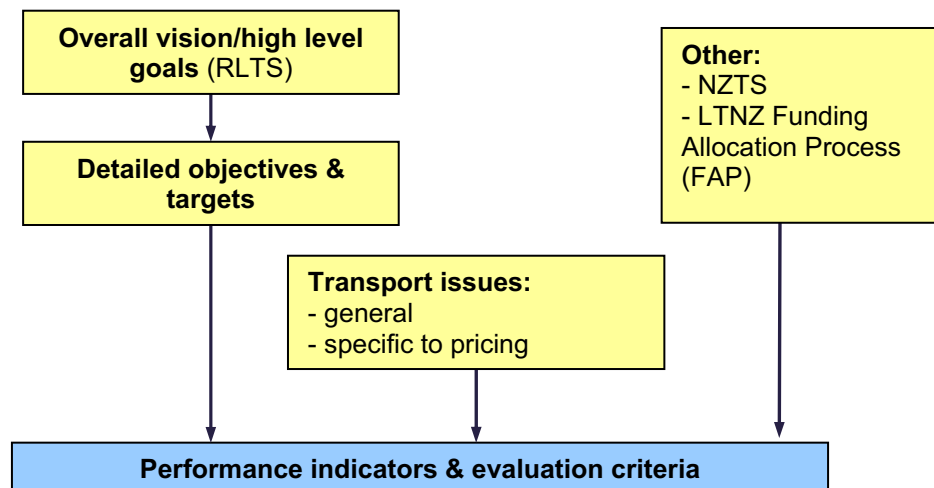
Major transport strategy components, such as road pricing, should be evaluated against the broader vision, objectives and goals of national and regional transport policy. Therefore in Stage 1 of this Study, a review of all relevant sources of transport policy was undertaken, from which a set of

¹ NRB GWRC May/June 2004 Transport Perceptions Survey



detailed transport objectives for the region was established. From these, performance measures were identified which could be used to evaluate the road pricing strategies. Figure 2-3 summarises this approach.

Figure 2-3: Development of Road Pricing Performance Indicators and Evaluation Criteria



It was agreed with the Technical Group that the evaluation of road pricing options should be undertaken using the six *draft* objectives of the RLTS, which encompass the New Zealand Transport Strategy (NZTS) objectives:

- assist economic and regional development;
- assist safety and personal security;
- improve access mobility and network reliability;
- protect and promote public health;
- ensure environmental sustainability; and
- consider economic efficiency and affordability.

A general approach to road pricing performance measures was detailed in the report *Wellington Road Pricing Study - Objectives and Performance Measures*, SKM, 2004. The report was based on the national, regional and local objectives as well as a set of performance measures developed for consideration in the Auckland Road Pricing Study terms of reference.

Performance measures were developed in the *Wellington Road Pricing Study – Stage 1 –Initial Road Pricing Viability Study*, SKM, 2005. These measures were further refined and are set out in Table 2-2.

**Table 2-2: Indicative Performance Measures Used in the Evaluation**

OBJECTIVE	MEASURE
ASSIST ECONOMIC AND REGIONAL DEVELOPMENT	
Regional economic impact	Review of regional economic and land use impacts
Average cost of travel per kilometre by mode	Average generalised cost per km by private vehicle, PT and HCV
Charges paid	Average charge paid by those who pay a charge
ASSIST SAFETY AND PERSONAL SECURITY	
Road safety	Average annual injury crashes
Personal security on public transport	Access to help as measured by % increase in PT trips
IMPROVE ACCESS MOBILITY AND NETWORK RELIABILITY	
Impact on travel	Person km of travel by private vehicle, PT and HCV
	Total No. of trips
Travel times	Vehicle travel times on key routes
Vehicle speeds	Average private vehicle, and PT speeds
Level of congestion and network reliability	Congested VKT (where congestion is defined as V/C > 0.8)
	V/C ratios at identified bottlenecks
Level of charges	Average charge paid by those who pay a charge
Distribution of charges	Spread of charges being paid
PROTECT AND PROMOTE PUBLIC HEALTH	
Effects on air quality	Volume of nitrous oxides (NOX), particulates, and volatile organic compounds (VOC) for the whole modelled area
Effects of noise	The sum of traffic volumes on approx. 100 selected links in residential areas (used as a measure of the impact of noise emissions on people)
Amount of active travel (walking and cycling)	No. of walking, cycling and PT trips
ENSURE ENVIRONMENTAL SUSTAINABILITY	
Effects on sensitive receiving environments	Traffic volumes on selected links adjacent to sensitive water receiving environments
Greenhouse gas emissions	CO ₂ emissions
Fossil fuel use	Fuel use
CONSIDER ECONOMIC EFFICIENCY AND AFFORDABILITY	
Consider economic efficiency	User benefits / Scheme costs
Consider financial performance	Revenues / Scheme Costs



2.3 Rating the Measures

A Planning Balance Sheet approach was used to undertake the evaluation. A score was given to each of the performance measures using a \sqrt and X based scoring system (Table 2-3). An average of each of the measures was then used to calculate an overall score against each objective.

Table 2-3: Rating System

Rating	Meaning
XXX	Very poor
XX	Poor
X	Worse than average
0	Average
\sqrt	Better than average
$\sqrt\sqrt$	Good
$\sqrt\sqrt\sqrt$	Very good
+, -	These are used for marginal adjustments to the above ratings at the summary level

2.4 Model Development and Testing Procedures

The WTSM model has been used to forecast the impacts of the road pricing strategies. The original version of the model had a base year of 2001, with associated planning data, networks and other model inputs along with a specification and model validation (which was formally documented) and a User Guide.

Since then a number of potential changes have been investigated and others implemented in the model by GWRC. Some of the changes have been incorporated into the model used for the Western Corridor Study. For the Stage 1 of the study, these changes were reviewed in the “Model Specification Report” and the following were implemented by the Study team:

- small base year network corrections implemented by GWRC;
- incorporate the latest gross domestic product (GDP) growth forecasts used by GWRC;
- the revised model iteration procedures.

The same version of the model has been used in Stage 2.

2.5 Forecasting Scenarios

The forecast years and future networks and other inputs used in Stage 1 were discussed and agreed with GWRC and the Technical Group at that time. These were then confirmed prior to the commencement of Stage 2.



The forecast years are 2016 and 2026, with the analysis focused on 2016. The land use inputs (population, employment, etc) are the medium projection as currently used by GWRC.

The future networks consist of a likely base plus improvements for the Hutt, Western (old package) and the Wellington CBD (pragmatic view) corridors. The 2016 network specifically includes:

- Adelaide Road Upgrade
- Dowse / SH2 Grade Separation
- Inner City Bypass
- MacKays Crossing 2 laning
- Kapiti Link Road Stages 1 & 2
- Paekakariki Hill Road Improvements
- Roundabout Changes at Paremata and Plimmerton
- Paremata Bridge Duplication
- Pauatahunui Bridge Replacement
- Pukerua Bay to Plimmerton 4 laning
- Mana Interim Improvements
- Wellington CBD bus priorities and general increases in bus and rail frequencies

2.6 Timing of Option Implementation

It is considered that given the political process, the need to undertake detailed feasibility and design and the need for legislative changes (refer to Section 5.1.1) a pragmatic programme for implementation of a road pricing scheme would see 2011 as a likely timeframe for implementation. Therefore, for this investigation it has been assumed that any of the road pricing concepts considered would be implemented in 2011. The modelling of options has focused on a model year of 2016.

2.7 Review of Road Pricing Concepts

The first phase of the Stage 2 work was to review the appropriateness of different road pricing concepts. This was to help identify the most promising options which would be developed further and evaluated in detail.

A review of the different forms of road pricing was undertaken, followed by a range of tests using the WTSM model to identify the potential of the different forms in the Wellington context. This testing included looking at new concepts as well as building on some of the earlier concepts identified in Stage 1. The key performance measures identified in our earlier work were produced



for a relative assessment of the option performance. In addition to the cordon and screenline concepts developed in Stage 1, the following concepts were considered:

- Toll Lanes / HOV Lanes
- New Toll Roads
- Area Charges
- Full Network Charges
- Strategic Network Charges
- Parking Charges

Specific details of the options investigated and preliminary testing undertaken is detailed in the report *Wellington Region Road Pricing Study – Stage 2 – Option Development Report*, SKM, 2007.

2.7.1 Toll Lanes / HOT Lanes

Toll and HOT lanes result in changes within specific corridors and are individual projects rather than forming by themselves a strategic pricing scheme. Like any other individual project they may have a role to play in an environment in which road pricing is planned in the greater Wellington region. Because of this, they have not been taken forward for further evaluation as part of this Study.

2.7.2 New Toll Roads

Like toll lanes and HOT lanes, new toll roads do not, in themselves, form a strategic pricing scheme. Further, the objectives of tolling individual roads are usually for funding reasons rather than to manage demand or improve network performance and so lack the rationale consistent with a proposed pricing strategy. However, individual toll roads may have a role in a wider strategy of transport measures accompanying road pricing. It was agreed with GWRC that toll roads are beyond the scope of this study both as standalone schemes and as part of the expected future road network.

2.7.3 Full Network Charges

Whilst Full Network charging may be a theoretical ideal, in practice it was not considered as a useful option. This is because lesser schemes can mimic much of the effectiveness of a full network scheme with much less cost and simpler technology.

It was concluded that this charging concept should not be considered further as part of this study. Investigations have focused on more practical options that achieve similar benefits and could be expanded to Full Network charging in the future when the technology becomes available at acceptable costs.



2.7.4 Strategic Network Charges

International considerations of Strategic Network charging have revealed that these schemes have unacceptable consequences. Strategic Network charges lead to traffic reassigning to the local road network to avoid paying the charge. This in turn leads to unacceptable levels of traffic and consequential adverse environmental and community impacts. Further, this leads to inefficient underutilisation of the strategic network.

As the impacts on travel, rerouting issues, technology requirements, and Strategic Network Charging performance were similar to much simpler schemes, it was concluded that this charging concept should not be considered further as part of this study.

2.7.5 Parking Charges

Initial investigations and testing identified that parking charges are not targeted at congestion bottlenecks and have little effect on congestion which is the primary objective of this study. This is because they are not locationally specific and do not target congestion causing trips. Therefore, it was concluded that parking charges should not be considered further.

2.7.6 CBD Cordons and Area Charges

The original Wellington CBD cordon tested in Stage 1 did not include a charge on the Inner City Bypass (ICB). This cordon was found to be ineffective due to traffic rerouting to the ICB to avoid charges. This caused a very high level of congestion at the Terrace Tunnel entrance.

As a result of these deficiencies, alternative Wellington CBD Cordon and Area Charging designs were developed for stage 2 which included:

- A wider cordon that performed better than those tested in Stage 1 and was taken forward for detailed evaluation.
- An area charge concept that when tested provided no significant advantages over the cordon with the same boundary. As the Area Charge would be more expensive to implement than the equivalent CBD cordon, Area Charges would not be considered further.

2.7.7 Ngauranga and Y Screenline Charges

A variety of Ngauranga and Y Screenline schemes were developed as part of the Stage 1 work. The Y Screenline schemes were based on a series of screenlines acting as cordon boundaries starting around the Wellington CBD area and then extending northwards on the SH1 and SH2 corridors.

The Ngauranga Screenline (NS), Y medium emphasis (YM) and the Y inner emphasis (YI) charging options were the most promising of the options investigated in Stage 1 and were taken forward for further evaluation.



The Y-outer emphasis (YO) option tested in Stage 1 did not perform well due to the relatively small number of vehicles travelling from outer parts of the region, the overall benefits were relatively small. It was concluded that tolls on the outer edges of the Y were inefficient and create disbenefits elsewhere on the network. This option was not taken forward for further evaluation.

2.7.8 State Highway 58

SH58 is the main east-west route between SH1 and SH2. The route is not forecast to experience significant peak period congestion in 2016. Therefore, it was not considered appropriate to apply charges to this link.

2.7.9 Option Refinement

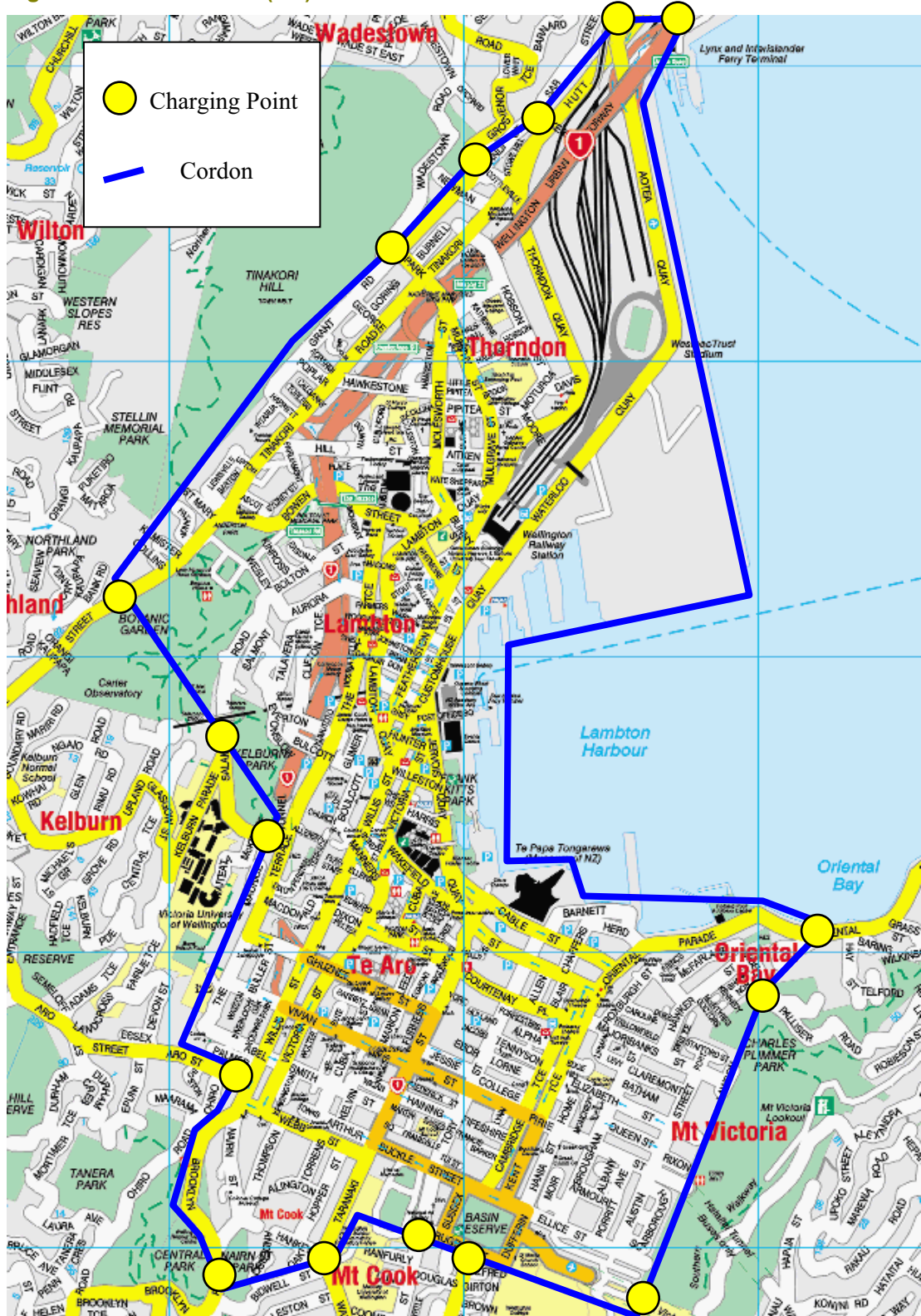
Once the basic concepts to be taken forward were agreed, a process of refinement was undertaken to develop options which were practical, had minimal impacts on the wider community and were comparable between options. The refinement included reconsidering the screenline locations to maximise the efficiency, and to minimise the adverse impacts of the schemes being investigated. Refinement of the charge levels was also undertaken. The location of the final screenlines is set out below.

2.7.9.1 CBD Cordon (CC)

The Wellington CBD cordon includes the central city, Thorndon and Mt Victoria. It is bounded to the east by the waterfront. The northern boundary runs along Tinakori Road and runs through the Botanical Gardens to the Terrace crossing Salamanca Road and Aro Street. The southern boundary runs level with the basin reserve, crossing Brooklyn Road, Taranaki Street Adelaide Road and the Mt Victoria Tunnel.



Figure 2-4: CBD Cordon (CC)





2.7.9.2 Ngauranga Screenline (NS)

The Ngauranga screenline was located immediately south of the of the SH1 / SH2 merge to capture trips into and out of the central Wellington area from the north of the region. Charging points were placed on SH1 and on the adjacent Hutt Road as indicated in Figure 2-5 below.

Figure 2-5: Ngauranga Screenline Charging Point Location



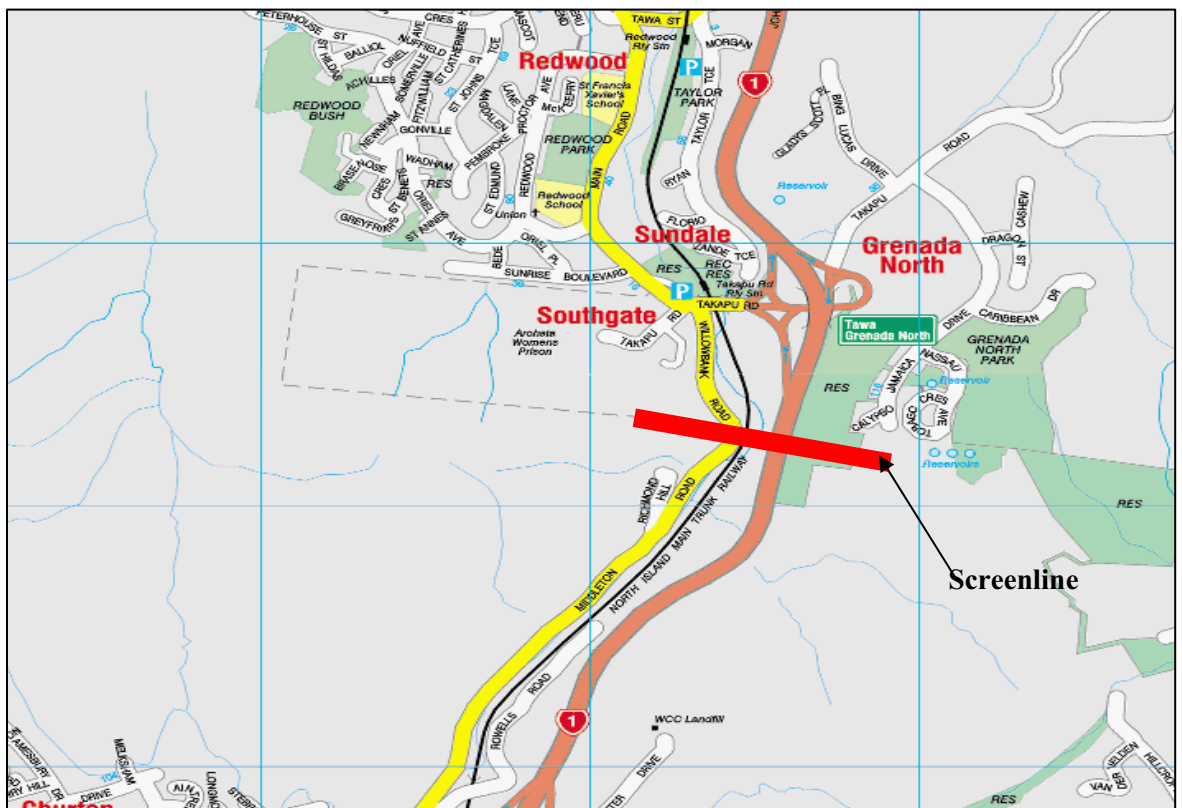


2.7.9.3 Tawa / Petone Screenline

The Tawa / Petone screenline was located to capture trips from the north of the region on the SH1 corridor and from the Hutt Valley on the SH2 corridor prior to merging at Ngauranga.

The charging points at the Tawa section of the screenline were placed on SH1, immediately south of the Tawa / North Grenada interchange and on Middleton Road (the local road which runs parallel to the motorway) as indicated in Figure 2-6.

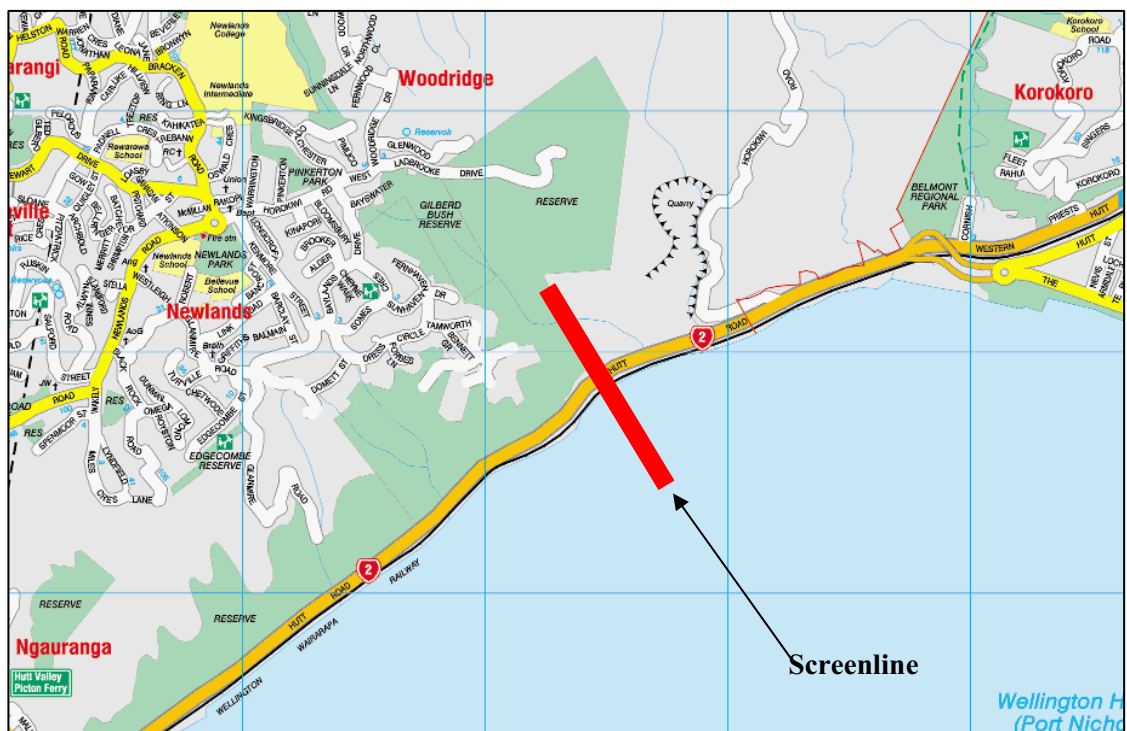
Figure 2-6: Tawa Charging Point Locations





The charging point at the Petone section of the screenline was placed on SH2, immediately south of the junction with Horokiwi Road which runs along the Petone foreshore, as indicated in Figure 2-7.

Figure 2-7: Petone Charging Point Location





2.7.9.4 Pukerua Bay / Hutt Screenline

The Pukerua Bay / Hutt screenline was located to capture trips from the northernmost parts of the region on the SH1 corridor and north of Hutt City on the SH2 corridor.

The charging point at Pukerua Bay (Figure 2-8) was located to ensure that the communities at Mana and Pukerua Bay are not separated from their local shopping and health facilities in and around Porirua.

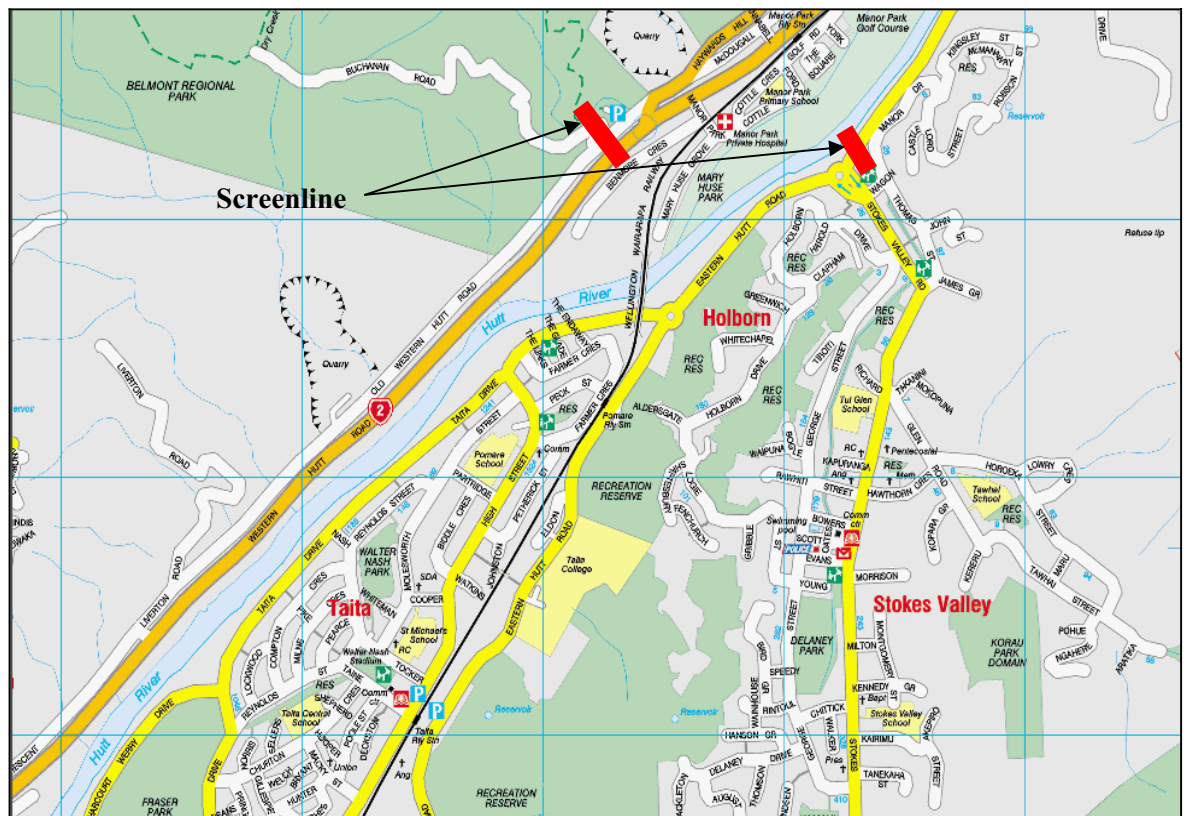
Figure 2-8: Pukerua Bay Charging Point Locations





The charging points at the Hutt section of the screenline have been placed on SH2, immediately south of the junction with SH58 Haywards Hill and on Eastern Hutt Road (Figure 2-9). The screenline on Eastern Hutt Road was located north of the Stokes Valley Roundabout to ensure access for the Stokes Valley community to local shopping and health services at Lower Hutt.

Figure 2-9: Hutt Charging Point Location

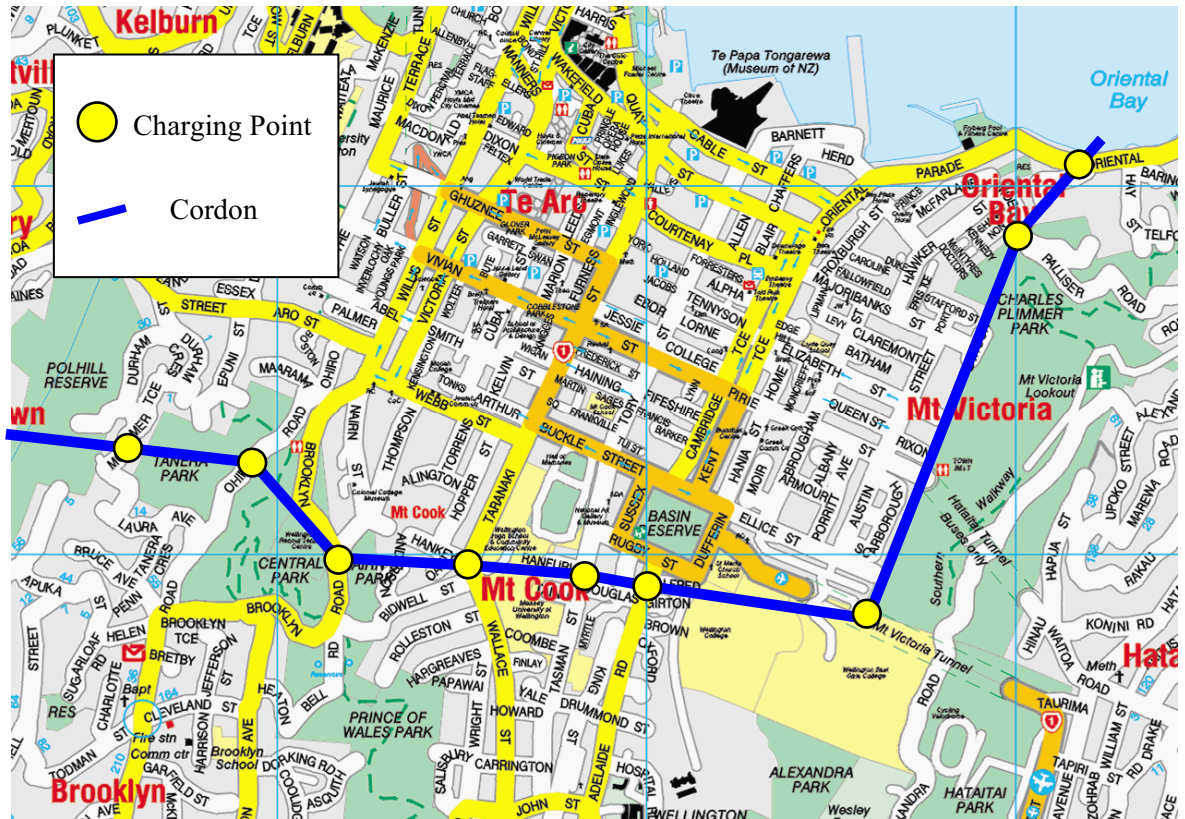




2.7.9.5 Southern Screenline

The location of charging points on the southern screenline are essentially the same as for the southern part of the CBD cordon (Figure 2-10)

Figure 2-10: Southern Screenline Charging Point Locations



2.7.9.6 Charging Level Refinement

All charges stated are in base year (2001) dollar terms and it was assumed that the real cost of the charges would rise at the same rate as GDP per capita. As a result, in 2006 these would be 26% higher, i.e. a \$4 toll in 2001 would be the equivalent of \$5 in 2006.

For each of the options taken forward for more detailed evaluation, the charge levels were reviewed. For this, a series of tests were carried out using WTSM in which the charges at individual locations were varied in an attempt to achieve better performance.

We have sought charges which achieve the highest congestion reduction with the lowest charges, thus maximising the economic performance. What this means is that the best performance of a road pricing scheme is bringing the bottlenecks / road network to the point of operating just on /



under capacity (a v/c ratio just below 1). Of course, higher charges would achieve a greater improvement in congestion but the network would not be being used efficiently.

In addition there was some rounding of charges to convenient currency. Finally, the charge levels of the final options were chosen such that they all had similar maximum charges which were comparable with public transport fares. For example rail fares from Wellington to Lower Hutt, Porirua, Upper Hutt or Paraparaumu is in the range of \$4-9 for a cash fare or with 10 trip tickets \$3.20-7.20. The additional cost of the road pricing schemes is therefore in same order as travelling by public transport.

2.8 Final Options Taken Forward for Detailed Evaluation

Using the refined screenline locations and the charging levels developed, the following final options were confirmed for detailed evaluation, with final option labels in brackets:

- Wellington CBD Cordon (CC)
- Ngauranga Screenline (NS)
- Y Screenlines - Inner Emphasis (YI)
- Y Screenlines - Medium Emphasis (YM)
- CBD + Y Screenlines (CY)
- Y + South of CBD Screenline (YMS)

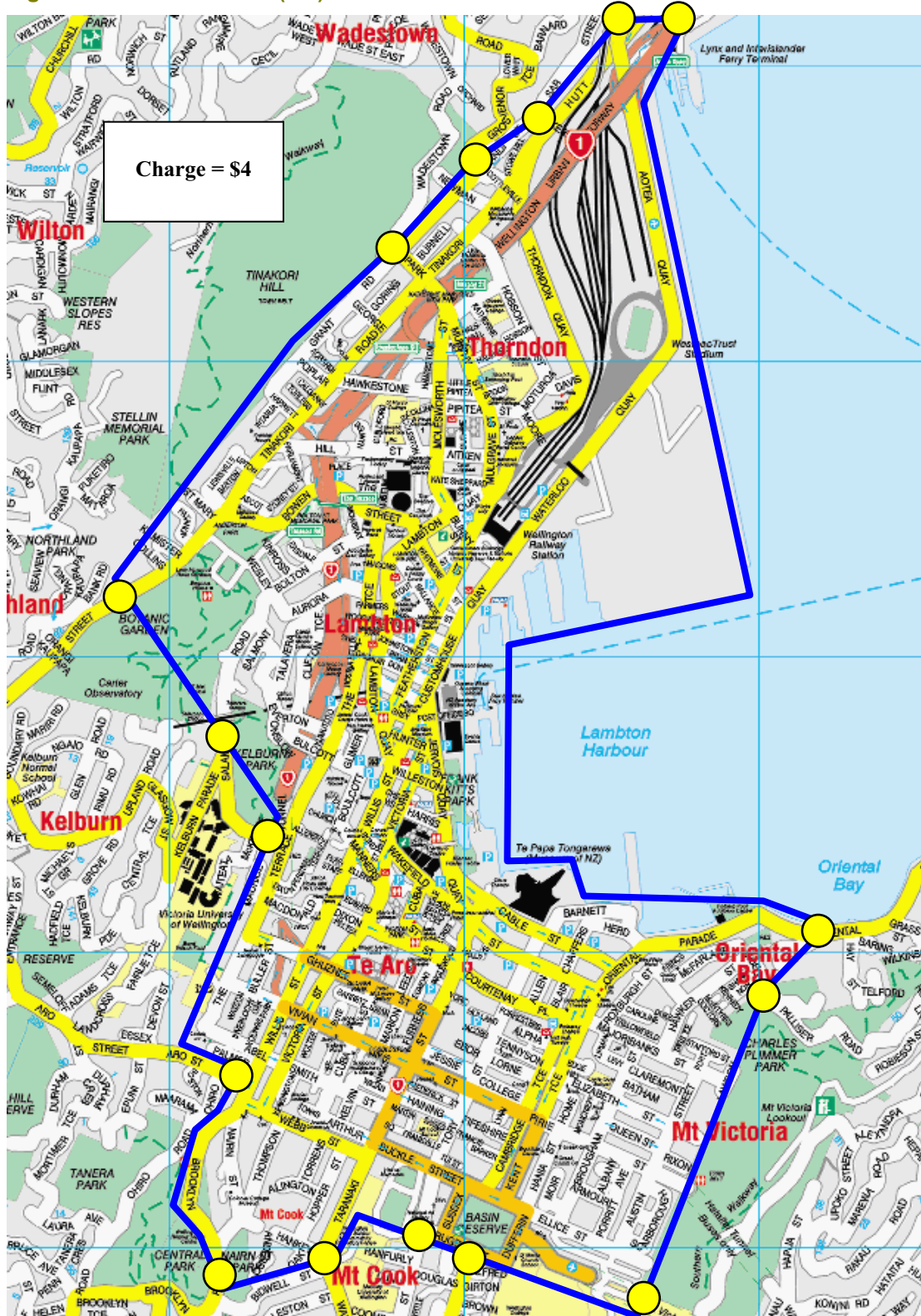
A description of the charge location and charge levels is set out below. The yellow dots shown on the figures represent the charging points and the figures shown indicate the level of charge imposed at those points.

2.8.1 CBD Cordon (CC)

The Wellington CBD cordon intercepts all peak period traffic to/from the Wellington CBD and imposes a charge of \$4. All vehicles crossing the cordon were assumed to pay the same charge regardless of location. Charges were made for trips that crossed the cordon in the peak direction i.e. inbound to the CBD in the AM peak and outbound from the CBD in the PM peak.



Figure 2-11: CBD Cordon (CC)

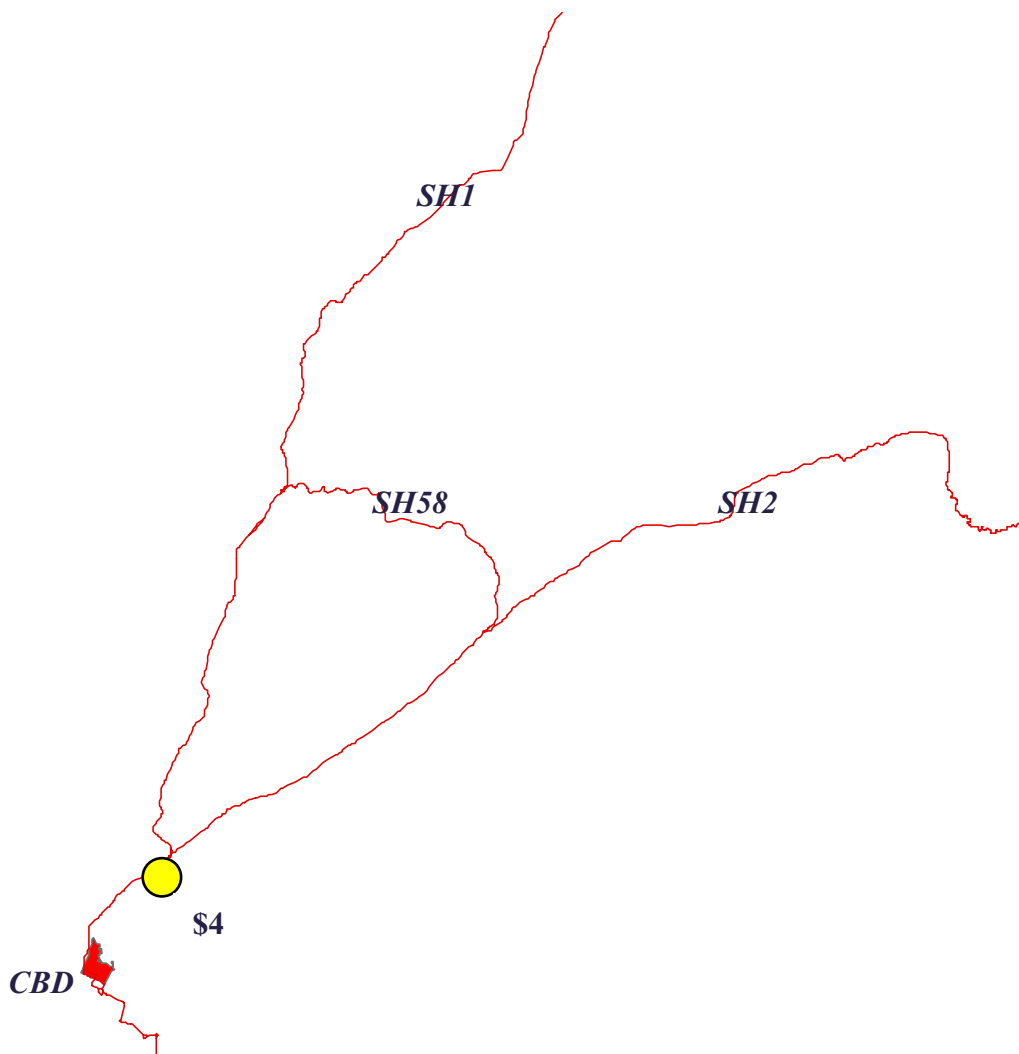




2.8.2 Ngauranga Screenline (NS)

A charge of \$4 is levied for trips that crossed the screenline in the peak direction i.e. inbound towards Wellington CBD in the AM peak and outbound away from the CBD in the PM peak.

Figure 2-12: Ngauranga Screenline (NS)

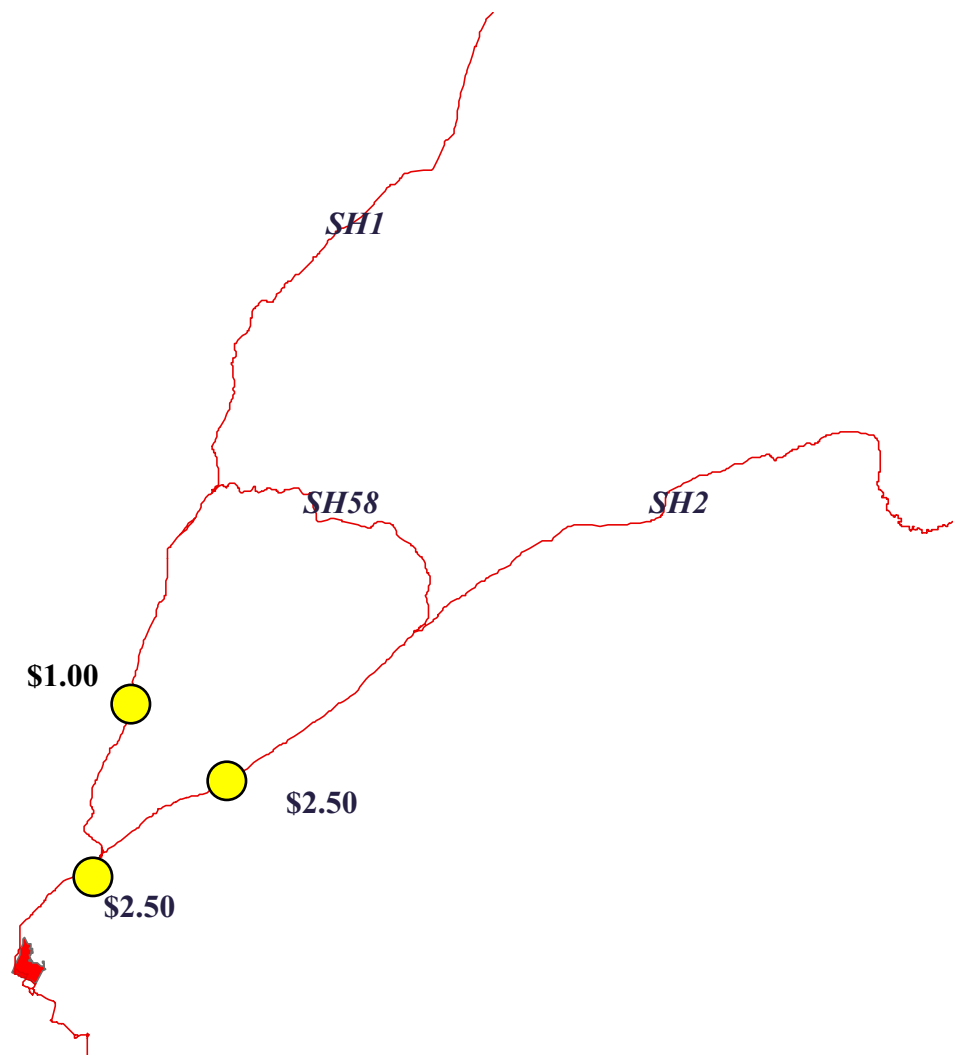


2.8.3 Y Screenlines - Inner Emphasis (YI)

The charges imposed are shown in Figure 2-13. The lowest charge tested was \$1 for trips between the area north of Tawa and the Ngauranga merge. The highest charge paid would be at total of \$5 for trips originating north of Petone on the SH2 corridor and ending in the central Wellington area. In that situation, \$2.50 would be charged at the Petone screenline and \$2.50 would be charged at the Ngauranga screenline.

The charges are higher for trips from the Hutt Valley on the SH2 corridor than for trips from the north on the SH1 corridor, reflecting the results of the charging optimisation process. Charges are made for trips that crossed the screenlines in the peak direction i.e. inbound towards Wellington CBD in the AM peak and outbound away from the CBD in the PM peak.

Figure 2-13: Y Screenlines - Inner Emphasis (YI)



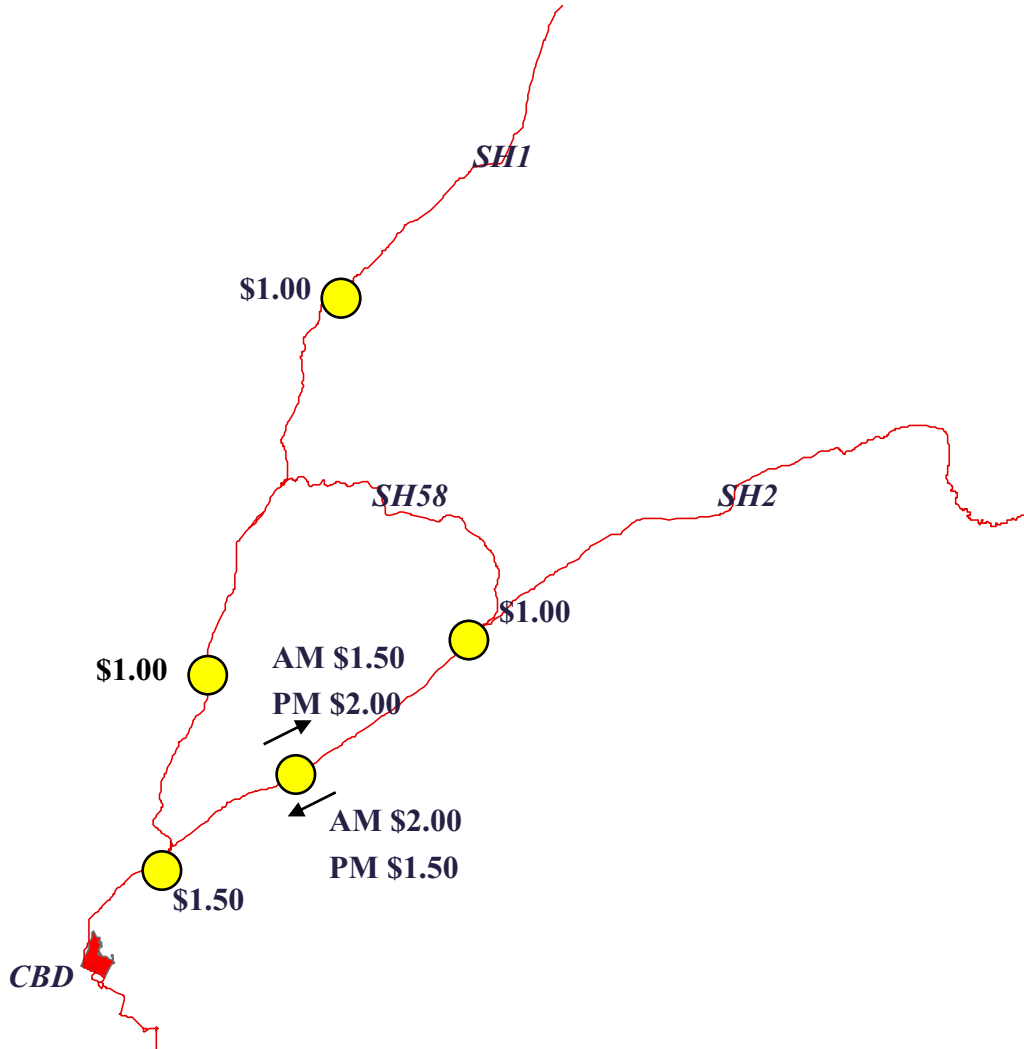
2.8.4 Y Screenlines - Medium Emphasis (YM)

The charges imposed are shown in Figure 2-14. The lowest charge tested was \$1 for trips that only cross the Pukerua, Tawa, or Hutt screenlines. The highest charge paid would be \$4.50 for trips originating north of Lower Hutt on the SH2 corridor and ending in the central Wellington area. In that situation, \$1 would be charged at the Hutt screenline, \$2 would be charged at the Petone screenline and \$1.50 would be charged at the Ngauranga screenline.

It should be noted that while the larger number of charging points mean that the total number of trips that incur a charge is likely to be greater, the individual charges are lower than the other Y options. Charges continue to be higher for trips from the Hutt Valley on the SH2 corridor than for trips from the north on the SH1 corridor reflecting the results of the optimisation process.

Charges are made for trips that cross the screenlines in the peak direction i.e. inbound towards Wellington CBD in the AM peak and outbound away from the CBD in the PM peak. The charging optimisation process undertaken also indicated that congestion levels experienced on SH2 in the counter-peak direction warranted counter-peak charges at the Petone screenline. The directional charges are indicated by the arrows in Figure 2-14 below.

Figure 2-14: Y Screenlines - Medium Emphasis (YM)

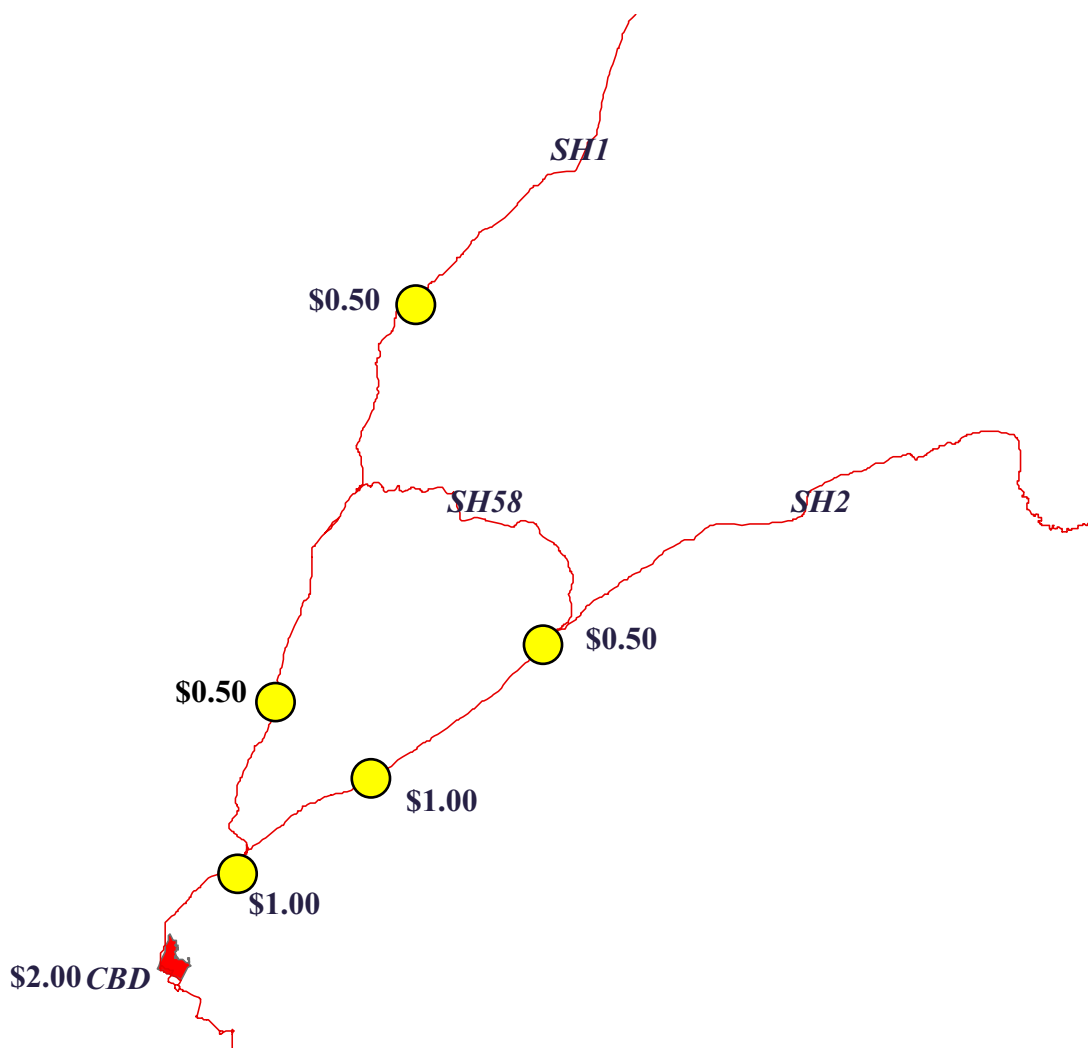


2.8.5 CBD + Y Screenlines (CY)

The charges imposed are set out in Figure 2-15. The lowest charge tested was \$0.50 for trips only crossing the Tawa, Hutt or Pukerua Bay screenlines. The highest charge paid would be \$4.50 for trips originating north of Lower Hutt on the SH2 corridor and ending in the Wellington CBD. In that situation, \$0.50 would be charged at the Hutt screenline, \$1 would be charged at the Petone screenline, \$1 would be charged at the Ngauranga screenline and \$2 would be charged at the CBD cordon. Charges continue to be higher for trips from the Hutt Valley on the SH2 corridor than for trips from the north on the SH1 corridor.

Charges are applied for trips that cross the screenlines in the peak direction i.e. inbound towards Wellington CBD in the AM peak and outbound away from the CBD in the PM peak.

Figure 2-15: CBD + Y Screenlines (CY)

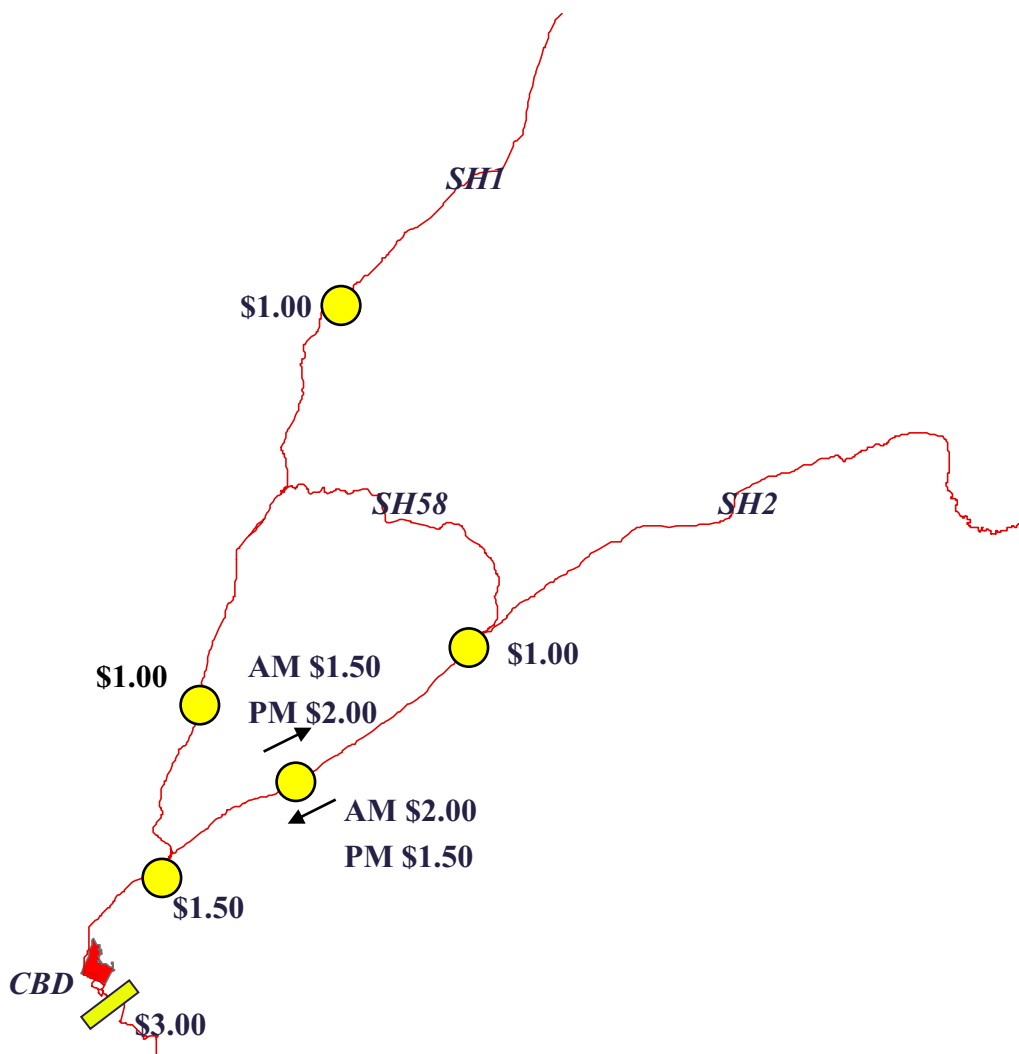


2.8.6 Y + South of CBD Screenline (YMS)

The charges imposed are set out in Figure 2-16. The lowest charge tested was \$1 for trips only crossing the Tawa, Hutt or Pukerua Bay screenlines. The highest charge paid would be \$4.50 for trips originating north of Lower Hutt on the SH2 corridor and ending in the Wellington CBD. In that situation, \$1 would be charged at the Hutt screenline, \$2 would be charged at the Petone screenline, and \$1.50 would be charged at the Ngauranga screenline. Charges continue to be higher for trips from the Hutt Valley on the SH2 corridor than for trips from the north on the SH1 corridor. Trips from the south and east would be charged \$3.

Charges are applied for trips that cross the screenlines in the peak direction i.e. inbound towards Wellington CBD in the AM peak and outbound away from the CBD in the PM peak.

Figure 2-16: Y + South of CBD Screenline (YMS)



2.9 System Operation, Technology and Cost Review

2.9.1 Introduction

A review of road pricing concepts and potential system operation and road pricing technologies was undertaken as part of Stage 1 of this Study. The options developed in Stage 2 through the Option Definition phase detailed in above are generally cordon or screenline charges. This section reviews the system operation, technology and costs in relation to the options identified at a strategic level.

The technologies identified as appropriate and indicative for cordon or screenline road pricing schemes in Wellington are:

- Vehicle mounted electronic tags (majority of users)
- Offline payment options via Short Message Service (SMS), internet, call centre, on-street meters and retail shops (for infrequent users etc.)
- Enforcement using Automatic Number Plate Reader (ANPR) and colour context cameras

These technologies have been chosen for a number of reasons. They have been used extensively in tolling systems around the world and are therefore proven. There are reduced costs in processing transactions because they are handled electronically and do not require costly manual interaction with staff. Importantly, the technologies are also consistent with the technologies proposed in the Transit NZ Toll Systems Project and the Auckland Road Pricing Evaluation Study. This means that there is potential for the same onboard units to be utilised nationally and significant cost savings to be made by combining the systems set up and operations. A stand alone 'back office' management system which stores and process the information collected has been assumed for this evaluation, but could potentially be combined with other schemes.

2.9.2 Charging and Enforcement Technologies

There are two main functional components of a road pricing scheme that influence technology choices. The first of these is the charging component whereby drivers pay for road usage and the second is the enforcement component whereby the payment is checked in relation to travel.

2.9.3 Charging Technologies

Cordon or screenline based charging involves levying a charge for crossing a defined screenline and the charge only applies when the screenline is crossed (in one or both directions). Travel within the area enclosed by the cordon does not involve a charge. When multiple screenlines are included payment is made for each crossing.

For a freeflow pricing scheme using cordons or screenlines, the technological options available include:

Offline Payment (as used in London Congestion Charging) whereby the payment is separated from the charged event. A payment can be made in a number of different ways including by phone, SMS, retail outlet, internet and on-street payment machine. It must be linked to an easily identifiable aspect of the vehicle that can be used in the enforcement process. In London this is the Vehicle Registration Mark (number plate). It is important that offline payment uses a very simple charging basis. A fixed charge is ideal, and offline payment is very suitable for simple screenline crossing charges.

Electronic Tag Payment is based upon a device fixed within and associated with a particular vehicle that transacts with a payment site on the road. The modern Singapore System uses a 'microwave tag' fitted in the vehicle windscreen which communicates with a gantry mounted beacon. Similar technology is used for road tolling schemes such as the Melbourne City Link Toll Road. Direct Short Range Communication (DSRC) is the most common method for this type of transaction internationally using radio communication. However, infra red technology could be used.

GPS Payment is based on a module fitted in the vehicle that can be used to detect a passage across a screenline, or for measuring distance along a road. For enforcement and checking there would normally be a communications method provided between the Global Positioning System (GPS) unit and the outside world. This can be using cellular radio or by DSRC to a roadside or gantry mounted beacon. Reports on trials undertaken in London² indicate that an average buffer of 60m would be required around a screenline to be able to give a 99% confidence that a position reported was actually within the cordon and this could increase up to 250m in some instances. Technology within the accuracy requirements needed is unlikely to be available before 2014. The report indicates that GPS units would need to be installed as part of a vehicle's construction, as retrofitting of units is likely to be problematic.

A practical charging system may utilise a number of payment methods and should be designed so that it can be extended and new technology be introduced as it matures. For example, a cordon based system could be set up based upon a tag payment system. It is highly unlikely that all vehicles could be assumed to be equipped as infrequent users need to be catered for. Although they could be equipped with tags, it is likely to be more flexible to allow an offline payment option. As more vehicles become equipped with satellite navigation systems, payment options using that technology may be appropriate as much of the cost would already be covered by the satellite navigation in-vehicle equipment.

² *London Congestion Charging Technology Trials, Stage 1 Report*, Transport for London, February 2005

The payment method assumed as part of this study is a combination of electronic tag based and offline payment. GPS technology has not been considered because the technology is unlikely to be sufficiently accurate and cost effective for some time, particularly in the New Zealand context.

2.9.3.1 Enforcement Technologies

In practice, the only enforcement method that has been found to be practical involves the use of the Vehicle Registration Mark (VRM). This is unique to a vehicle and is normally linked to the vehicle keeper via a central Vehicle Licence Database. It is relatively easy to read automatically, if, as in New Zealand, retro reflective number plates are used. VRMs are used extensively for enforcement of motoring offences and their use for this process is well understood. ANPR technology is the most commonly used technology for enforcement.

In order to introduce an enforcement system, it is necessary to provide cameras at suitable locations on the road that are able to read number plates. Depending upon the road width (number of lanes) it would normally be possible to mount cameras on poles at the roadside. A normal system would require two types of camera.

The first camera would be the one that focuses on number plate reading. This would normally operate in the infra red (IR) band and would have an associated infra red illuminator. The output from the IR camera is fed into an ANPR computer system, normally at the roadside. This reads the number plate in real time and stores the information. The second camera would be a colour context camera to record an overview image of the vehicle. The overview image together with the number plate image, ANPR output, time stamps and location data would form an evidential record that is sufficient to prove that the vehicle was present.

The enforcement process starts with the capture of an 'evidential record' at the enforcement site. To reduce transmission costs, the records would probably be stored at site and details of the VRM only sent to the centre. These would be stored in a database and compared with the 'Current Payments' database in the payments system. Where a record of payment existed, the evidential record stored at site could be deleted. At the end of the allowed period for payment, the enforcement system would list the VRMs of vehicles that had been seen by the enforcement system, but where no payment had been registered.

In parallel with receipt of evidential records, access will be necessary to the Vehicle Licensing database to obtain keeper details of vehicles where an offence is suspected. The details and evidential record would be checked manually and a Penalty Charge Notice (PCN) issued.

The enforcement technology assumed as part of this study is ANPR and colour context cameras.

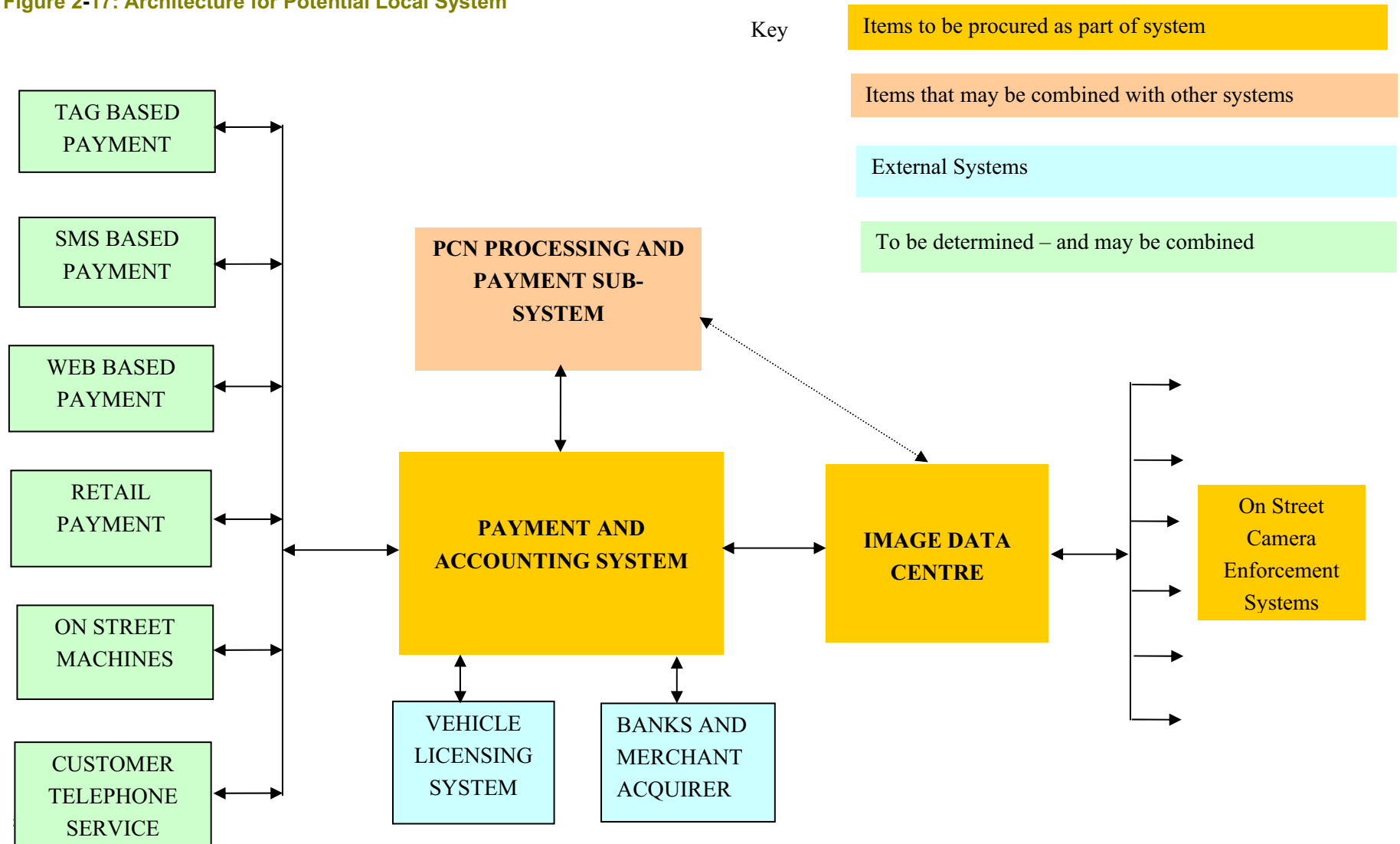
2.9.4 System Architecture

In developing the costs for the road pricing schemes considered, we have assumed that a stand alone local system would need to be constructed. For a local system, the functional areas should be determined on the basis of potentially available existing technology and systems that might be adapted for road pricing. This will ensure that there is minimum risk associated with procurement and that costs are minimised.

It is assumed that the total system is divided into a Payment and Accounting System - dealing with cash handling and accounting, and an enforcement Image Management System, dealing with image capture and enforcement issues. The overall architecture is shown in Figure 2-18:

- The Payment and Accounting System are linked with a number of payment channels that may be specifically provided or shared with other uses.
- The Image Management Centre is linked with the on street enforcement cameras and deals with the capture, validation and storage of enforcement images.
- The PCN Processing and Payment Sub-system may be separate or combined with parking PCNs.

Figure 2-17: Architecture for Potential Local System





2.9.5 Compatibility with other Schemes

Although the purpose of road tolling and road pricing are quite different, the technology required for the operation of both are very similar. This provides the opportunity to link road pricing and tolling projects in New Zealand. This will potentially result in large cost savings and allow a user to have one (or more) account and to use it anywhere within the country.

Two major studies have been undertaken recently which include some consideration of the technology requirement for tolling and road pricing schemes:

- Toll Systems Project
- Auckland Road Pricing Evaluation Study

2.9.5.1 Toll Systems Project

The LTMA 2003 provided a legislative framework for the implementation of tolling schemes for new roading infrastructure. Transit has a number of schemes that it intends to operate as toll roads in the near future and the Toll Systems Project (TSP) was initiated by Transit to develop a national strategic approach to the standards applying to the collection and processing functions of toll transactions for all toll roads. Initially, one of the requirements for the development of the system was that it should be flexible enough to also cater for urban road pricing schemes.

Recent developments have seen the scope of this project (now led by Transit and the MoT) amended, to focus on development of a scheme for operation of the ALPURT B2 scheme only. Indications are that the preferred technology is based on electronic tags with DSRC communication to roadside beacons, and that enforcement would be through ANPR cameras. This is consistent with the technology assumptions made in this study.

2.9.5.2 Auckland Road Pricing Evaluation Study

The Auckland Road Pricing Evaluation Study (ARPES) considered technology options for a wide range of road pricing options. The preferred technology for Cordon, Area and Strategic Network charging options (which are similar to the options being considered in this evaluation), were based on electronic tags with DSRC communication, and enforcement through ANPR. This is consistent with the technology assumptions made in this study.

2.9.6 Technology Conclusions

The technologies identified as appropriate and indicative for cordon or screenline road pricing schemes in the greater Wellington region are:

- Vehicle mounted electronic tags (majority of users)
- Offline payment options via SMS, internet, call centre, on-street metres and retail shops (for infrequent users etc.)
- Enforcement using ANPR and colour context cameras

These technologies have been chosen for the following reasons:

- Proven technologies;
- Reduced cost of processing transaction;
- Provides for non-regular users;
- Consistent with proposals for the TSP and the ARPES.

2.9.7 Cost Estimates

An important factor in assessing the viability of road pricing in the Wellington region will be the cost of the system, initially to implement - *capital costs*, and subsequently to run - *operational costs*. The costs of providing and running a road pricing system are significant, and need to be covered by the revenues if the scheme is to be financially viable.

There are a number of uncertainties with developing costs for a road pricing scheme in greater Wellington:

- The large scheme set up costs could be reduced if other schemes (i.e. TSP or ARPES) were progressed
- Legislative requirements for technology and enforcement
- Technology costs are reducing in real terms over time
- The scalability of operational costs with the number of transactions processed

To enable realistic costings to be produced, the following high level assumptions were made:

- That the roadside technology would be similar to that proposed by the TSP and ARPES, which is essentially in vehicle transponders (e-tags) with roadside beacons to detect passage across a particular screenline.
- Enforcement would be decriminalised and carried out by the operating entity as part of the system operation. Enforcement would be undertaken electronically through the use of ANPR. Colour context cameras would be used to take enforcement images.
- Payment would be available by electronic means only. This would be via e-tag (DSRC communication) or prepay via phone, Internet, SMS, payment machines etc. No form of manual payment at the site of charging would be provided.

- The system would be a stand-alone, owned and operated by a single operating entity. All front office and back office functions would be undertaken in house. This approach is conservative as integration with a national system, for example the TSP or ARPES, could provide savings.

2.9.7.1 Capital Costs

Capital costs are made up of central equipment and outstation equipment costs and tag costs:

2.9.7.1.1 Central Equipment Costs

International experience indicates that design and procurement costs for the back office system are relatively unscalable in terms of the number of transactions that need to be catered for and the limited options for procurement of these types of systems. A cost of approximately \$30M was developed for designing and procuring a stand alone back office system and central equipment for any of the options being considered. This figure included all hardware, software, systems development and professional services fees.

2.9.7.1.2 Outstation Equipment

Outstation costs were developed based on the number of gantries, cameras, beacons, and the amount of communications equipment required at each screenline crossing point. Depending on the nature of the screenline crossing locations, cost varied between \$200K and \$250K per site for outstation equipment.

2.9.7.1.3 Tags

It was assumed that tags would cost in the order of \$80 per unit and that approximately 40% of the vehicle fleet in the region would be fitted with tags. It is assumed that in practice this take up would be encouraged by increasing the amount charged to people who pay manually giving people a financial incentive to have a tag fitted in their vehicle. However for simplicity in the analysis, all vehicles are assumed to pay the same charge.

2.9.8 Operating Costs

As noted above, there are a number of uncertainties with developing operating costs for a road pricing scheme in Wellington. Because of these uncertainties, two different approaches were used to identify the likely range of operating costs.

2.9.8.1 Payments Based Operating Costs

The first method used to determine the operating costs of the different options was developed from experience with operating road pricing schemes in the UK. It developed costs for operation of the schemes from first principles, making assumptions about the cost of employing staff to operate and manage the system, processing payments for non-regular users, maintenance costs for hardware and software etc. Key assumptions for the payment based operating costs are set out in Table 2-4.

Table 2-4: Key Assumptions for Payments Based Operating Costs

Transaction Type	Percentage	Transaction costs
Tag	85%	\$ 0.00
Call Centre	1%	\$ 2.60
Machine	4%	\$ 0.52
Internet	4%	\$ 0.52
SMS	3%	\$ 0.52
Retail	3%	\$ 0.52
Other	1%	\$ 0.52
Total	100%	

Maintenance costs pa - central equipment (% of capital expenditure)	15%
Maintenance costs pa - outstation equipment (% of capital expenditure)	10%
Number of vehicles fitted with tags	89,750
Cost per tag	\$80
Tag percentage replacement pa	20%
Assumed % PM peak payments made by vehicles which also paid in the AM peak	75%
Staff costs pa	\$945,000
Operating days pa	250
Annual coms cost per site pa	\$2,000
Equipment economic life	10 years
Equipment replacement cost at end of economic life (% of capital cost)	75%

No. of Transactions

Option	AM	PM	AM + PM ³
CC	22,611	21,288	27,933
NS	10,098	9,713	12,526
YI	14,324	18,319	18,904
YM	24,311	24,935	30,544
YMS	32,018	32,428	40,125
CY	35,710	34,873	44,428

No. of Screenline Crossings Points

Option	1 lane	2 lane	3 lane
CC	20	6	2
NS	0	2	2
YI	2	6	2
YM	6	10	2
YMS	18	14	2
CY	26	16	4

³ Assumes that 75% of PM users of the system also use the system in the AM peak. Therefore, the number of unique transactions each day is equal to the number of AM users + 25% of the number of modelled PM users.

2.9.8.2 Transactions Based Operating Costs

The second method used to determine the operating costs of the different options was developed based on assuming a cost per transaction for a tag based transaction and a cost per transaction for a non- tag based transaction. This cost includes for all operating costs including maintenance and staff. A cost is assumed for incomplete transactions where the transaction is not processed automatically and requires further investigation. The costs were based on international experience of transaction costs for road pricing and tolling schemes. Typical transaction costs quoted for schemes of this nature range between \$0.30 and \$ 0.45. Where possible we have normalised our assumptions with those made in the ARPES study to ensure a consistent evaluation. Key assumptions for the transactions based operating costs are set out in Table 2-5.

Table 2-5: Key Assumptions for Payments Based Operating Costs

Transaction Type	Percentage	Transaction costs
Tag	84%	\$ 0.40
Call Centre	3%	\$ 4.50
Machine	0%	\$ -
Internet	3%	\$ 0.57
SMS	5%	\$ 0.70
Retail	5%	\$ 1.00
Other	0%	\$ -
Total	100%	\$ 0.57

No. of vehicles fitted with tags	89,750
Cost per tag	\$80
Operating days pa	250
Equipment economic life	10 years
Equipment replacement cost at end of economic life (% of capital cost)	75%
Incomplete transaction	1.5%
Incomplete transaction cost	\$5

No. of transactions

Option	AM	PM	AM + PM
CC	22,607	21,282	43,889
NS	10,063	9,754	19,817
YI	23,325	22,080	45,404
YM	37,240	37,799	75,039
YMS	46,232	46,597	92,828
CY	58,615	56,832	115,448

No of Screenline Crossings Points

Option	1 lane	2 lane	3 lane
CC	20	6	2
NS	0	2	2
YI	2	6	2
YM	6	10	2
YMS	18	14	2
CY	26	16	4

2.9.9 Cost Conclusions

Table 2-6 below shows the cost estimates developed for the options under evaluation using both the payments and transactions methods.

Table 2-6: Operating Costs (\$m)

Method	Costs	CC	NS	YI	YM	YMS	CY
Payments	Capital Costs	40	37	38	39	40	42
	Operational Cost (pa)	7	4	5	5	5	6
Unscaled Transactions	Capital Costs	40	37	38	39	40	42
	Operational Cost (pa)	7	3	7	12	15	18

Capital costs using both methods were the same. Capital costs were higher for those options with more screenline crossing points and require more outstation equipment. The central equipment and back office costs were similar for all options.

The “payments” method of determining operating costs resulted in a higher cost for those options with fewer numbers of vehicles crossing screenlines (compared with the transactions method). The operating costs do not increase as quickly with increasing numbers of screenline crossings. Options with higher numbers of screenline crossings have lower costs (compared with the transactions method). This is considered reasonable given that the staff costs and maintenance costs for fixed infrastructure would remain reasonably similar and not increase linearly with increased screenline crossings.

The costs developed provide a good range of likely capital and operating costs which could be expected for the schemes. Tolling and congestion pricing is a new sector of the transport market for New Zealand and technological developments in these sectors are advancing at a considerable pace. Experience with Intelligent Transport Systems indicates that the cost of technology is reducing in real terms over time and it is likely that road pricing technology will become more affordable in the future.

3. Evaluation

Using the performance measures developed in Section 2.2.2, the schemes have been evaluated using a planning balance sheet approach. The following sections present the evaluations under each Objective in turn with modelled data as extracted from WTSM. This is supplemented in most cases by percentage differences and an evaluation score.

3.1 Objective 1: Assisting Economic Development

The following measures were used in the evaluation of the objective Assisting Economic Development:

- Regional economic and land use impact review
- Average cost of travel per kilometre by mode
- Charges Paid

3.1.1 Regional Economic and Land Use Impact Review

The economic assessment considering scheme specific user benefits, crash reductions etc detailed in Section 3.6 shows that there are clear economic benefits to the schemes from a national perspective. The charges paid will however impact on wider regional economic activity if they are additional to current taxes. A review of the possible impacts of the road pricing schemes developed was undertaken to identify any potential adverse impacts on the regional economy and land use from the imposition of charges. Full details of the review are included as Appendix B.

3.1.1.1 Regional Economy

The greater Wellington regional economy provided some 12.8% of the national economic activity of New Zealand in the year to March 2004. This compares with some 11.3% of the total population. The regional GDP in the same year was \$17.5 billion with a per capita nominal GDP of some \$36,700 (year to March 2003). Wellington's per capita GDP is the highest of the twelve regions covered by the nzier's regional economic data sets.

Wellington's economic growth between March 2000 and March 2004 averaged 3.9% per annum compared with growth in the national economy of 3.5%. However, Wellington's real per capita growth averaged 1.6% between 1998 and 2001 below the national per capita growth rate of 2.3%⁴.

A number of characteristics of the regional economy offer scope to complement road pricing in supporting further regional economic growth. For example the relatively high self-containment of employment in most of the individual local authority areas means that employment is already

⁴ *New Zealand's regional economic performance nzier Report to MED, nzier, September 2004*

located near to the contributing population centres. There is potential to build on this local employment reducing the need for travel across the region for employment.

The regional workforce is also relatively highly qualified. A qualified professional workforce offers the potential for more flexible work practices including arrangements with employers for flexible hours allowing the AM and PM peak travel periods to be spread, as is happening in London, and also for increased levels of working from home.

The greater Wellington regional economy is also strong in some of the faster growing industry sectors such as business and other services and transport and communications. The transport sector will benefit directly from reduced congestion. While some parts of the business services sector will have a competitive advantage from location in the Wellington CBD, much of the services sector and the communications sector will have more flexibility in terms of location decisions, again potentially reducing the need for peak travel to and from the Wellington CBD.

The relatively high self-containment of employment is highlighted in Table 3-1, which also shows the importance of Wellington City as a regional employment centre.

Table 3-1: Journey to Work Information Percent of Usual Residence by Workplace (2001 Census)⁵

	Workplace Area				
	Wellington City	Hutt City	Upper Hutt	Porirua	Kapiti Coast
Usual Residence					
Wellington City	78.1	5.5	0.6	2.5	0.3
Hutt City	27.7	52.8	3.3	1.2	0.2
Upper Hutt	20.7	20.6	43.1	1.7	0.2
Porirua	37.7	7.1	1.3	35.7	1.3
Kapiti Coast	18.6	4.1	1.0	4.4	54.7

The six options are estimated to cost in the order of \$37 to \$42M to install and some \$3 to \$18M to operate and maintain (O&M). The capital cost equates to some 0.21% to 0.24% of the regional GDP and the annual O&M cost equates to some 0.02 % to 0.10 % of the regional GDP. The highest total toll income under the six options is estimated at just over \$47 million or some 0.27% of regional GDP. It can therefore be seen that the construction, operating costs and charges paid equate to a very small proportion of the regions GDP and road pricing is therefore unlikely to have a significant impact on the regional economy.

⁵ Note that this table does not include Wairarapa or unidentified destinations

3.1.1.2 Economic Impact

Analysis of 2001 Census journey to work data indicates that only around a third of the journeys to the Wellington CBD are by car. The traffic modelling suggests that under the CC and NS options 14% and 6% of trips will pay the highest charge respectively (a flat charge of \$4). Under all other options, less than 4% of trips will pay the highest charge. While it could be argued that this puts an uneven burden on a small section of the community rather than spreading it widely across the whole community, it is noted that those who would pay the highest charges tend to be travelling the longest distances and are therefore incurring higher travel costs already and have the opportunity to obtain the higher time savings. This said, there could be a very small number of members of the community who would be adversely affected and are unable to change their travel patterns. Consideration could be given to compensating them in a way that does not impact on the beneficial effects of road charges.

3.1.1.3 Use of Surplus Revenues

If the bulk of the operations and maintenance including administration, are undertaken from within the region and the net toll income, after O&M costs, is allocated to transport projects or other uses within the region, the net impact on the region could be negligible. In this case any impact would only relate to any outflow of funds from the region for such aspects as debt servicing, taxes, imported spare parts and/or specialist technical services.

In theory, if the surplus revenues are spent on projects that generate higher than average multipliers, the schemes could generate a positive regional economic impact. If, surplus revenues are reinvested back into the economy by way of additional transportation infrastructure and services, this would generate even higher user benefits, particularly if the reinvested revenues are deployed on economically efficient proposals.

The annual surplus revenues are such that, if the surplus revenues were deployed on schemes that gave even quite modest returns, there is potential for these revenues to deliver strong benefits to the regional economy.

3.1.1.4 Land Use Impacts

There may be some limited opportunities for more intensive land use and development in specific areas of the region within road user charging screenlines to reflect changes in road use related to user charges. While it is unlikely that there would be major development opportunities there could be some opportunities for incremental minor development of regional commercial centres and associated residential areas and possibly some changes in retail and commercial tenancies.

The proposed road pricing options are unlikely to have a significant impact on land use. However there is some potential for limited effects including:

- Opportunities for some limited support for urban consolidation policies and programmes including some higher value land uses at specific locations. These include possible opportunities to develop specific service centres on one side of a screenline to service the community on that side to enable them to avoid payment of the road user charge. Given the type and level of charges proposed it is unlikely that there will be many, if any, of these opportunities
- More intensive use by the relevant sub-regional population of the regional activity centres (eg: Lower Hutt, Porirua, Kapiti) to avoid incurring road user costs
- Increased residential development within a regional commercial centre's catchment that avoids road use charging points e.g. increased development in areas that allow 'free' access to regional centres. This is linked to the more intensive development of the regional centres above
- Possible marginal change in retail and commercial mix to reflect changed demand from customers who are avoiding some or all road user charges.

As noted while these land use opportunities are possible they are likely to be limited.

3.1.1.5 Regional Economic and Land Use Conclusions

On the basis of the changes to transport patterns explored, it is likely that the direct adverse regional economic effect of road pricing will be at most marginal. If, as assumed, the surplus revenue from the charges is spent in the region the net impact on the region as a whole could be insignificant although there may be a limited number of individuals or groups who are disadvantaged particularly in the short term. If revenues are allocated to economically efficient transport infrastructure projects the impact could be positive.

In terms of overall regional economic growth, while the impacts will be small, road pricing is likely to contribute positively, based on the estimated benefits from reduced congestion and improved travel times at the peak, identified in the study. However, there could be differential impacts by location, although these are likely to be small.

3.1.2 Average Cost of Travel per kilometre by Mode

Table 3-2 gives the average generalised cost of travel by private vehicle, passenger transport (PT), and heavy commercial vehicle (HCV) in each of the three modelled time periods. Figure 3-1 presents this for the AM peak period. The data for private vehicles and HCV includes the charges paid as well as time and operating costs.

With all the options, both private car and HCV have increased costs. This means the charges paid are greater than the time and distance savings as calculated from LTNZ Project Evaluation Manual (PEM) values. The increase is greatest with the Wellington CBD Cordon, and least - and only very

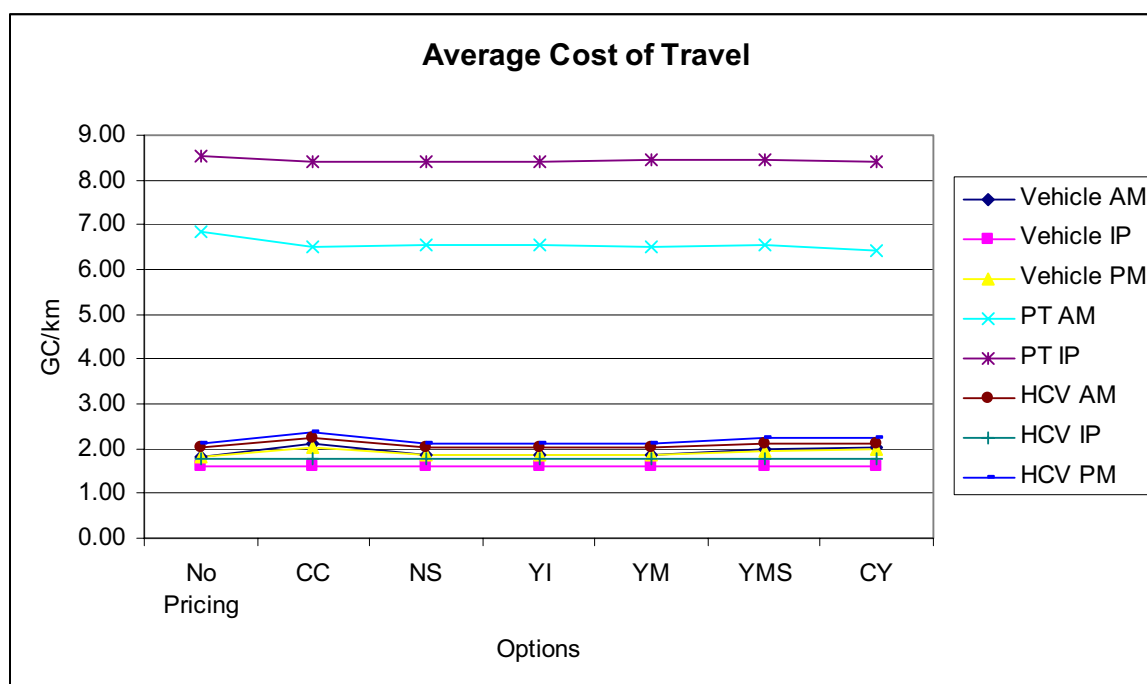
slight – with the Ngauranga Screenline and Y-Screenline options. When the Y-options are combined with the CBD Cordon (whole or part), the cost increase is between these two extremes.

PT costs per km, on the other hand, decline under the options, with all showing about the same level of improvement (5%). This is the result of decongestion impacts on buses.

Table 3-2: Average Generalised Cost of Travel per kilometre by Mode (min/km)

	No Pricing	CC	NS	YI	YM	YMS	CY
Vehicle AM	1.84	2.12	1.86	1.86	1.87	1.98	2.03
Vehicle IP	1.60	1.59	1.61	1.61	1.60	1.60	1.60
Vehicle PM	1.83	2.05	1.85	1.86	1.86	1.95	1.98
PT AM	6.84	6.51	6.55	6.55	6.51	6.56	6.41
PT IP	8.52	8.41	8.40	8.40	8.44	8.44	8.41
HCV AM	2.02	2.22	2.02	2.02	2.04	2.11	2.10
HCV IP	1.79	1.78	1.79	1.79	1.79	1.79	1.79
HCV PM	2.11	2.36	2.12	2.13	2.13	2.24	2.22
AM Vehicle	100%	115%	101%	101%	102%	108%	111%
AM PT	100%	95%	96%	96%	95%	96%	94%
AM HCV	100%	110%	100%	100%	101%	104%	104%

Figure 3-1: Average Generalised Cost of Travel per kilometre by Mode (AM peak)



The data shown in the figure above is depicted using a line chart where the results for each data series are shown linked between options. This is not intended to suggest any linkage between the options, but is to display a large amount of data on one chart as clearly as possible. This approach has been continued, where appropriate, throughout the evaluation below.

3.1.3 Charges Paid

Table 3-3 and Figure 3-2 show both the average charge paid for those trips that pay a charge and the overall average charge paid for all trips. No differentiation is made between the classes of vehicle, as it has been assumed that commercial and private vehicles pay the same charges.

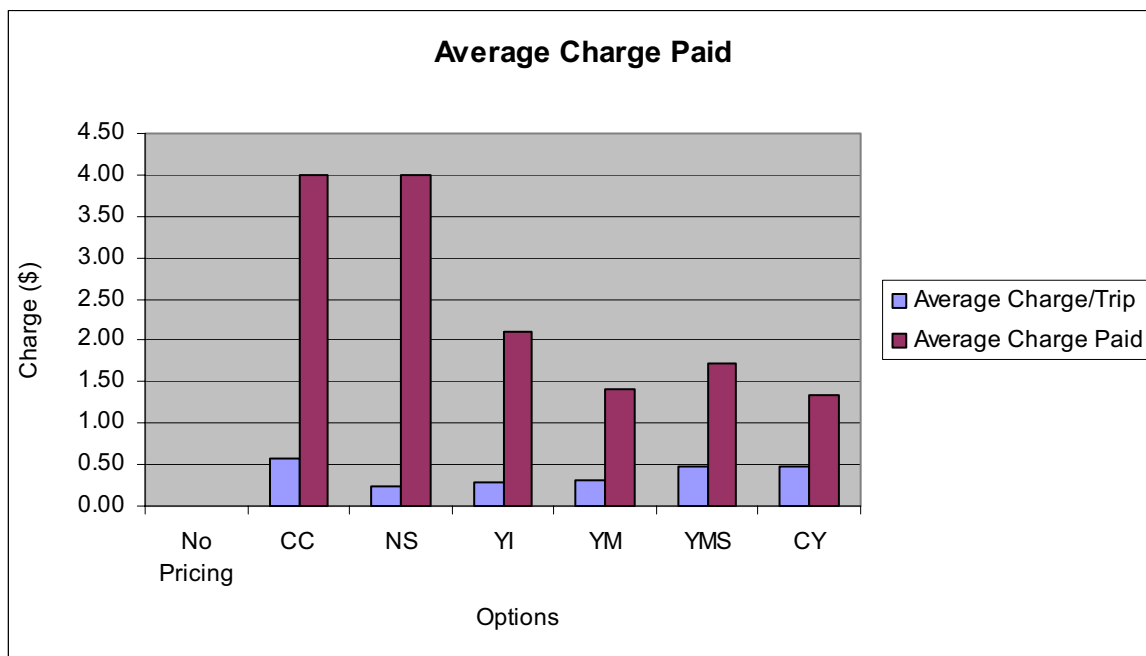
The average charge paid over all trips is low for all options, ranging between \$0.25 and \$0.60 in the AM peak, and with those options which target trips through the CBD having the highest average charges. The charges are imposed in both the AM and PM peaks. The average daily charge for private vehicles (which pay a charge) would be much less than \$1.20 in all cases because only some vehicles would get charged in both directions.

The \$4 average charge (for those trips that pay a charge) in the CC and NS options are the highest because these are flat \$4 charges for all vehicles that cross the screenlines. The other options which include charges on the Y-Screenlines have lower charges for each crossing point and spread the charges, so that some trips that cross fewer screenlines pay less.

Table 3-3: Average Charge Paid (\$)

	No Pricing	CC	NS	YI	YM	YMS	CY
AM Charges – Car							
Average Charge/Trip	0	0.56	0.25	0.30	0.32	0.49	0.49
Average Charge Paid	0	4.00	4.00	2.10	1.42	1.73	1.35
AM Charges - HCV							
Average Charge/Trip	0	0.39	0.15	0.21	0.24	0.36	0.31
Average Charge Paid	0	4.00	4.00	2.17	1.44	1.73	1.31
PM Charges - Car							
Average Charge/Trip	0	0.43	0.20	0.24	0.27	0.40	0.38
Average Charge Paid	0	4.00	4.00	2.14	1.41	1.70	1.32
PM Charges - HCV							
Average Charge/Trip	0	0.46	0.18	0.23	0.27	0.42	0.35
Average Charge Paid	0	4.00	4.00	2.16	1.43	1.76	1.32

Figure 3-2: Average Charge Paid (of those trips that pay a charge) (AM peak)



3.1.4 Assist Economic Development Summary

Table 3-4 shows the overall score for the objective Assist Economic Development.

All options are considered to have a neutral impact on economic development except the CC option which was considered to have a minor negative impact.

This is primarily based on the review of regional economic and land use impacts which indicates the overall impact will be minor. While the cost of travel and average charge analysis is useful in that it provides the relative impacts of each option, all have been scored as having no significant impact except the CC option which has been scored as having a minor negative impact due to it having higher cost of travel average charges.

We have not allowed here for the potential benefits of hypothecating /reinvesting the revenues, which would at least reduce any negative impacts of these charges and possibly outweigh them in some circumstances.

Table 3-4: Assist Economic Development Score

	No Pricing	CC	NS	YI	YM	YMS	CY
1 ECONOMIC DEVELOPMENT							
Unweighted overall assessment	0	X	0	0	0	0	0

3.2 Objective 2: Assist Safety and Personal Security

The objective Assisting Safety and Personal Security was measured in terms of:

- Road safety
- Personal security on public transport

3.2.1 Road Safety

Road safety has been measured in terms of estimated annual injury crashes. A simple crash rate model was used with different rates applied to the vehicle-kilometres of travel (VKT) (from WTSM) on motorways, urban arterials and rural arterials. This does not account for any changes in crash rates due to, speed changes, safety improvements, changes in numbers of pedestrians or cyclists, or other external factors. It is therefore considered to represent a relative measure rather than an absolute one.

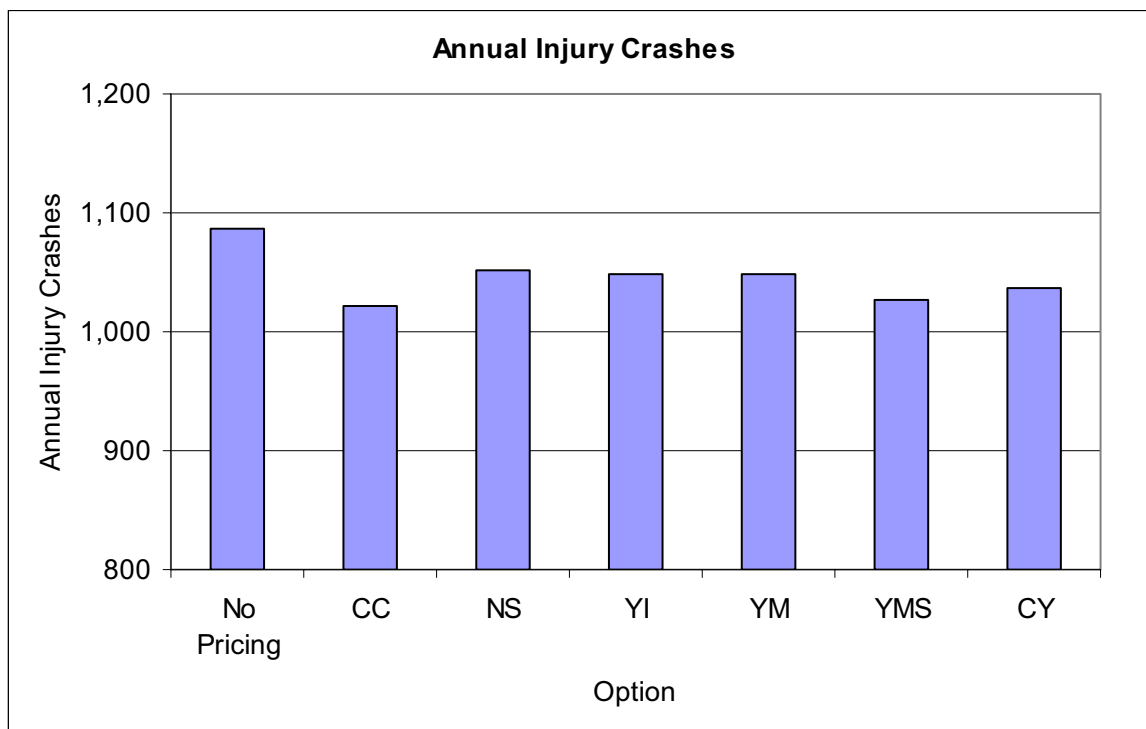
Table 3-5 gives the crash estimates for the no pricing case and the six options, along with the resulting scores, and Figure 3-3 shows the total crashes graphically (note vertical scale is between 800 and 1200 to show differences).

The data show that all options reduce the estimated crashes to some extent, though this varies between them. The reductions are due to reduced VKT. The greatest reductions (for CC, YMS and CY) were in the order of 5% which is considered a reasonably significant improvement. Hence these options have been scored as having a moderately positive effect on road safety, while the rest of the options have a minor effect.

Table 3-5: Annual Injury Crashes

	No Pricing	CC	NS	YI	YM	YMS	CY
On urban arterials	610	563	590	587	590	569	579
On rural arterials	310	304	305	309	306	305	304
On motorways	166	155	156	153	153	152	153
Total	1087	1,022	1,051	1,049	1,048	1,026	1,037
	100%	94%	97%	97%	96%	94%	95%
Annual Injury Crashes Score	0	√√	√	√	√	√√	√√

Figure 3-3: Annual Injury Crashes



3.2.2 Personal Security on Public Transport

Personal security on PT has been measured in terms of access to help as measured by the percentage increase in PT trips. This is on the basis that the more people using PT, the more passive surveillance there is, and the more people there are, to intervene or call for help during a crime.

Table 3-6 gives the number of PT trips in each of the three modelled time periods for the no pricing case and the six options, and Figure 3-4 shows the number of PT trips graphically for the AM peak.

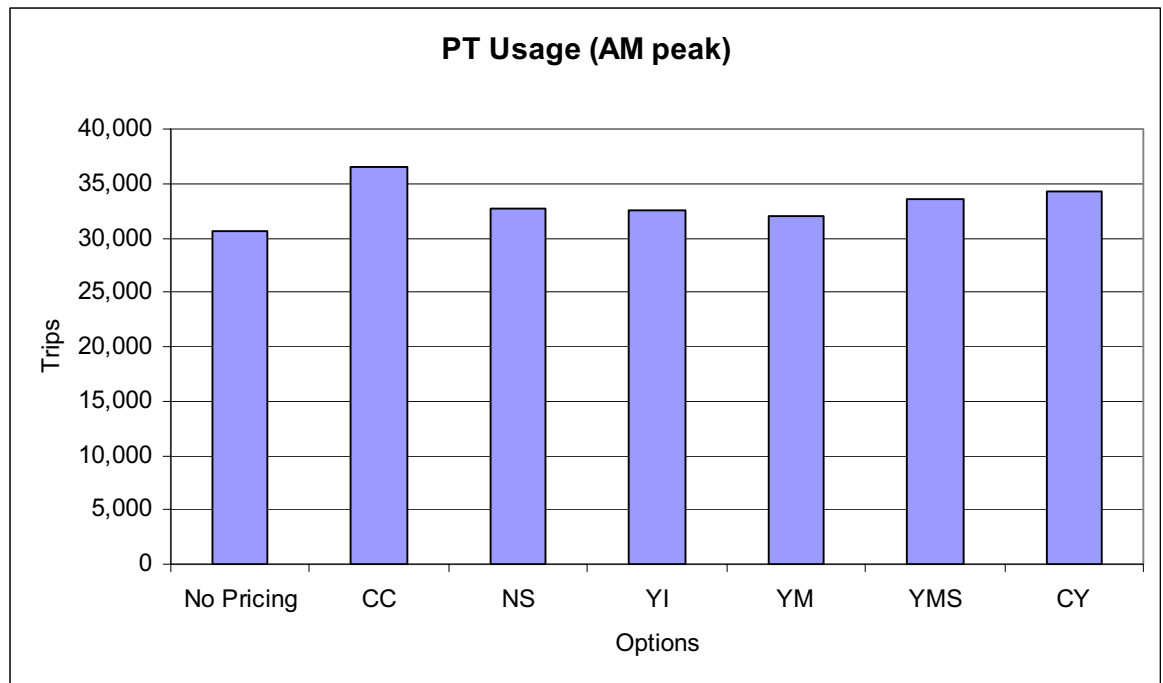
The data shows that all options increase the number of PT trips to some extent, though this varies between them. The number of PT trips increased by up to 19% for the CC option.

Those options with the higher increases in PT trips are considered to have a minor positive impact on personal security, and the remaining options to have no significant impact.

Table 3-6: No of PT Trips

	No Pricing	CC	NS	YI	YM	YMS	CY
PT AM	30,661	36,478	32,713	32,568	31,942	33,492	34,316
PT IP	10,326	11,453	10,622	10,597	10,506	10,830	10,980
PT PM	26,283	31,644	28,036	27,903	27,366	28,800	29,558
Personal Security Score	0	√	0	0	0	√	√

Figure 3-4: No of PT Trips (AM peak)



3.2.3 Assist Safety and Personal Security Summary

Table 3-7 shows the overall score for the objective Assist Safety and Personal Security, where each of the measures has been given equal weighting.

All options have a positive effect on Safety and Personal Security, more so for those schemes with a full or part Wellington CBD Cordon.

Table 3-7: Assist Safety and Personal Security Score

2 SAFETY & PERSONAL SECURITY	No Pricing	CC	NS	YI	YM	YMS	CY
Annual Injury Crashes Score	0	√√	√	√	√	√√	√√
Personal Security Score	0	√	0	0	0	√	√
Overall assessment (equal weights)	0	√+	0+	0+	0+	√+	√+

3.3 Objective 3: Improve Access, Mobility & Network Reliability

The following measures were used in the evaluation of the objective Improve Access, Mobility & Network Reliability, and are discussed in turn:

- The impacts on travel
- Travel times
- Vehicle speeds
- Level of congestion and network reliability
- Distribution of charges

3.3.1 The Impact on Travel

The impact on travel was measured in terms of: person-kilometres of travel by private vehicle, PT and HCV. Table 3-8 gives the person-kilometres of travel by private vehicle, PT, and HCV, and Figure 3-5 presents this for the AM peak period.

Where there was more person-km of travel made there was assumed to be a positive impact on access and mobility because people are able to travel where they want to travel. A reduction was therefore seen as a negative impact on travel because people's mobility is restricted.

All options have a negative impact on travel, in that the sum of person-kilometres is less than in the no pricing case. Private vehicle person-kilometres are reduced by up to 7.9% in the AM peak (CC option), and for person-kilometres this is 4.3% (YMS option). There are small increases in person-kilometres in the non-charged Interpeak period up to 2.1%.

The change in HCV person-kilometres is due to changes in routes taken as, in the model, the number of HCV trips and their distribution (i.e. the HCV trip matrix) remains the same.

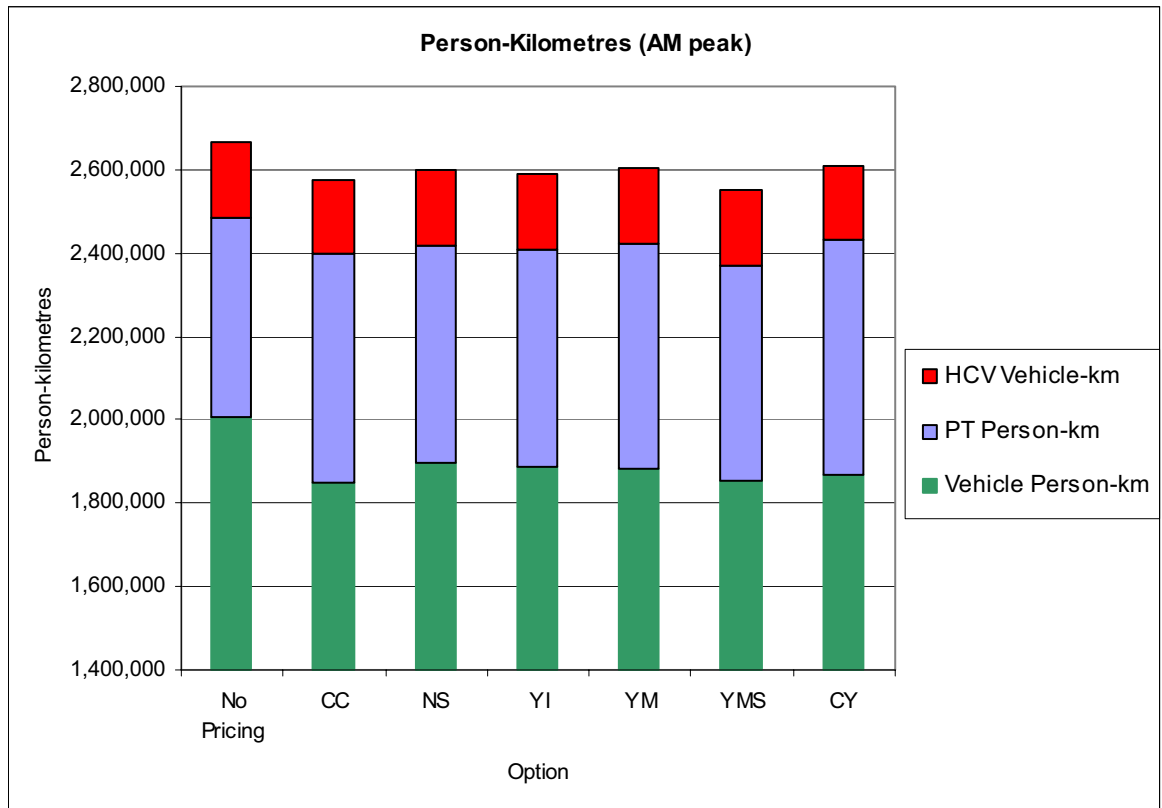
The person-kilometres by passenger transport increases over the no pricing case with all options in both the AM peak and the Interpeak, the greatest being with the CY option.

Table 3-8 includes the resulting scores for the measure impact on travel. All options have a negative impact on travel; the options with the Wellington CBD Cordon, alone and with the Y-Screenlines, have been judged to have a moderately negative impact, while the rest have a minor impact.

Table 3-8: Person-kilometres of Travel

	No Pricing	CC	NS	YI	YM	YMS	CY
Vehicle Person-km							
AM	2,007,031	1,848,187	1,897,666	1,889,118	1,882,829	1,851,956	1,867,285
IP	216,931	216,963	217,071	217,169	217,216	217,139	217,151
PM	2,309,089	2,138,935	2,179,526	2,165,131	2,161,107	2,132,302	2,150,893
PT Person-km							
AM	476,925	549,235	521,379	520,681	539,514	519,710	564,541
IP	127,893	141,053	134,252	134,146	132,164	134,737	136,989
HCV Vehicle-km							
AM	180,890	179,283	179,399	179,467	179,537	179,274	179,371
IP	191,206	189,497	189,526	189,523	189,543	189,517	189,528
PM	168,649	167,151	167,259	167,322	167,388	167,142	167,233
Impact on Travel Score	0	XX	X	X	X	XX	X

Figure 3-5: Person-kilometres of Travel (AM peak)



3.3.2 Travel Times

Vehicle travel times were measured using vehicle travel times on key routes for this criteria.

All options improve the travel times on the key routes considered (Table 3-9 and Figure 3-6):

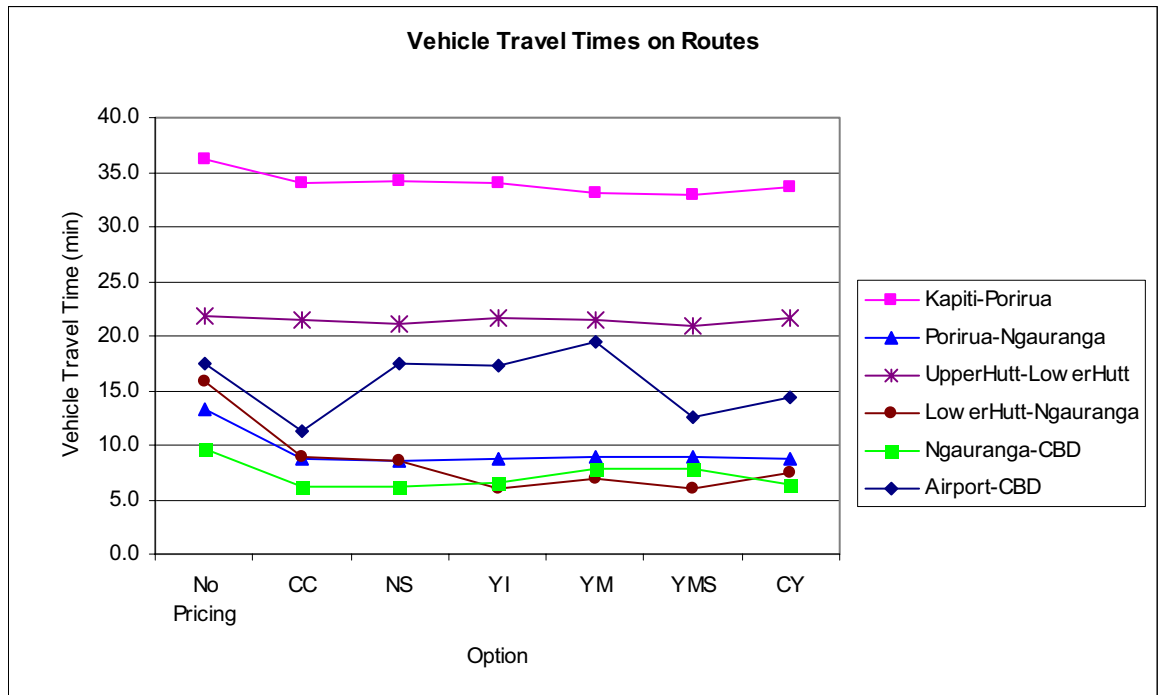
- All options reduce travel times between Porirua and Ngauranga in the order of 35%
- All options reduce travel times between Lower Hutt and Ngauranga between 43 and 62% with options which included charges on the Y (YI, YM, YMS and CY) being most effective
- All options reduce travel times between Ngauranga and the CBD between 18 and 36%, with options including charges at the Ngauranga Screenline and the CBD cordon being the most effective
- Travel times between the Airport and the CBD are reduced by between 17 and 35% for the options which included charges at the CBD cordon or the southern screenline (CC, YMS and CY). Other options did not significantly address travel times on this route
- In the contra-peak direction, where generally there are not congestion issues, the only route to be significantly impacted was between Ngauranga and Lower Hutt, which is where counterpeak charges were imposed at Petone by the Y options

Table 3-9 includes the resulting scores for the measure, all of which are positive. The options with the Wellington CBD Cordon included in part of whole have been scored the highest, much of which was due to improvement on the Airport-Wellington CBD route. The improvement in travel times in these options was considered to be a significant impact, while the remainder of the options have a moderate positive impact.

Table 3-9: Vehicle Travel Times on Routes (AM peak) (min)

Towards CBD	No Pricing	CC	NS	YI	YM	YMS	CY
Kapiti-Porirua	36.2	34.1	34.2	34.0	33.0	32.8	33.6
Porirua-Ngauranga	13.3	8.7	8.6	8.7	8.8	8.8	8.8
Masterton-Upper Hutt	58.2	58.2	58.2	58.2	58.2	58.2	58.2
Upper Hutt-Lower Hutt	21.8	21.4	21.1	21.6	21.5	20.9	21.7
Lower Hutt-Ngauranga	15.8	9.0	8.5	6.1	6.9	6.1	7.4
Ngauranga-CBD	9.6	6.2	6.2	6.5	7.8	7.8	6.4
Airport-CBD	17.5	11.4	17.5	17.3	19.5	12.5	14.4
Away from CBD							
Porirua-Kapiti	31.5	31.4	31.4	31.4	31.2	31.2	31.3
Ngauranga-Porirua	8.4	8.4	8.4	8.3	8.3	8.3	8.4
Upper Hutt-Masterton	61.4	61.4	61.5	61.4	61.3	61.4	61.4
Lower Hutt-Upper Hutt	21.0	20.7	20.7	20.9	20.5	20.6	20.6
Ngauranga-Lower Hutt	7.3	6.6	7.2	5.5	5.6	5.4	7.4
CBD-Ngauranga	4.6	4.6	4.6	4.6	4.6	4.6	4.6
CBD-Airport	13.5	12.2	13.1	13.2	13.3	12.7	12.8
Inbound average	24.6	21.3	22.1	21.8	22.3	21.0	21.5
	100%	86%	90%	88%	90%	85%	87%
Travel Times on Routes Score	0	√√√	√√	√√	√√	√√√	√√√

Figure 3-6: Vehicle Travel Times on Routes (AM peak)



3.3.3 Vehicle Speeds

The criteria of vehicle speeds was measured using average vehicle speeds.

Average speeds by private vehicle (Table 3-10 and Figure 3-7) increase by 5-10% over the whole network; the greatest improvements being for the CC, YMS and CY options which charge trips between the south and east and the Wellington CBD (note vertical scale in the figure is between 40 and 46 kph to show differences). The average PT speeds (which are weighted by the trips made by each mode) increase very slightly over the no pricing case due to improved bus speeds on the roads.

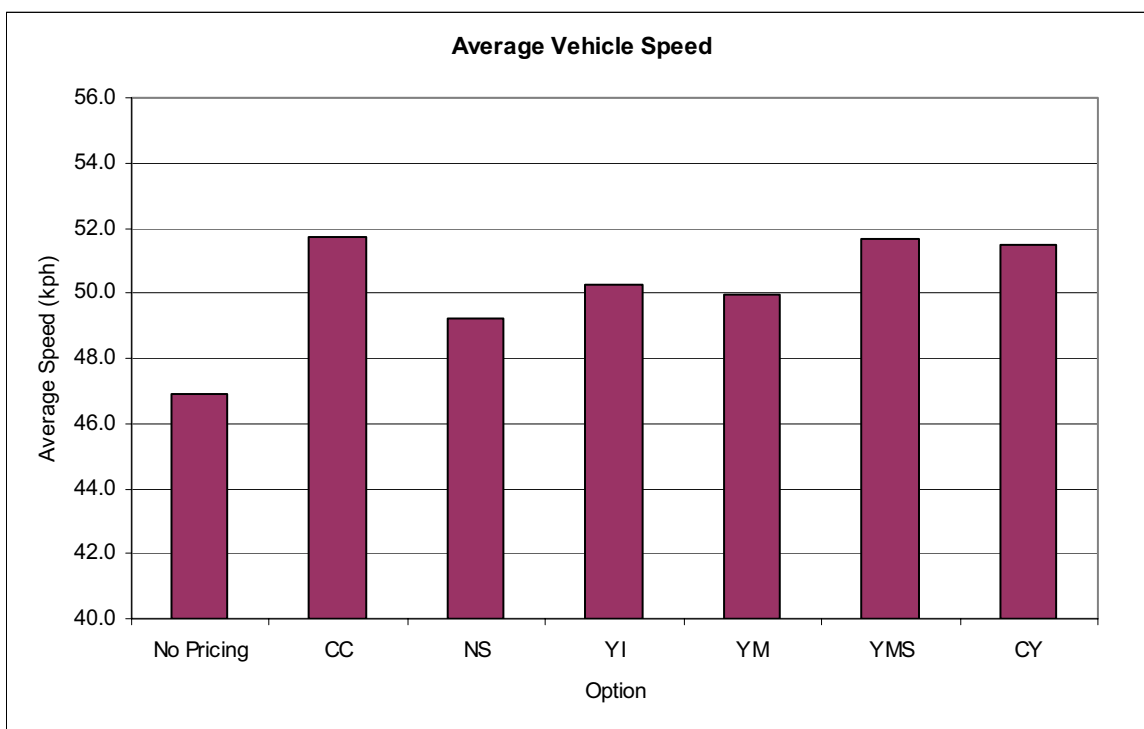
This clearly shows that road pricing in Wellington would significantly increase average vehicle speeds. Localised impacts would be quite substantial given that this is a network wide average.

Table 3-10 includes the resulting scores for the measure. The options with all or part of the Wellington CBD Cordon included in them (CC, YMS, CY) are considered to have, on average, a significant positive impact on vehicle speeds, and the rest of the options a moderate impact.

Table 3-10: Average Private Vehicle Speed (AM peak) (kph)

	No Pricing	CC	NS	YI	YM	YMS	CY
Average Vehicle Speed	46.9	51.8	49.2	50.3	50.0	51.6	51.5
	100%	110%	105%	107%	107%	110%	110%
Average Speed Score	0	√√√	√√	√√	√√	√√√	√√√

Figure 3-7: Average Private Vehicle Speed (AM peak)



3.3.4 Level of Congestion and Network Reliability

The level of congestion and network reliability was measured using:

- the level of congested VKT, where congested is defined as $V/C > 0.8$, and
- V/C at identified bottlenecks

All options have a positive impact on the level of congestion by reducing the amount of congested VKT (Table 3-11 and Figure 3-8). All options reduce congested VKT significantly in the AM peak, between 30 and 43%.

Table 3-11 includes the resulting scores for the measure. Because the options performed equally well and had a significant impact all were scored at the highest level.

Table 3-11: Congested VKT (000 km)

	No Pricing	CC	NS	YI	YM	YMS	CY
AM	318,705	220,315	222,565	180,899	216,113	193,257	215,852
IP	37,274	35,104	36,974	37,345	37,022	36,333	36,242
PM	338,324	227,867	234,663	226,525	227,811	216,439	231,515
AM %	100%	69%	70%	57%	68%	61%	68%
VKT with V/C > 0.8 Score	0	√√√	√√√	√√√	√√√	√√√	√√√

Figure 3-8: Congested VKT (AM and PM peak)

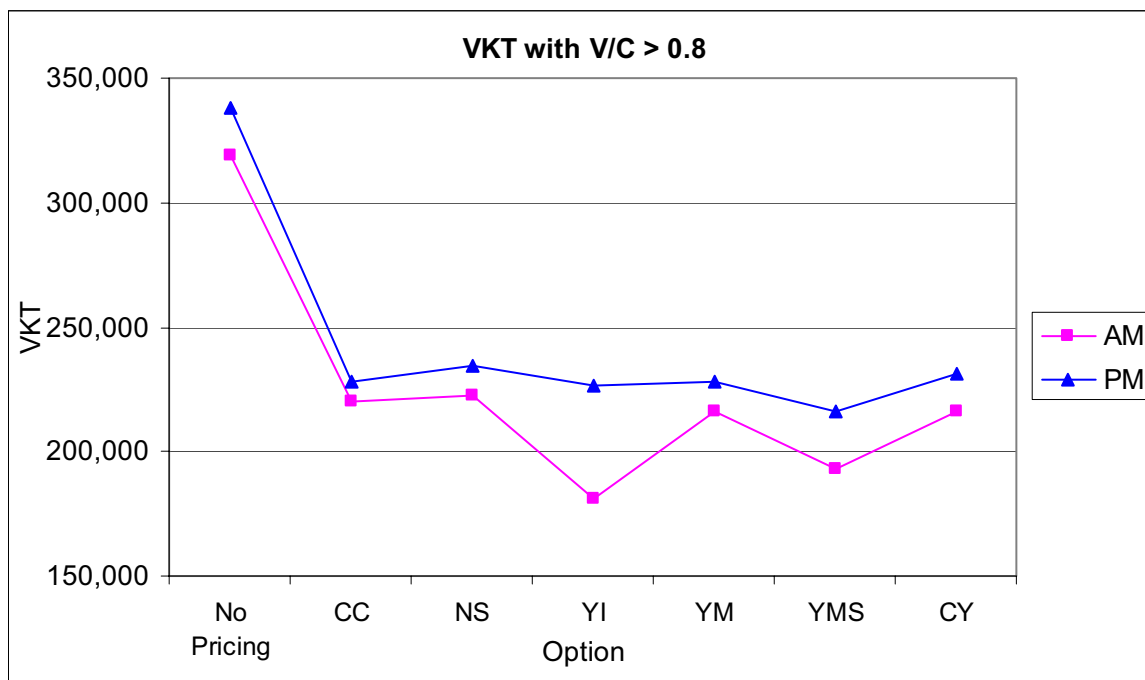


Table 3-12 gives the volume to capacity ratio at selected existing congestion bottlenecks in the morning peak and highlights the number of bottlenecks where the V/C < 1. Figure 3-9 shows the volume to capacity ratio at identified bottlenecks for each option graphically.

The options generally improve the network performance at these bottlenecks, but this varies between the sites and the options as follows:

- Congestion through the Mt Victoria Tunnel was only addressed by those options which included a Wellington CBD Cordon or Southern Screenline which charged trips between the south and east and the Wellington CBD. (CC, YMS and CY).
- Congestion at the Terrace Tunnel and on SH2 north of the SH1/SH2 merge at Ngauranga was affected by all options reducing the V/C ratios slightly to approximately 1.
- Congestion on SH1 immediately south of the SH1/SH2 merge at Ngauranga was most affected by options with charges focused closest to the Wellington CBD (CC, NS, YI and CY), which reduced V/C ratios down towards 0.9.
- Congestion on SH1 north of the SH1/SH2 merge at Ngauranga is reduced significantly by all options. The NS option reduced V/C ratios the most down to approximately 0.8 which suggests that parts of the network may not be used as efficiently as they might at this charging level.
- Congestion on SH2 near Petone was reduced by all options, but most significantly by the Y-options which included a charge in this location.
- Congestion on SH2 between Upper and Lower Hutts was largely unaffected by the Wellington CBD and Ngauranga Screenline options. The Y options reduced this to a V/C ratio of approximately 1 which included a charge at this location.

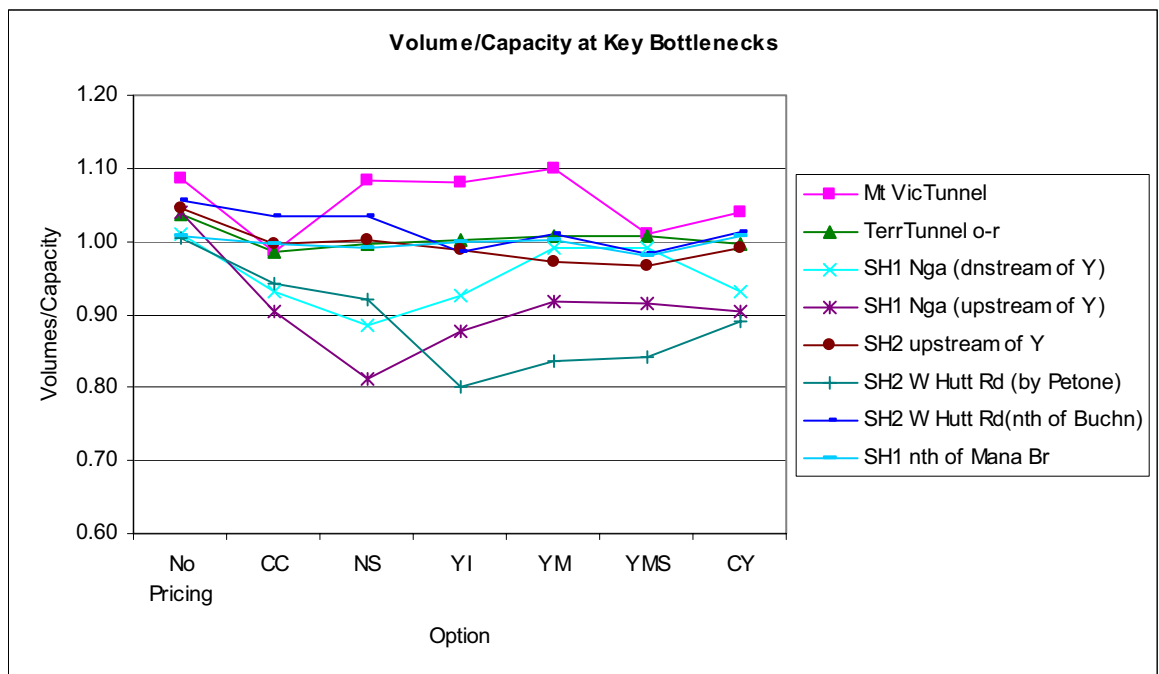
In summary, the YMS option has the lowest average V/C ratio for the bottlenecks highlighted and the greatest number of sites with $V/C < 1$ (6 of the 8 sites). The other options perform to a similar level overall.

Table 3-12 includes the resulting scores for the measure. The option with the Y and south of Wellington CBD screenlines was scored ahead of the other options, and was judged to have a significant impact on the V/C ratios – the rest have a moderate impact.

Table 3-12: Volume/Capacity at Bottlenecks (AM peak)

	No Pricing	CC	NS	YI	YM	YMS	CY
Mt Victoria Tunnel	1.08	0.98	1.08	1.08	1.10	1.01	1.04
Terrace Tunnel off-ramp	1.04	0.98	1.00	1.00	1.01	1.01	1.00
SH1 Ngauranga (downstream of Y)	1.01	0.93	0.88	0.93	0.99	0.99	0.93
SH1 Ngauranga (upstream of Y)	1.04	0.90	0.81	0.88	0.92	0.91	0.90
SH2 upstream of Y	1.05	1.00	1.00	0.99	0.97	0.97	0.99
SH2 Western Hutt Rd (by Petone)	1.00	0.94	0.92	0.80	0.84	0.84	0.89
SH2 Western Hutt Rd(north of Buchanan)	1.06	1.03	1.04	0.98	1.01	0.98	1.01
SH1 north of Mana Bridge	1.01	1.00	0.99	1.00	1.00	0.98	1.01
Average	1.04	0.97	0.97	0.96	0.98	0.96	0.97
No. <1	0	5	4	5	4	6	4
Average v/c at key bottlenecks Score	0	√√	√√	√√	√√	√√√	√√

Figure 3-9: Volume/Capacity at Bottlenecks (AM peak)



3.3.5 Distribution of Charges

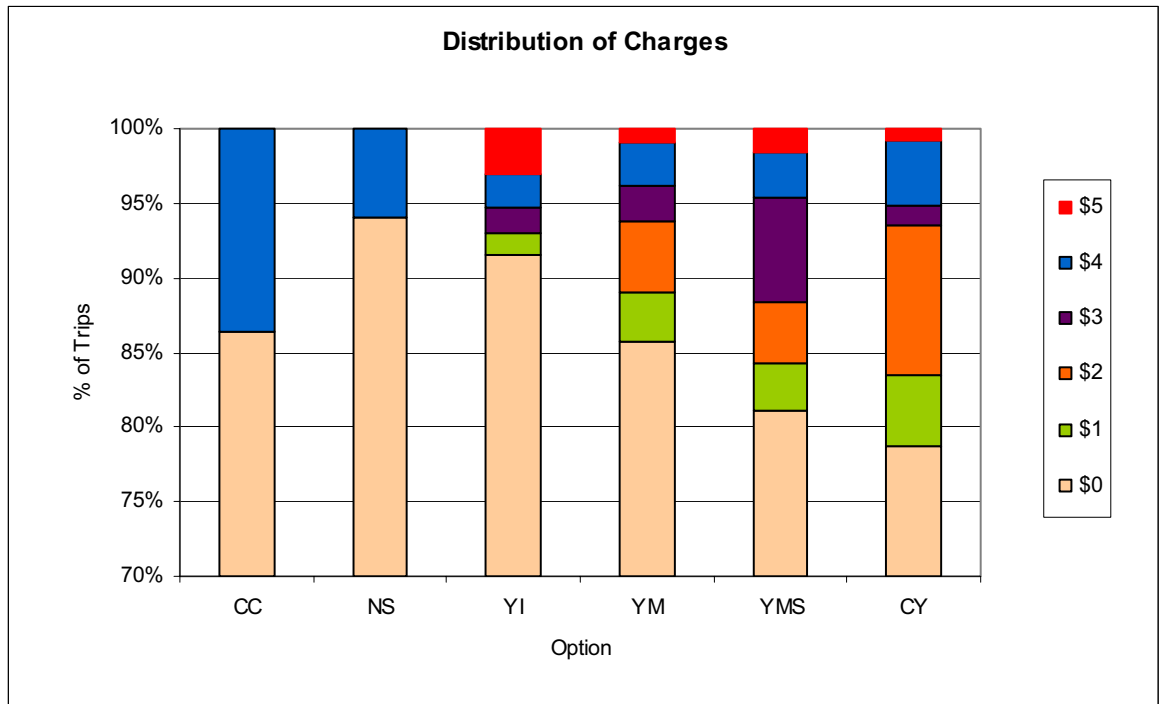
Table 3-13 and Figure 3-10 show the distribution of charges paid. This is the percentage of all vehicle trips that pay different charge levels, including zero charge. Note that the majority of trips on the network do not incur any charge. The vertical scale in Figure 3-10 does not begin at zero in order to show the differences between the options.

In the scoring (Table 3-13) evaluation, a wider distribution of charges and lower charges were considered better than a narrow one and higher charges. This was because it was considered a negative impact to have a small group of people paying high charges reducing their mobility and more equitable to have the charges spread. For the Wellington CBD Cordon option all trips paying charges pay the same relatively high amount and the percentage of people paying is relatively high, so it was scored as having a significantly negative impact. The remainder of the options were considered to have a lower negative impact.

Table 3-13: Distribution of Charges (AM peak)

	No Pricing	CC	NS	YI	YM	YMS	CY
\$0	100%	86%	94%	92%	86%	81%	79%
\$1	0%	0%	0%	1%	3%	3%	5%
\$2	0%	0%	0%	0%	5%	4%	10%
\$3	0%	0%	0%	2%	2%	7%	1%
\$4	0%	14%	6%	2%	3%	3%	4%
\$5	0%	0%	0%	3%	1%	2%	1%
Distribution of Charges Score	0	XX	X	X	X	X	X

Figure 3-10: Distribution of Charges (AM peak)



3.3.6 Improve Access, Mobility & Network Reliability Summary

Table 3-14 shows the overall score for the objective Improve Access, Mobility & Network Reliability, where each of the measures has been given equal weighting.

An examination of the criteria used to measure access, mobility and network reliability was undertaken. It is recognised that the mobility barrier created by having to pay a charge is directly measured by the impact on travel and therefore the criteria average charge paid and distribution of charges were not included in the overall evaluation.

Table 3-14 presents the overall evaluation of this objective. The key reason for introducing road pricing is reduce congestion by managing the demand for travel. Table 3-14 demonstrates that road pricing in Wellington has the potential to be very effective in this area. However, road pricing may reduce mobility for some people as the total amount of travel is reduced. Investing the surplus revenues generated by road pricing in efficient transport schemes will further improve travel conditions on the road network and reduce the impact of charges pricing people off the road network.

Table 3-14: Improve Access, Mobility & Network Reliability Score

3 ACCESS, MOBILITY & NETWORK RELIABILITY	No Pricing	CC	NS	YI	YM	YMS	CY
Impact on Travel Score	0	XX	X	X	X	XX	X
Travel Times on Routes Score	0	√√√	√√	√√	√√	√√√	√√√
Average Speed Score	0	√√√	√√	√√	√√	√√√	√√√
VKT with V/C > 0.8 Score	0	√√√	√√√	√√√	√√√	√√√	√√√
Average v/c at key bottlenecks Score	0	√√	√√	√√	√√	√√√	√√
Distribution of Charges Score	0	XX	X	X	X	X	X
Unweighted overall assessment	0	√	√	√	√	√+	√+

3.4 Objective 4: Protect and Promote Public Health

The objective of Protecting and Promoting Public Health was measured in three ways:

- Effects on air quality, and
- Effects of noise and emissions on people, and
- Amount of active travel (walking and cycling)

3.4.1 Effects on Air Quality

Estimates of vehicle emissions, nitrous oxides (NO_x), particulates, and volatile organic compounds (VOC), for the whole of the modelled area have been used to assess the effects on air quality. The data was produced on a network wide basis to give an overall indicator of performance and is therefore appropriate for a region wide strategic study. It should be recognised that it does not relate to emissions guidelines, take account of dispersion effects, consider the effect on people or localised effects.

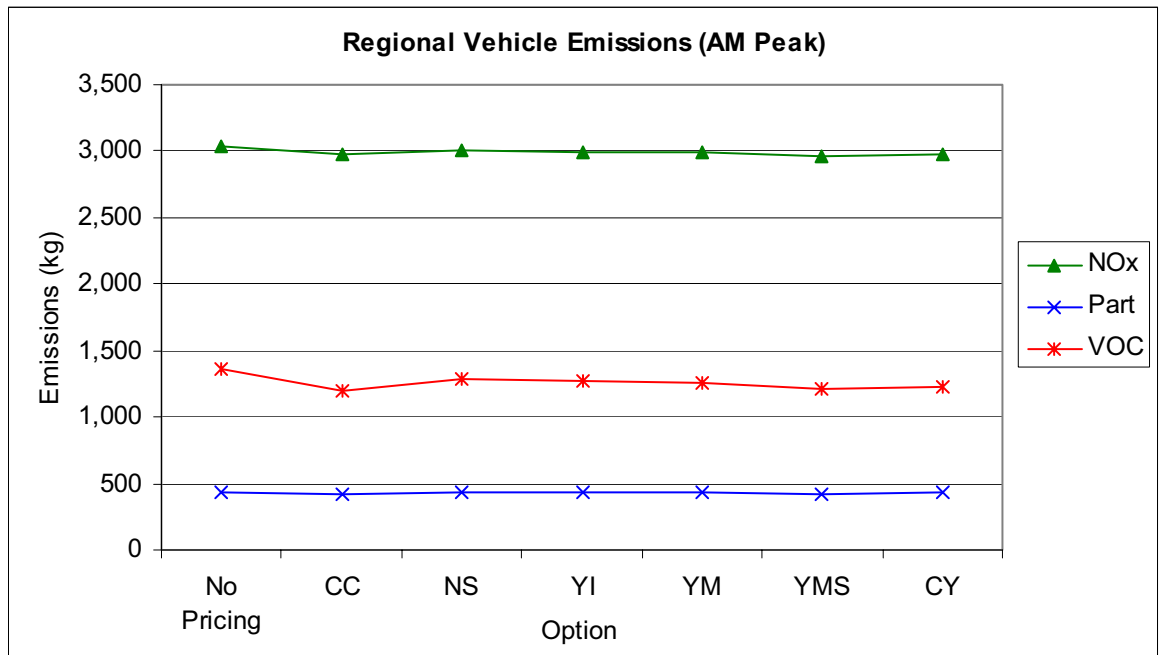
The vehicle emissions have been estimated with the same procedures and emissions factors used in the Western Corridor Study as provided by GWRC. Table 3-15 gives the estimate of the three emissions for each of the modelled time periods and Figure 3-11 shows those for the AM peak period.

Table 3-15 includes the resulting scores for the indicator vehicle emissions. The lower the emissions, the higher the score. All options reduce vehicle emissions to some extent, with VOC reduced by around 10% for all options in the AM peak. Hence all have been scored as having a minor effect, taking into account the global and simplified nature of the measure.

Table 3-15: Vehicle Emissions (kg)

	No Pricing	CC	NS	YI	YM	YMS	CY
AM							
NOx	3,037	2,970	3,001	2,997	2,989	2,969	2,979
Part	432	426	429	429	428	426	427
VOC	1,361	1,203	1,285	1,276	1,256	1,218	1,227
	100%	88%	94%	94%	92%	89%	90%
IP							
NOx	2,945	2,934	2,942	2,942	2,941	2,937	2,939
Part	437	436	437	437	437	436	437
VOC	948	929	942	943	944	933	936
	100%	98%	99%	99%	100%	98%	99%
PM							
NOx	2,971	2,914	2,932	2,925	2,920	2,903	2,920
Part	415	410	412	411	410	409	411
VOC	1,484	1,345	1,408	1,383	1,374	1,338	1,368
	100%	91%	95%	93%	93%	90%	92%
Regional Emissions Score	0	√	√	√	√	√	√

Figure 3-11: Vehicle Emissions (AM Peak)



3.4.2 Effects of Noise and Emissions on People

The second criteria for this objective is the impact of noise and emissions on people which has been measured by the sum of traffic volumes on approximately 100 selected links in residential areas. This makes the simple assumption that traffic volumes and these impacts are directly related and ignores localised spatial effects and the effects of individual vehicles.

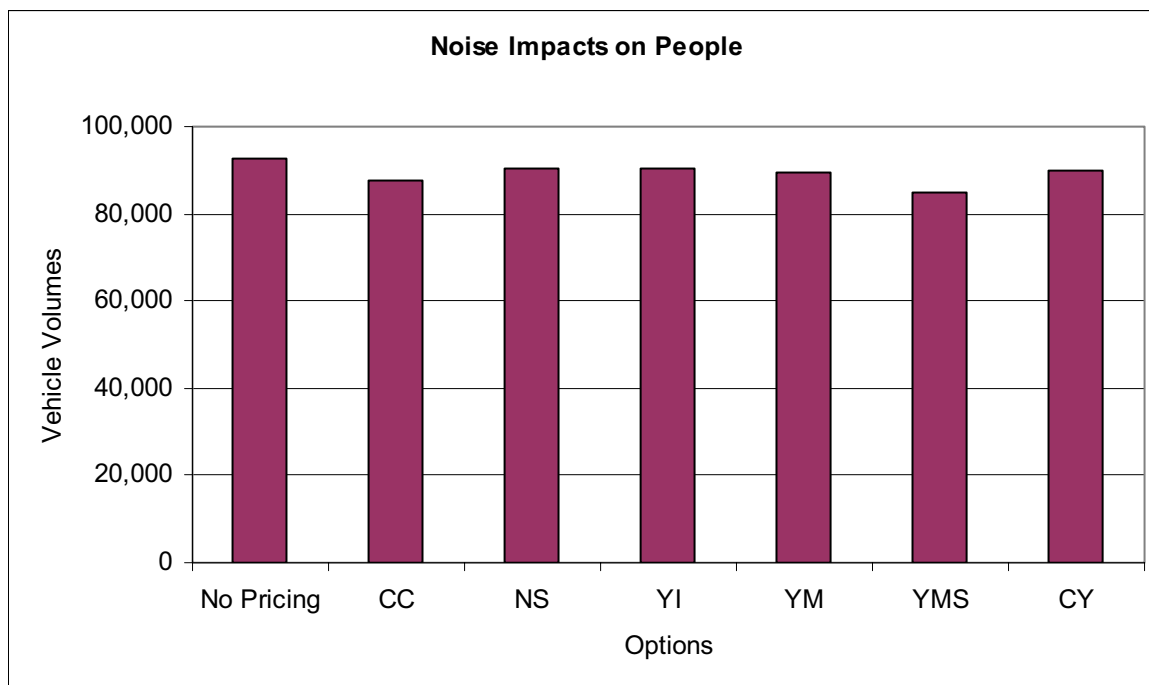
The traffic volumes are given in Table 3-16 along with the resulting scores and the volumes are shown graphically in Figure 3-12. All options show a reduction in traffic volume and hence reduced noise and emission impacts on people. These reductions will be slight in real terms, especially given the logarithmic variation in noise with distance.

All options, bar one, perform similarly - only the YMS option shows more reduction than the others. Accordingly this option has been scored the highest (considered to have a small positive impact) while the rest were considered to not be materially different from the no-pricing case.

Table 3-16: Impact of Noise and Emissions on People (VKT)

	No Pricing	CC	NS	YI	YM	YMS	CY
Traffic volumes on selected links	92,443	87,664	90,264	90,206	89,319	84,937	90,116
	100%	95%	98%	98%	97%	92%	97%
Noise and Emission Impacts	0	0	0	0	0	√	0

Figure 3-12: Impact of Noise and Emissions on People



3.4.3 Amount of Active Travel

The number of trips made by active modes (walking and cycling) has been used as a measure of the amount of active travel, which has public health benefits. Passenger transport (PT) usage is one measure of the amount of active travel in the region because there is often a walking component of the trip between the PT stop / station and the origin / destination. Active travel and PT trips are given in Table 3-17 and active mode trips are shown graphically in Figure 3-13.

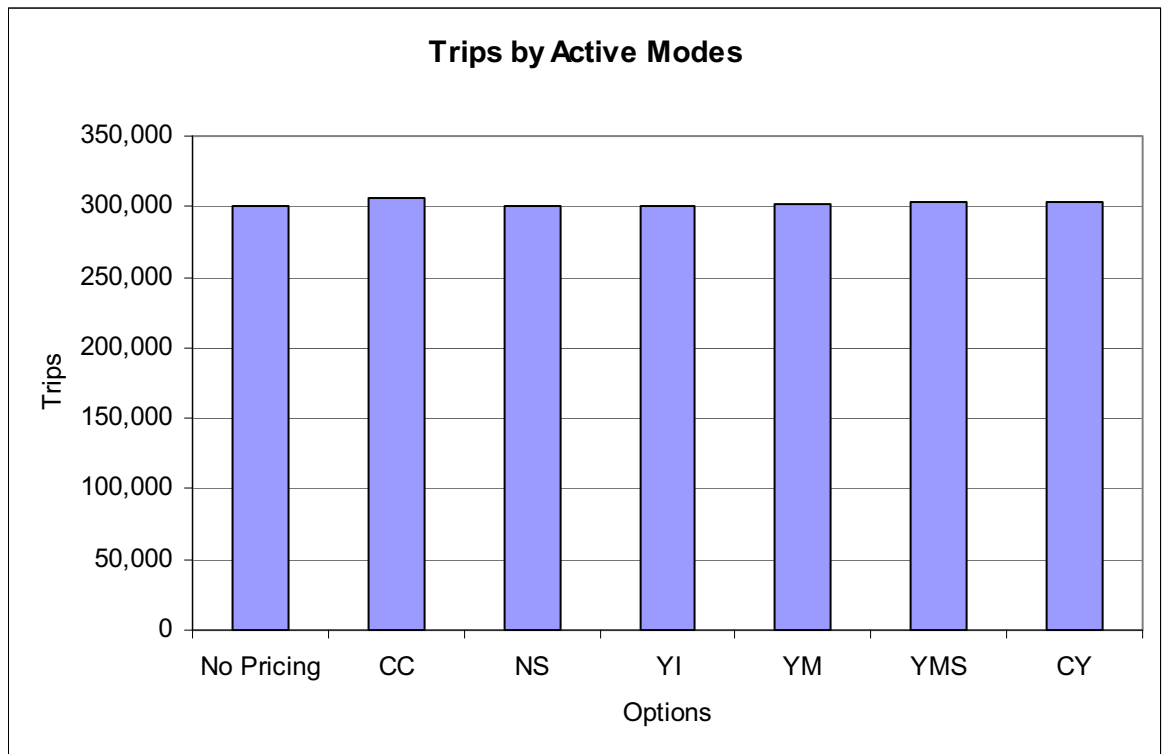
All options show increased PT usage and more active travel, though these are slight in the regional context. All options show similar increases though that for the CC option is slightly greater.

Table 3-17 includes the resulting scores; all but the CC option, were considered to be not materially different from the no-pricing case. The CC option was scored as having a small positive impact on the amount of active travel because of the level of increase in PT. This is understandable as this option imposes a high charge on even short trips and significant residential populations live within walking distance of the Wellington CBD which also has the best PT access in the region.

Table 3-17: Amount of Active Travel

	No Pricing	CC	NS	YI	YM	YMS	CY
Walk and cycle	300,292	305,564	301,090	301,085	301,285	303,455	303,268
PT AM	30,661	36,478	32,713	32,568	31,942	33,492	34,316
PT IP	10,326	11,453	10,622	10,597	10,506	10,830	10,980
PT PM	26,283	31,644	28,036	27,903	27,366	28,800	29,558
Trips by active modes Scores	0	√	0	0	0	0	0

Figure 3-13: Amount of Active Travel



3.4.4 Protect and Promote Public Health Summary

Table 3-18 shows the overall scores for the objective Protect and Promote Public Health, where each of the measures has been given equal weighting. From this all options have a slight positive impact on public health.

Table 3-18: Protect and Promote Public Health Score

4 PUBLIC HEALTH	No Pricing	CC	NS	YI	YM	YMS	CY
Regional Emissions Score	0	√	√	√	√	√	√
Noise Impacts	0	0	0	0	0	√	0
Trips by active modes	0	√	0	0	0	0	0
Overall assessment (equal weights)	0	0+	0+	0+	0+	0+	0+

3.5 Objective 5: Ensure Environmental Sustainability

The objective Ensuring Environmental Sustainability was measured in terms of:

- Effects on sensitive receiving environments
- Greenhouse gas emissions
- Fossil fuel use

3.5.1 Effects on Sensitive Receiving Environments

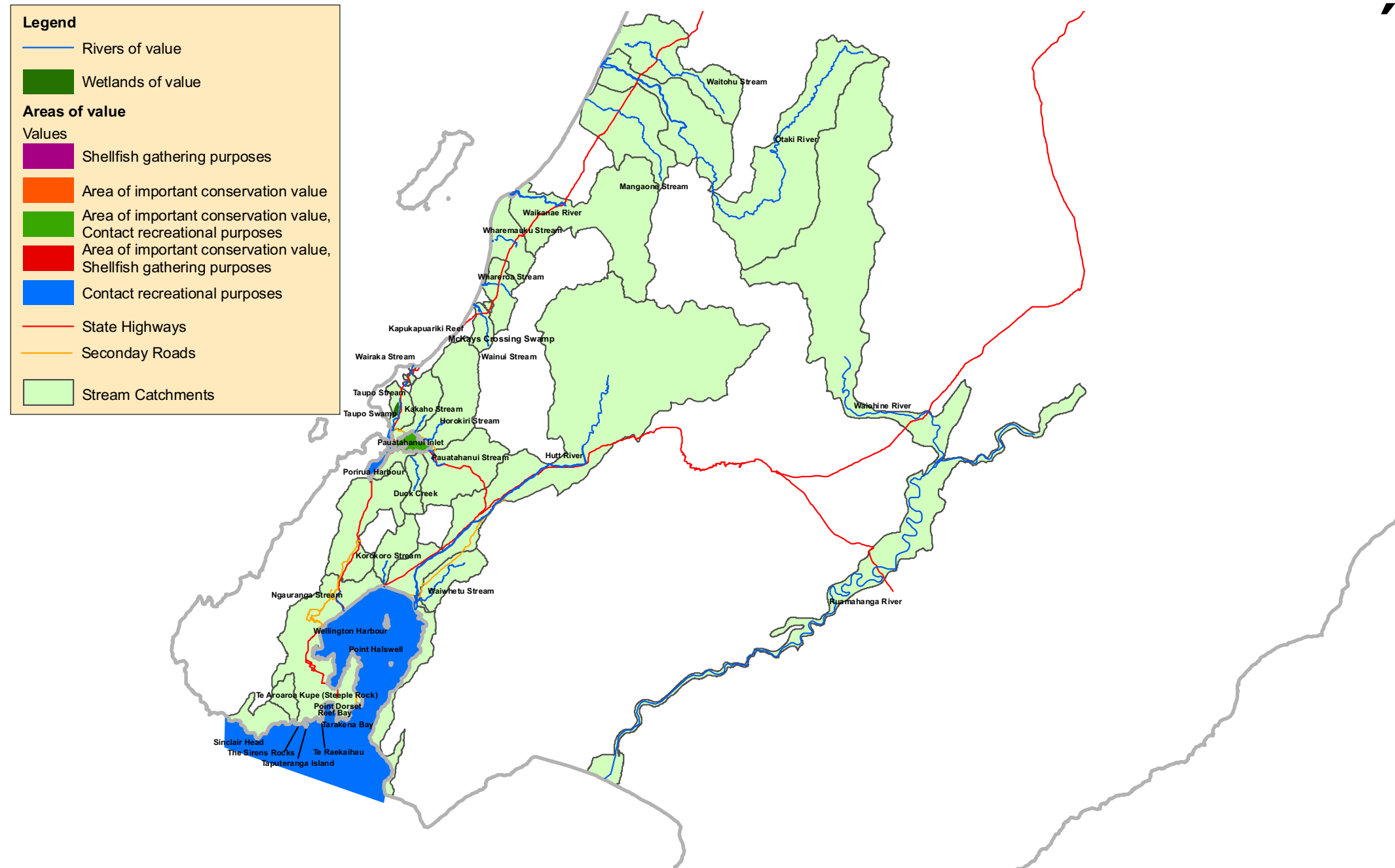
An initial review of water receiving environments was undertaken to identify locations in the region where traffic volumes could have a large impact on water quality and the associated environment. The environments identified included:

- Shellfish gathering areas,
- Areas of important conservation value, and
- Contact recreation areas.

Figure 3-14 shows the sensitive receiving environments identified.



Figure 3-14: Sensitive Receiving Environments





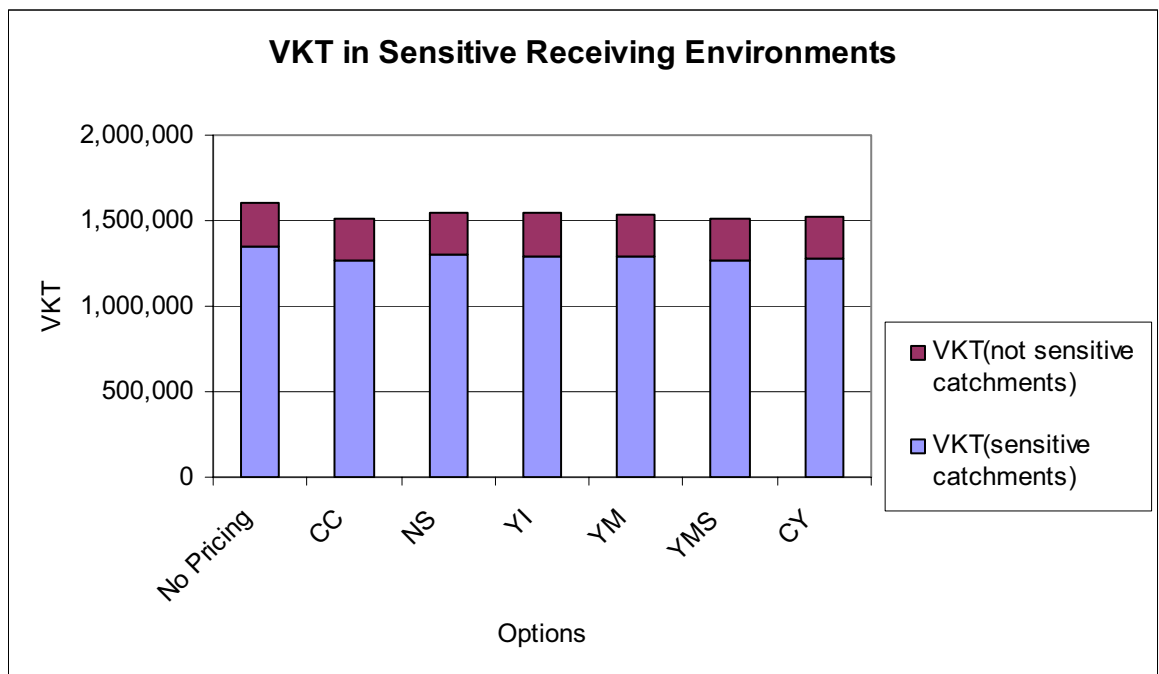
The water catchments for these areas were then identified and the modelled VKT within these catchments extracted. Table 3-19 and Figure 3-15 show these for the AM peak period. Because of the nature of the topography of Wellington, the majority of VKT actually occurs in the catchments of sensitive receiving environments.

All options reduce VKT to some extent with reductions up to 7%. Table 3-19 includes the resulting scores. Because the reductions are relatively small and the impact of these will only have a marginal impact on water quality, the options have been scored as having a small positive impact.

Table 3-19: VKT in Sensitive Receiving Environments

	No Pricing	CC	NS	YI	YM	YMS	CY
VKT(not sensitive catchments)	251,825	249,143	250,700	250,295	249,926	249,307	249,777
VKT(sensitive catchments)	1,354,303	1,262,133	1,299,890	1,293,120	1,288,746	1,264,877	1,275,670
	100%	93%	96%	95%	95%	93%	94%
VKT (sens catchments) Score	0	√	√	√	√	√	√

Figure 3-15: VKT in Sensitive Receiving Environments



3.5.2 Greenhouse Gas Emissions

Greenhouse gas emissions have been measured using estimates of carbon dioxide (CO₂) emissions extracted from WTSM. The estimates of daily CO₂ emissions are given in Table 3-20 and shown graphically in Figure 3-16 (note that the vertical scale is between 2 and 3 million in order to show the differences between the options).

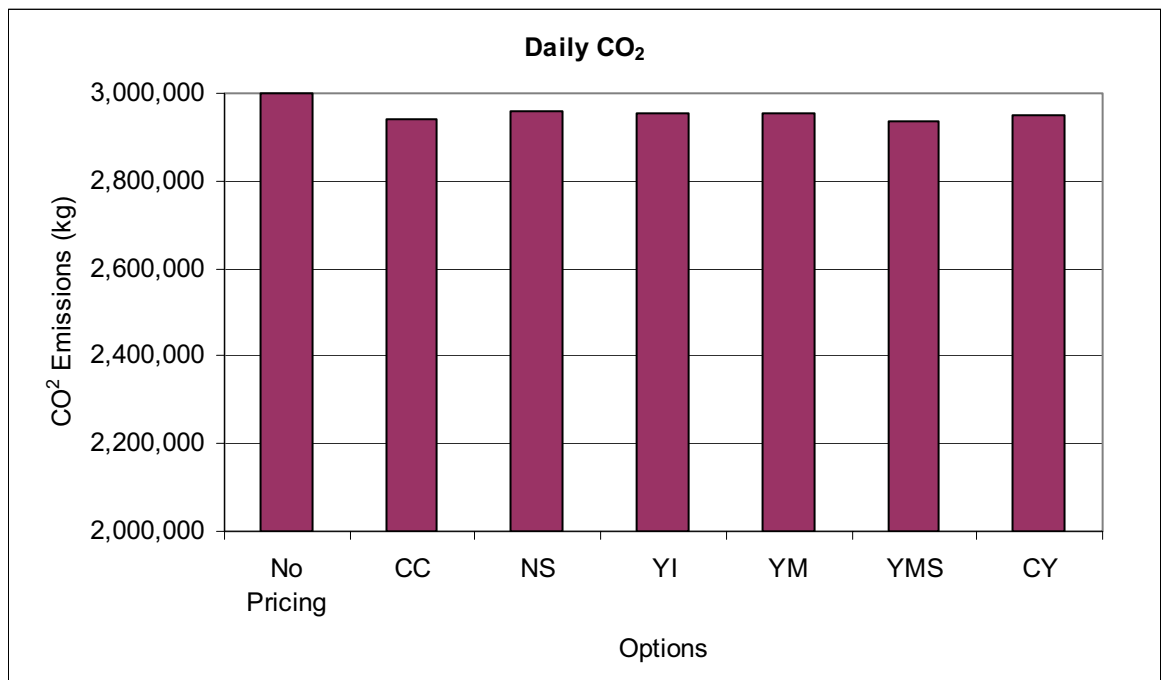
All options have reduced CO₂ emissions compared with the no pricing case by up to 2%.

In the scoring (Table 3-20) all options were considered to have no significant impact on greenhouse gas emissions compared with no pricing as the change in total VKT is small.

Table 3-20: Emissions of Carbon Dioxide (kg)

	No Pricing	CC	NS	YI	YM	YMS	CY
Daily CO ₂	2,997,808	2,938,956	2,960,563	2,955,543	2,953,132	2,936,147	2,948,271
	100%	98%	99%	99%	99%	98%	98%
CO ₂ Emissions Score	0	0	0	0	0	0	0

Figure 3-16: Emissions of Carbon Dioxide



3.5.3 Fossil Fuel Use

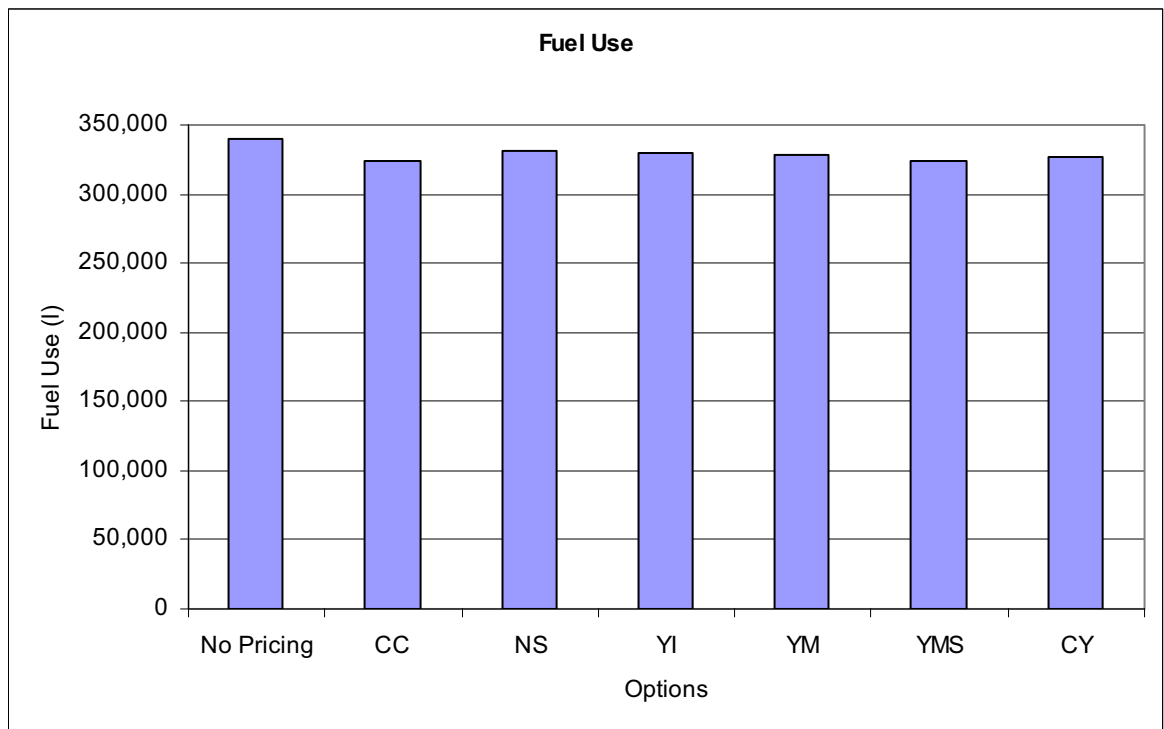
Estimates of fossil fuel use were extracted from WTSM as petrol and diesel usage. These are given in Table 3-21 for the three modelled periods, along with the resulting scores, and then shown graphically in Figure 3-17.

All options have reduced fossil fuel usage compared with the no pricing case, and all perform similarly. Hence all options have been scored equally as having a small impact on fuel usage.

Table 3-21: Fossil Fuel Use (l)

	No Pricing	CC	NS	YI	YM	YMS	CY
AM							
Petrol	65,492	59,041	62,102	61,710	61,161	59,426	60,139
Diesel	52,880	51,685	52,406	52,218	51,886	51,576	51,826
IP							
Petrol	45,925	45,056	45,584	45,613	45,653	45,230	45,334
Diesel	51,718	51,489	51,619	51,658	51,690	51,569	51,555
PM							
Petrol	72,601	66,606	68,865	68,078	67,742	66,296	67,526
Diesel	51,924	50,653	51,187	50,929	50,715	50,476	50,852
Fuel Use Score	0	√	√	√	√	√	√

Figure 3-17: Fossil Fuel Use



3.5.4 Ensure Environmental Sustainability Summary

Table 3-22 shows the overall score for the objective Ensure Environmental Sustainability, where each of the measures has been given equal weighting. From this evaluation all options have a slight and equal positive impact on environmental sustainability.

Table 3-22: Ensure Environmental Sustainability Score

5 ENVIRONMENTAL SUSTAINABILITY	No Pricing	CC	NS	YI	YM	YMS	CY
VKT (sensitive catchments) Score	0	√	√	√	√	√	√
CO ₂ Emissions Score	0	0	0	0	0	0	0
Fuel Use Score	0	√	√	√	√	√	√
Overall assessment (equal weights)	0	0+	0+	0+	0+	0+	0+

3.6 Objective 6: Consider Economic Efficiency and Affordability

The objective Economic Efficiency and Affordability was measured by way of a comparison of economic benefits, revenues and costs of the options.

Table 3-23 illustrates the range of scheme costs, which vary between \$43-125M. By comparison, benefits would range between \$40-93M. The figures presented are Net Present Values (NPV) discounted at 10% over a 25 year evaluation period with a base year of 2005. Details of assumptions and the financial and economic analysis are included in Appendix A. Being a strategic study, there are a number of assumptions made in the development of benefits and uncertainties surrounding costs and revenues. The economic evaluation undertaken is therefore only indicative.

As a measure of economic performance the ratio of User Benefits / Scheme Costs was developed. This measure is similar to a traditional BCR and looks at the efficiency of the benefits accrued compared to the total capital and operating costs (but ignores the benefits of revenues taken in) from the pricing agency perspective.

Using the “payments” method as describe in Section 2.9.8.1 of determining operating costs, all schemes showed a benefit cost ratio greater than 1 indicating the benefits outweigh the costs. This reduces to slightly below 1 for two of the schemes when the “transactions” method of developing operating costs is used as described in Section 2.9.8.2. These schemes are marginal and given that the real cost of technology is reducing over time, and that cost reductions could be achieved through economies of combining with other road pricing or tolling schemes it seems likely that these could show economic benefits.

The revenues over scheme costs is simply a financial measure to compare the revenues collected against the cost of constructing and operating the scheme – essentially whether the scheme can pay for itself. All schemes have ratios above 1.6 with one greater than 4.

This demonstrates that a road pricing scheme in the greater Wellington region could be self financing and provide surplus revenues to invest in transport schemes.

Table 3-23 includes the resulting scores for the benefits and costs based on the ratios of user benefits to scheme costs and revenues to scheme costs and then overall scores based on the unweighted average of the two.

Table 3-23: Benefits and Costs (\$M)

	CC	NS	YI	YM	YMS	CY
Payments Method						
NPV User Benefits	100	53	73	82	119	98
NPV User Charges (revenues)	-245	-110	-133	-147	-221	-214
NPV Scheme Costs	62	49	50	53	57	59
Ratios						
NPV User Benefits / NPV Scheme Costs	1.6	1.1	1.5	1.5	2.1	1.7
NPV Revenues / NPV Scheme Costs	4.0	2.3	2.6	2.8	3.9	3.6
Transactions Method						
NPV User Benefits	100	53	73	82	119	98
NPV User Charges (revenues)	-245	-110	-133	-147	-221	-214
NPV Scheme Costs	65	43	65	89	105	125
Ratios						
NPV User Benefits / NPV Scheme Costs	1.5	1.2	1.1	0.9	1.1	0.8
NPV Revenues / NPV Scheme Costs	3.8	2.5	2.1	1.6	2.1	1.7
Scores						
Economic	√√	√	√	√	√√	√
Financial	√√√	√√	√√	√√	√√	√√
Unweighted overall assessment	√√+	√+	√+	√+	√√	√+

If repayment of capital costs are excluded (i.e. if it was assumed that capital costs were paid up front from Government funds and the revenues were not required to fund the debt), annual revenue surpluses (after covering operating costs) could be substantial. Table 3-24 shows the range of expected surpluses (dependant on the expected operating cost assumptions).

Table 3-24: Annual Revenue Surpluses (\$M)

	CC	NS	YI	YM	YMS	CY
Annual Revenues	47	21	26	29	43	43
Annual Operating Costs (Payments)	7	4	5	5	5	6
Surplus Revenues (Payments)	41	17	21	24	38	37
Annual Operating Costs (Transactions)	7	3	7	12	15	18
Surplus Revenues (Transactions)	40	18	19	17	28	24

If the surplus revenues generated were allocated to efficient transport schemes, then there would be a significant increase in the NPV of user benefits and consequently an increase in the ratio of NPV of user benefits to net present value of scheme costs.

3.7 Planning Balance Sheet Scoring Summary

The evaluation scores given in the preceding sections are summarised here for the purposes of understanding the overall performance of each option.

Table 3-25 summarises the scores under each objective. This is based on the average of the scores for each measure, that is all with equal weightings, and no attempt was made to determine or apply different weightings. An overall score has not been determined as this would require consideration of the relative weight or importance given to each objective.

Table 3-25: Planning Balance Sheet Scores (Equal Weights)

Summary - Equal Weights	No Pricing	CC	NS	YI	YM	YMS	CY
1 ECONOMIC DEVELOPMENT	0	X	0	0	0	0	0
2 SAFETY & PERSONAL SECURITY	0	√+	0+	0+	0+	√+	√+
3 ACCESS, MOBILITY & NETWORK RELIABILITY	0	√	√	√	√	√+	√+
4 PUBLIC HEALTH	0	0+	0+	0+	0+	0+	0+
5 ENVIRONMENTAL SUSTAINABILITY	0	0+	0+	0+	0+	0+	0+
6 EFFICIENCY & AFFORDABILITY	0	√√+	√+	√+	√+	√√	√+

All options have positive impacts on:

- Safety and Personal Security (generally small impacts);
- Access, Mobility and Network Reliability (generally small impacts)
- Public Health (slight impacts and all options the same);
- Environmental Sustainability (slight impacts and all options the same);
- Efficiency and Affordability (generally moderate impact).

All options have no significant impact on Economic Development and allocation of the surplus revenues generated by road pricing into efficient transport schemes will reduce further the negative impacts and in some situations may lead to an overall positive impact on economic development.

Overall, whilst there are variations between road pricing options, we can draw the following generic conclusions about road pricing in the Wellington context at the level of charging contemplated:

- Adverse impacts on economic development will be minor; reinvestment of the surplus revenues into efficient transportation schemes will further reduce adverse impacts on economic development and may in some cases lead to a positive economic development impact.
- Road pricing will lead to small to moderate safety and personal security benefits.
- Road pricing will lead to strong positive access, mobility and network reliability benefits but may lead to some trip suppression. Reinvestment of the surplus revenues into efficient transport schemes will further enhance the strong positive access, mobility and network reliability benefits and reduce the level of trip suppression.
- Road pricing will produce small positive contributions to public health and environmental sustainability.
- Road pricing makes a moderate positive contribution to economic efficiency.

With regard to the specific options investigated, the CC and the YMS are promising options, in that they make strong contributions to access, mobility and network reliability, are economically efficient and affordable, and enhance safety and personal security.

YMS and CY are best at distributing the charges across a larger number of road users. However, it should be noted that in all pricing schemes at least 79% of road users pay no charge at all in the AM peak (Table 3-13).

4. Social Impacts

Because of the modest charges proposed, social impacts are likely to fall on particular segments of the community who are more vulnerable because of their socioeconomic status and lack of flexibility in their trip making. Lower socioeconomic groups will be less able to afford a charge as it would make up a larger proportion of their household income. These groups may have to travel by car in peak time because there is limited flexibility in working hours e.g. shift workers or because no viable passenger transport is available. The social impact of implementing a road pricing scheme will be an important issue. In the long term, people will be aware of the road pricing and make their decisions about location and employment with knowledge of the charges and their location.

The purpose of the social impact assessment undertaken in this study has been to:

- 1) identify groups which could be unfairly or severely disadvantaged by the implementation of road pricing schemes
- 2) identify the potential impacts on communities and key regional facilities
- 3) identify potential ways to mitigate the social impacts identified

This had been done in two ways. Firstly, through reviewing information on trip making taken from Census data and WTSM to identify trips made to and from areas with high levels of social deprivation to key destinations which would be effected by road pricing.

The second part involves a series of interviews undertaken with key individuals from the following organisations:

- Wellington City Council
- Hutt City Council
- Upper Hutt City Council
- Porirua City Council
- Capital and Coast District Health Board
- Wellington Airport
- The Ministry of Social Development

The purpose of these meetings was to identify where there may be potential for individuals to be unfairly disadvantaged and to identify potential social and equity issues for the community.

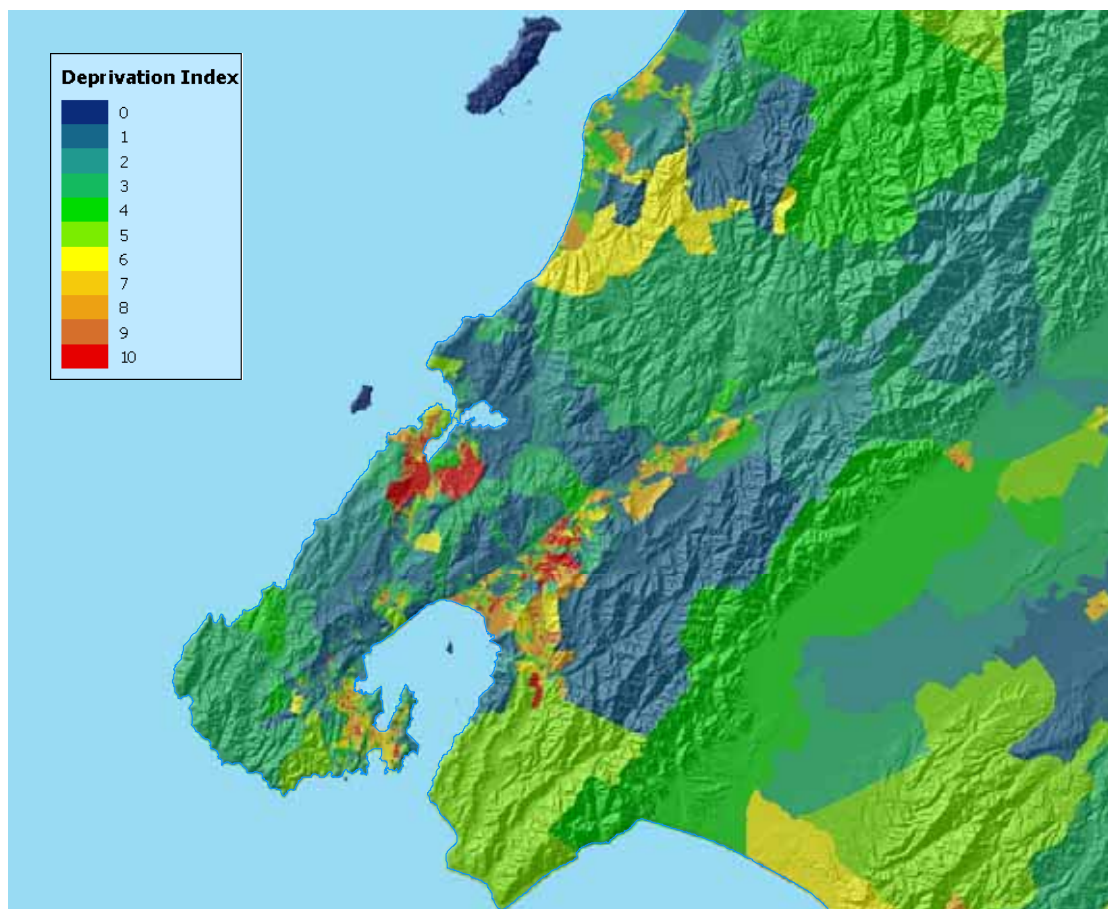
4.1 Socially Deprived Groups

Socially deprived groups may be unfairly disadvantaged by road pricing because their mobility would be significantly affected as they are less able to afford additional charges, may have less flexibility to change their travel patterns (fixed working times).

The deprivation index prepared by Statistics New Zealand combines nine variables from the 2001 census which reflect eight dimensions of deprivation. It provides a deprivation score for each meshblock in New Zealand. Meshblocks are geographical units defined by Statistics New Zealand containing a median of approximately 90 people in 2001. The index has a score which ranges from 1 to 10, where 1 represents areas with the least deprived scores and 10 the areas with the most deprived scores.

To enable direct correlation with the WTSM model outputs, the meshblock scores were combined, using a population weighted average approach, to give a score for each model zone. The deprivation index is represented in Figure 4-1.

Figure 4-1: Population Weighted Deprivation Index by WTSM Model Zone



An exercise was then undertaken to identify the locations where there were large population in areas with high deprivation scores. Figures 4-2 to 4-4 show the relative populations for areas with deprivation scores greater than 7, greater than 8 and greater than 9 respectively.

Figure 4-2: Population with Deprivation Index Score Greater than 7

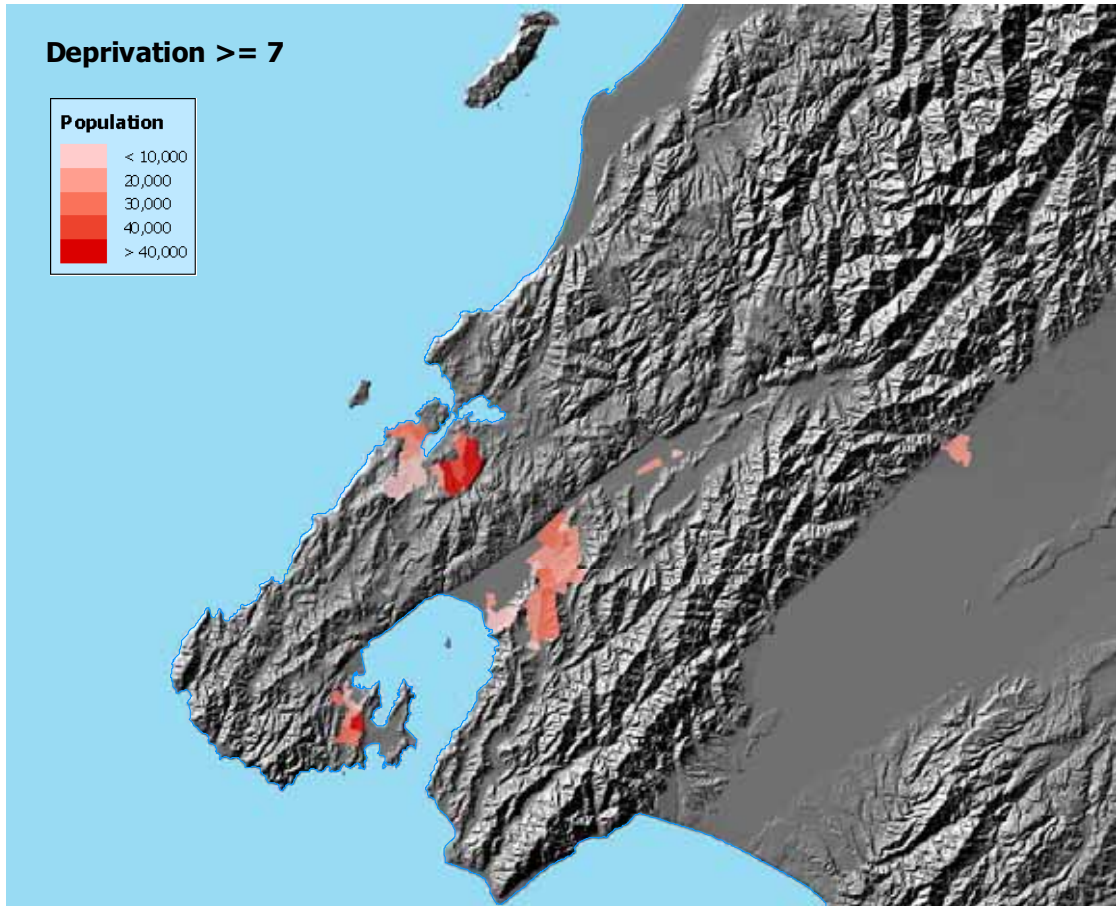


Figure 4-3: Population with Deprivation Index Score Greater than 8

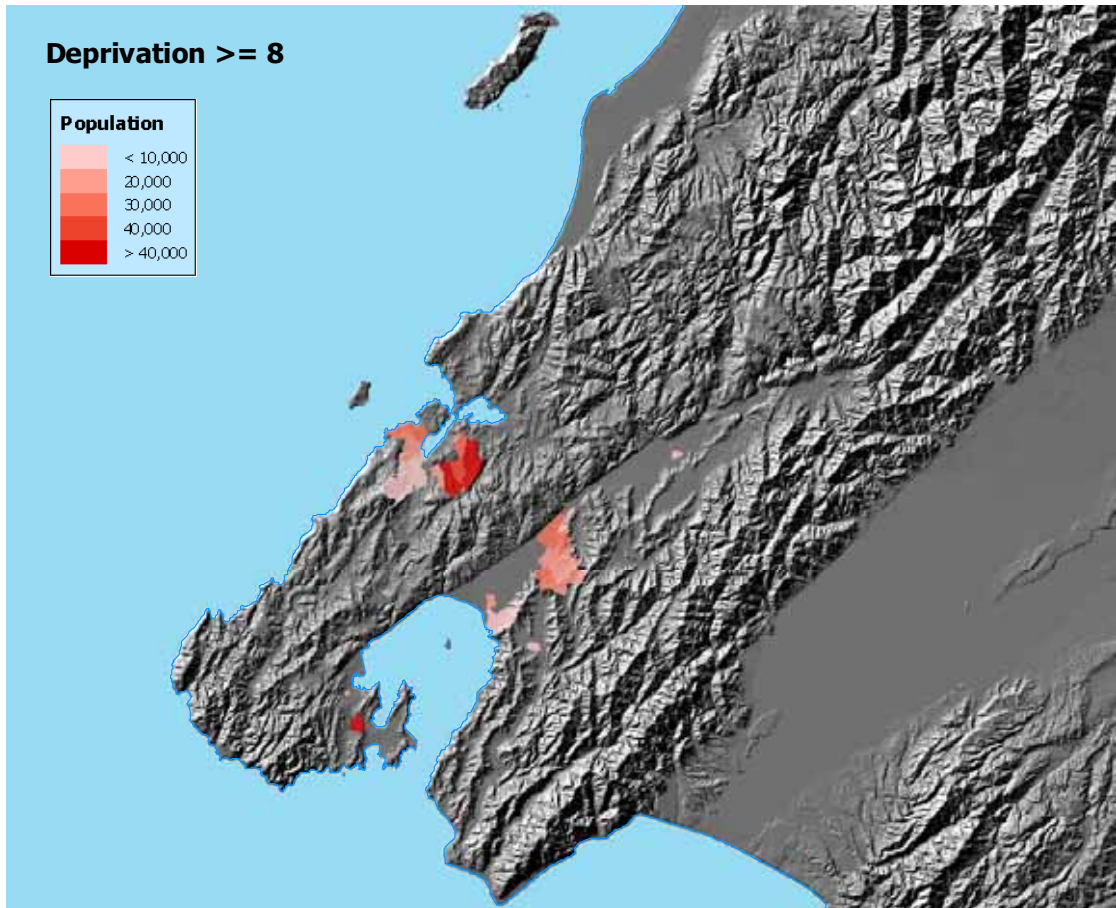
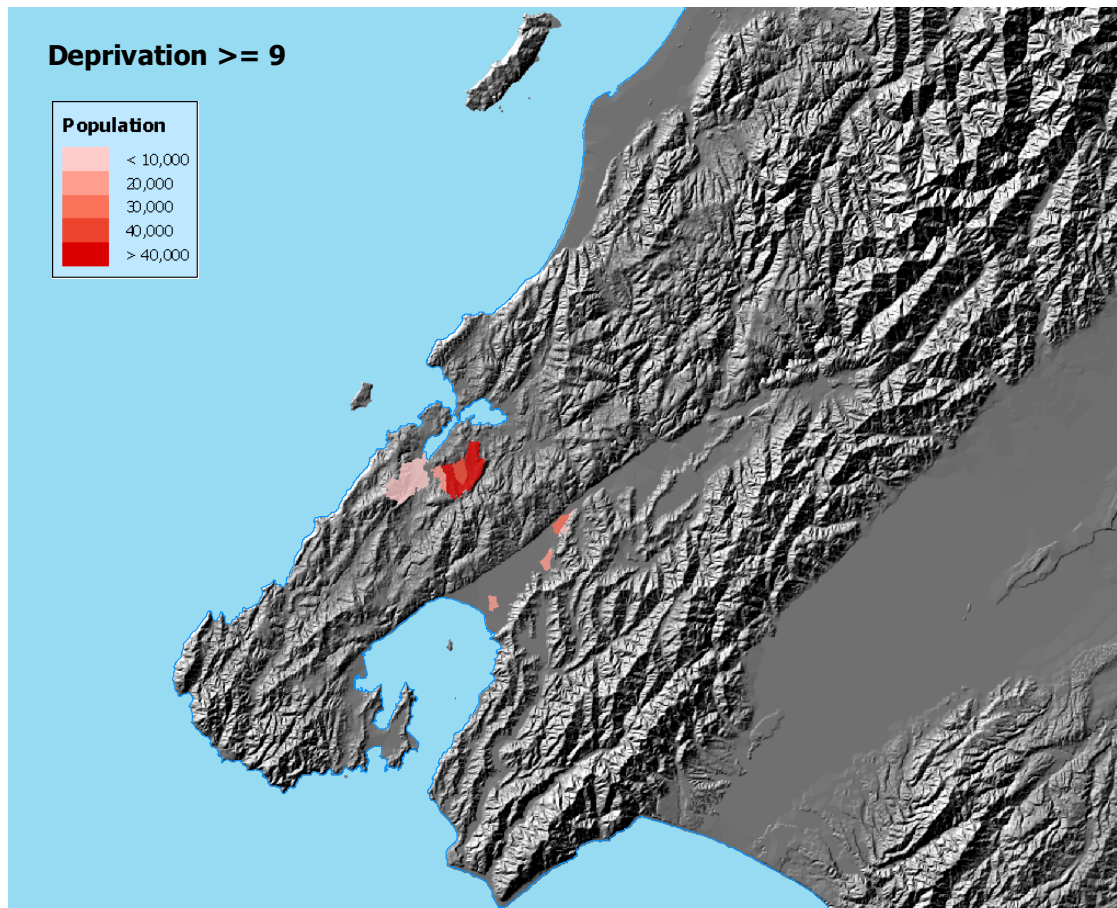


Figure 4-4: Population with Deprivation Index Score Greater than 9

This analysis highlights the areas where there is existing deprivation and additional charges could have a disproportionate impact on lower socioeconomic groups. Using knowledge of the region, the deprivation index and information provided from the interview programme, the following areas of high social deprivation were identified:

- Porirua (Porirua Central, Southern Titahi Bay, Porirua East, Cannons Creek, Waitangarua and Ascot Park) (Figure 4-5)
- South Central Wellington (Berhampore, Newtown, Te Aro and parts of the CBD) (Figure 4-6)
- Hutt Valley / Wainuiomata (Arakura, Naenae, Wingate, Taita, Pomare and Seaview / Gracefield) (Figure 4-7)

Figure 4-5: Socially Deprived Areas in Porirua

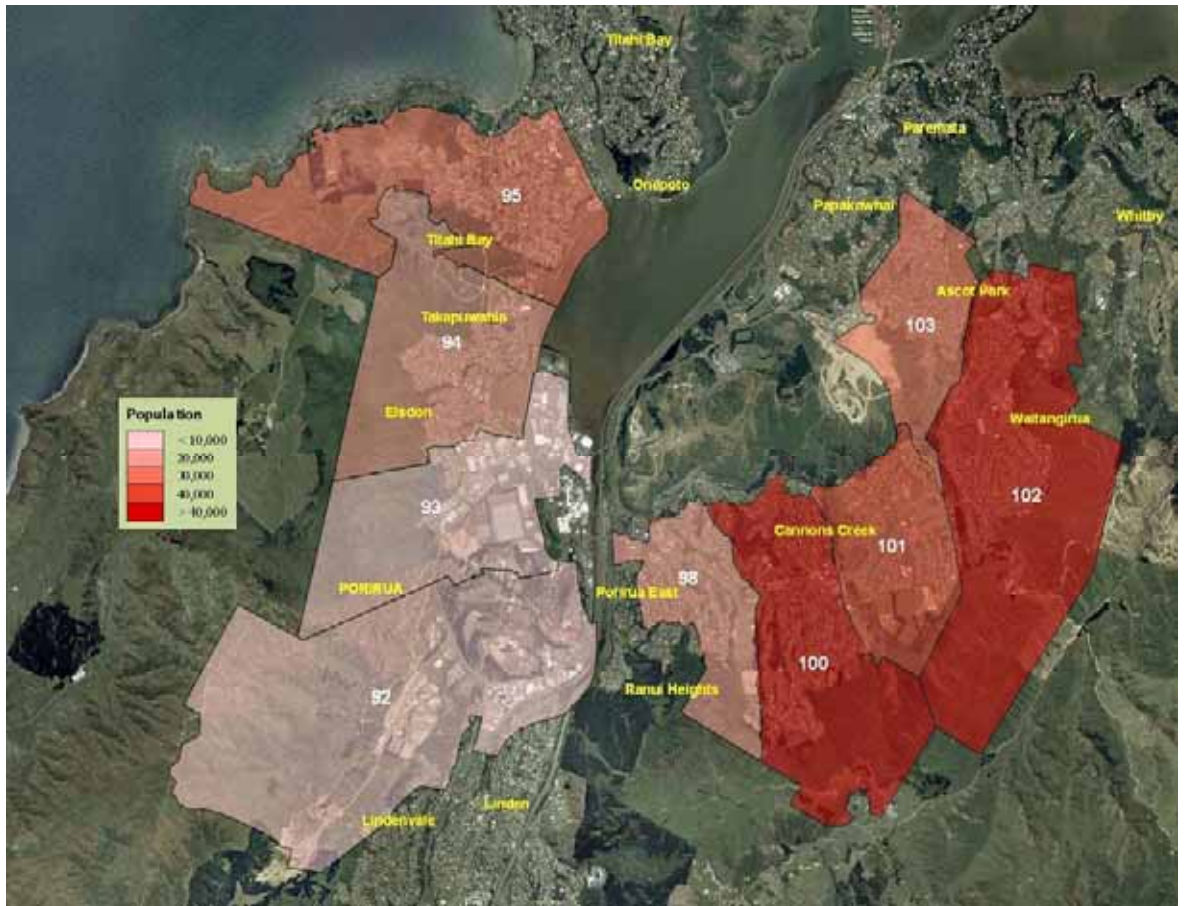
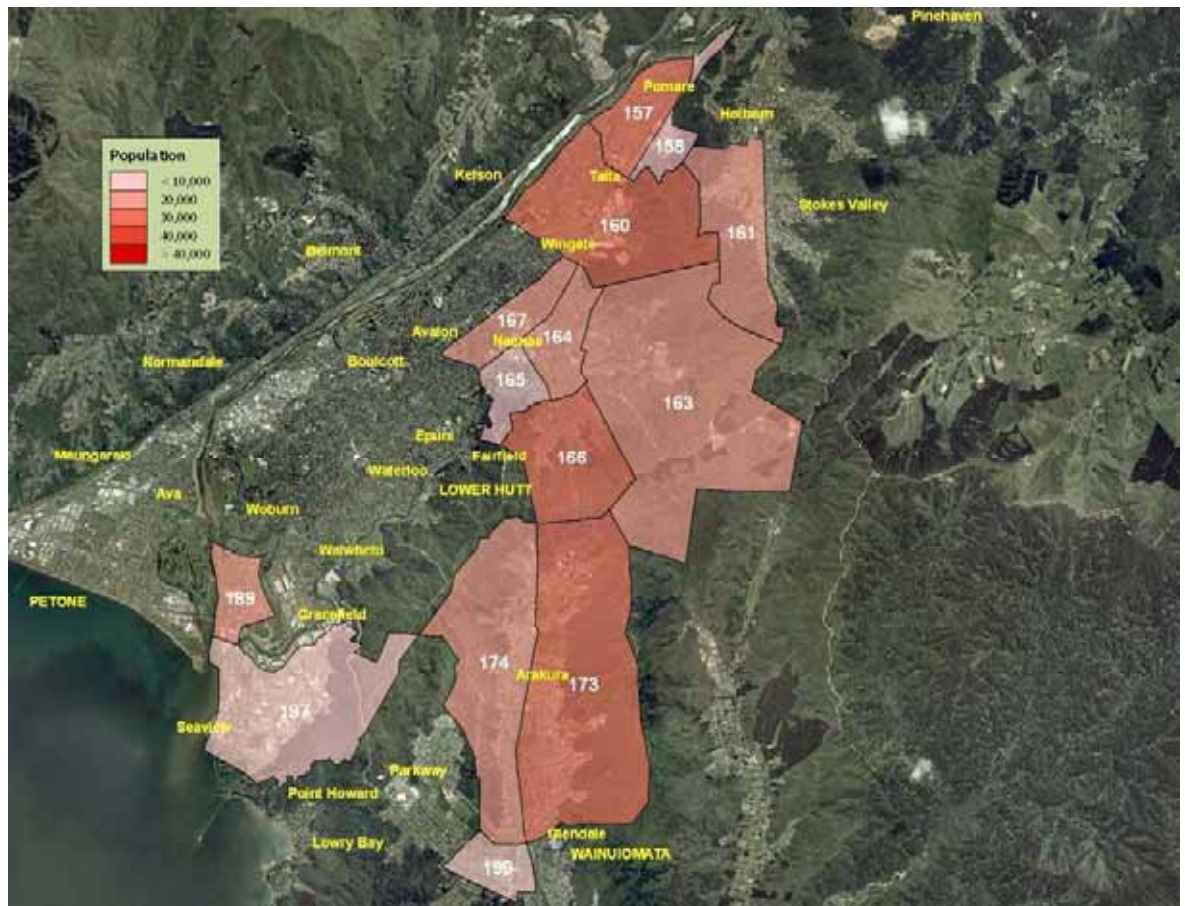


Figure 4-6: Socially Deprived Areas in South Central Wellington



Figure 4-7: Socially Deprived Areas in Hutt Valley / Wainuiomata



A number of key employment destinations in the region were identified and included:

- Wellington CBD (Figure 4-8)
- South Wellington (Newtown, Kilbirnie, Rongotai and the Airport. This is consistent with the WCC Urban Development Strategy Growth Spine concept which has identified this area for further intensification) (Figure 4-8)
- Hutt City (Petone, Seaview, Gracefield, Central Hutt City) (Figure 4-9)
- Porirua (Porirua Central, Kenepuru Hospital, Porirua Hospital) (Figure 4-10)
- Upper Hutt (Central Upper Hutt, Heretaunga, Trentham) (Figure 4-11)

Figure 4-8: Wellington CBD and South Wellington

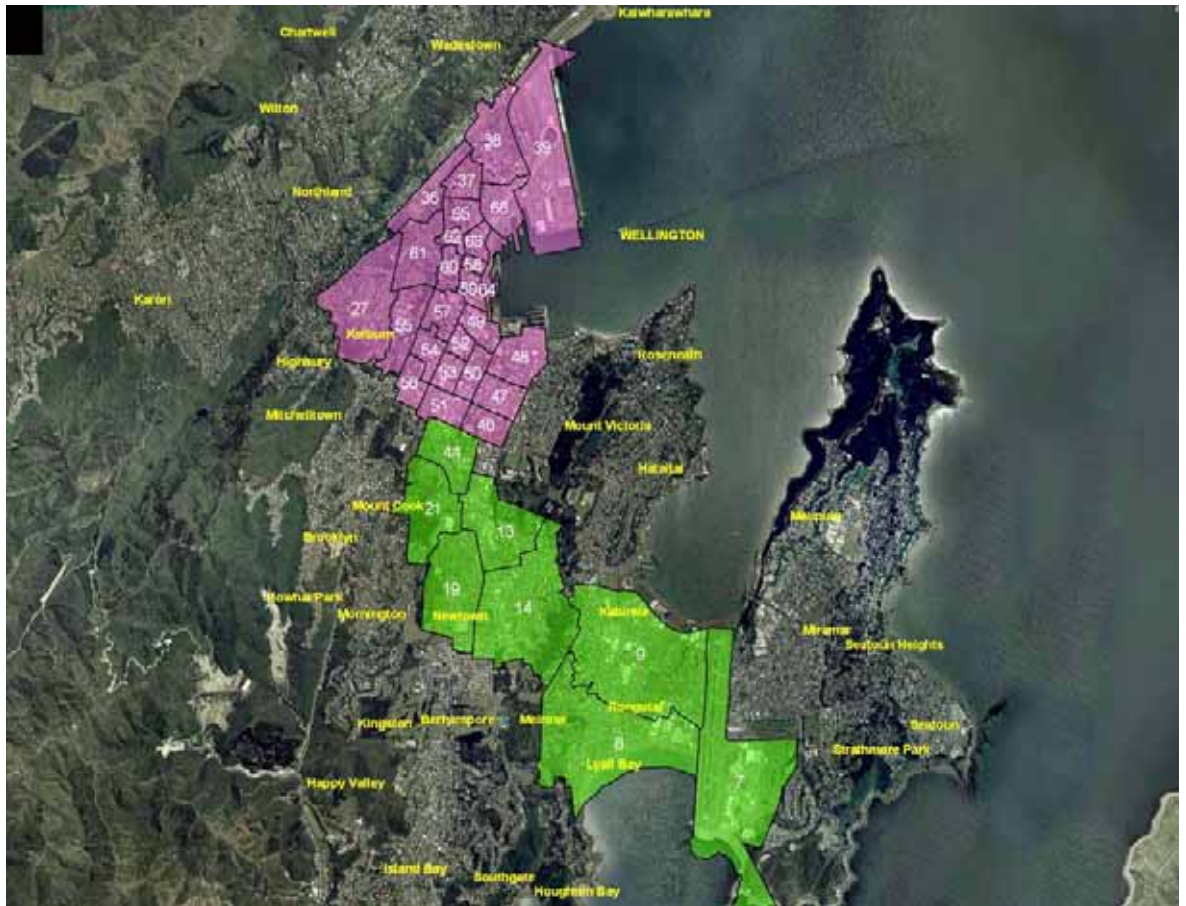
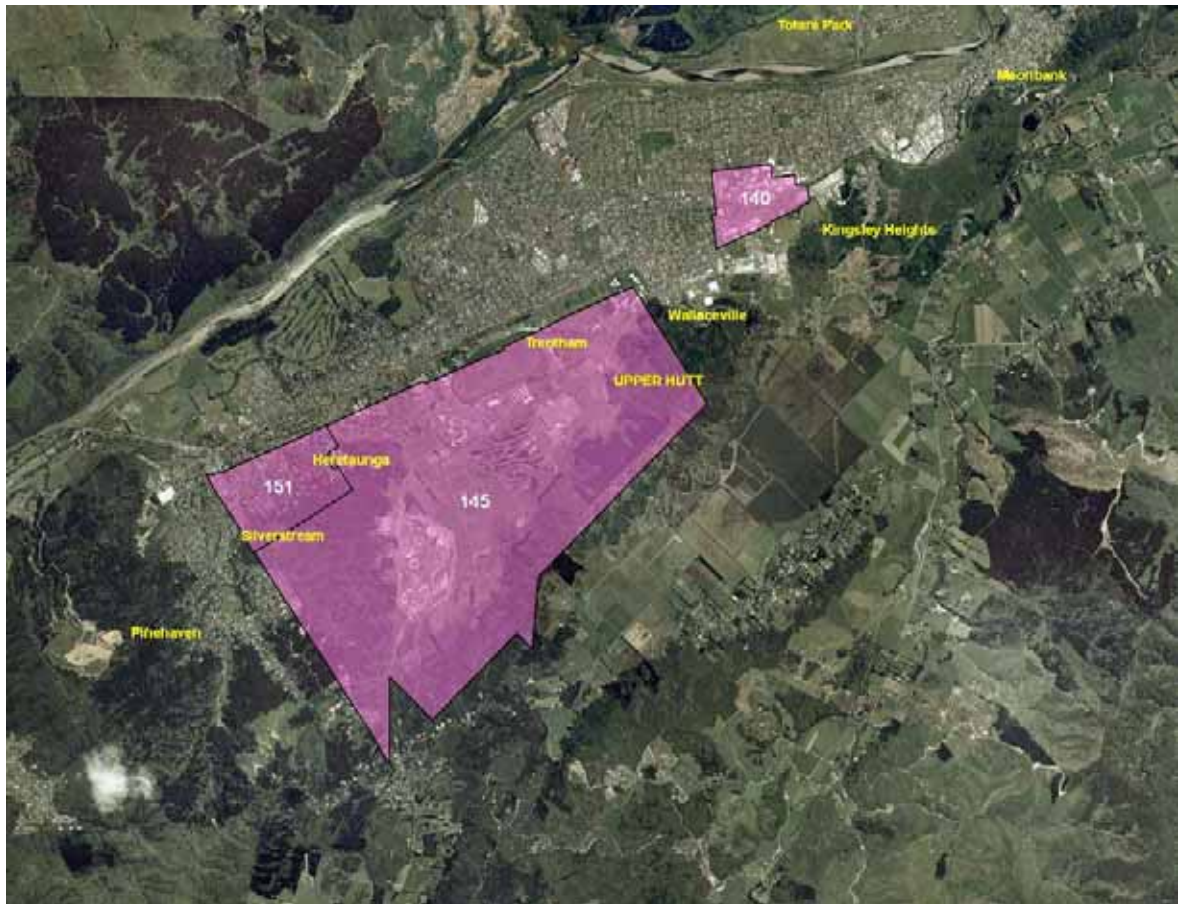


Figure 4-9: Hutt City



Figure 4-10: Porirua



Figure 4-11: Upper Hutt

Additionally, a number of regionally important community facilities were identified and included:

- Wellington Hospital
- Kenepuru Hospital
- Hutt Hospital
- Wellington Airport
- Victoria and Massey Universities

Table 3-1 included above highlights the relatively high self-containment of employment within the local authority areas. It shows the small percentage of work trips between the areas of deprivation and the key employment destinations identified above which would incur a charge for any of the schemes (apart from trips to Wellington City). A high proportion of workers from all areas work in Wellington City and smaller, but nonetheless notable percentages of Porirua, Wellington City and Kapiti Coast residents work in Hutt City.

A matrix (Table 4-1) has been prepared which identifies the charges that would be paid in the AM peak between the areas of social deprivation the key designations identified above.

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Table 4-1: Charges Paid between Areas of Social Deprivation and Key Employment / Social Destinations (AM Peak)

Deprived Areas	Wellington CBD / University						South Wellington / Hospital / Airport						Hutt City / Hutt Hospital						Porirua / Kenepuru Hospital						Upper Hutt					
	CC	NS	YI	YM	YMS	CY	CC	NS	YI	YM	YMS	CY	CC	NS	YI	YM	YMS	CY	CC	NS	YI	YM	YMS	CY	CC	NS	YI	YM	YMS	CY
South Central Wellington	\$4	\$0	\$0	\$0	\$3	\$2	\$0	\$0	\$0	\$0	\$0	\$0	\$4	\$0	\$0	\$1.5	\$4.5	\$2	\$4	\$0	\$0	\$0	\$3	\$2	\$4	\$0	\$0	\$1.5	\$4.5	\$2
Porirua	\$4	\$4	\$3.5	\$2.5	\$2.5	\$3.5	\$4	\$4	\$3.5	\$2.5	\$2.5	\$3.5	\$0	\$0	\$0	\$2.5	\$2.5	\$0.5	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1	\$2.5	\$2.5	\$0.5
Hutt Valley / Wainuimata	\$4	\$4	\$5	\$3.5	\$3.5	\$4	\$4	\$4	\$5	\$3.5	\$3.5	\$4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2.5	\$2	\$2	\$1	\$0	\$0	\$0	\$0	\$0	\$0

Analysis of the number of trips from deprived areas to key destinations in the no pricing case was then undertaken to identify where there would be a large number of trips which would also pay a high charge. Red highlights the highest road pricing charge levels.

Table 4-2: No. of Trips between Areas of Social Deprivation and Key Employment / Social Destinations (No pricing case AM Peak)

Deprived Areas	Wellington CBD / University	South Wellington / Hospital / Airport	Hutt City / Hutt Hospital	Porirua / Kenepuru Hospital	Upper Hutt
South Central Wellington	4,288	1,868	164	48	24
Porirua	856	148	161	1,539	55
Hutt Valley / Wainuimata	821	154	1,797	50	154

In Table 4-2 those trips which would not attract a charge under any of the options tested have been highlighted green. The highest number of trips from each of the deprived areas are made to the closest key employment / social destination. For all these deprived areas (except South Central Wellington) no charge would be incurred for these trips so there would be no adverse social impact. For the area of South Central Wellington, the most trips are made to the Wellington CBD. Only trips which cross the CBD cordon or the southern screenline in options CC, YMS or CY would pay a charge and some of these trips originate from inside the cordon and would not pay a charge. There is also good public transport and walking and cycling connectivity between these areas.



The next most popular destination from the deprived areas was the Wellington CBD which attracts almost 6000 trips in the AM peak. For all trips to the Wellington CBD, good public transport options are available and the level of charge is commensurate with public transport fares. A high proportion of the jobs in Wellington CBD are relatively highly paid “white collar” jobs and it could be expected that employees could have more flexibility in their working hours and / or be more able to pay a charge. As a result, the social impact on people making these trips is unlikely to be significant.

There are a relatively small number of trips (approximately 160) between Porirua and Hutt City and a good PT service is not available for these trips. However, the charges faced by these trips are less than \$2.50 for all options which is unlikely to result in a large social impact. Consideration could be given to providing an improved PT service between these locations if specific issues were identified.

164 trips are forecast between South Central Wellington and Hutt City. Under the CC and YMS options which impose charges on the southern screenline, reasonably high charges of \$4.00 - \$4.50 are imposed. Again, as some of the area is within the boundary, not all these trips would be charged. The Airport Flyer bus service provides an approximately half hourly bus service between Upper Hutt / Hutt City and the Airport stopping in central and south Wellington. Excess road pricing revenues could be used to improve frequencies on this service as a mitigation measure.

Trips from Porirua (148) and the Hutt Valley (154) areas to the South Wellington area will be charged relatively high charges under all options (\$2.50 - \$5.00). As such, there may be a larger social impact on people who make trips to South Wellington. These trips are longer distance trips which will benefit through larger travel time savings as a result of the charging. As noted above the Airport Flyer provides a bus service to and from Hutt City. Public transport options exist between Porirua and South Wellington, however there is some level of interchange required.

4.2 Community Severance

Screenline locations were chosen and refined specifically to reduce the opportunity for social severance. They were located between major communities so that travel to key facilities within the community would not be charged, therefore reducing the potential for adverse social impacts.

The screenline at Pukerua Bay in the options considered was originally located on the Mana Bridge. While this provided a better solution in terms of addressing congestion with a limited amount of charging equipment, it had the potential to cut the communities to the north off from their local shopping / community facilities. The location of the charging point was therefore moved north to Pukerua Bay.

The charging point on Eastern Hutt Road as part of the Hutt Screenline was originally located to the south of the Stokes Valley Road roundabout. This was relocated to the north so that Stokes Valley residents would not have to pay a charge to access their local facilities at Hutt City.

There are strong linkages between Upper Hutt and Hutt City for employment and shopping, social and community service purposes. Trips from Upper Hutt to Hutt City would incur a \$1.00 charge in the AM peak under the YM, YMS options and \$0.50 for the CY option.

The options that have the most potential to impact on local trips are those that include the CBD cordon of the southern screenline (CC, YMS and CY). These options apply a relatively high single charge for crossing the screenline which would impose a large barrier to local trip making. The CBD is surrounded by residential properties and there are a number of schools located adjacent to the screenline. Detailed design would need to ensure that severance is minimised while maintaining access to schools etc.

4.3 Key Regional Facilities

4.3.1 Wellington Hospital

Wellington Hospital is located to the south of the city centre just outside the proposed Wellington CBD cordon. Because of its location, those travelling to the Hospital from anywhere to the north must cross the city. There are no rail services from the north to the Hospital because of the northern location of the railway station and some interchange with bus services is required.

The hospital has a total staff of about 2,700, many of whom work shifts. There are rotating shifts for nursing, cleaning, midwifery, catering which generally start at 7am, 3pm and 11pm and as such would be unlikely to be effected by the peak period charges proposed. People on regular hours would start between 8 and 8.30 am. A recent hospital survey (September 2005) indicated that over 80% of respondents start work between 7am and 8.30 am.

The survey showed that about two thirds of all staff travel to work by car, of which 20% have more than one person in the car (they would presumably have less flexibility in their travel behaviour than single car drivers), 18% walked, 8% came by bus and only 3% by train.

The same survey showed that a large proportion of staff (close to 1000) live near the hospital or to the south and overall about 60% live within a 5 km radius and would be unlikely to be heavily impacted by charges.

Nearly 150 come from the Kapiti Coast area, 93 from Upper Hutt, close to 200 from Lower Hutt, 460 from the Porirua area, 200 from the Johnsonville area and 200 from other locations north of the City. All these people would be impacted by charges if they had to travel by car through the City to work in the charged period.

Analysis of the top 10 travel origin zones for vehicle trips in the AM peak to the hospital zone confirms that many trips are from the nearby surrounding area and would not be impacted by charges. Some relatively disadvantaged areas are however affected – for example Aro Valley. This raises issues of social equity, which was a major concern to the hospital representative consulted. There was particular concern for those on low incomes, part time workers (35% of Capital and Coastal District Health Board (CCDHB) staff are part time), women (75% of CCDHB staff) and shift workers where starting times are not flexible. It was suggested that staff in lower income groups and women who are not flexible and must rely on the car could be significantly disadvantaged. This could potentially impact on the ability of the hospital to recruit and retain staff.

Wellington Hospital is both a district hospital and a regional hospital. It provides some services at a regional level that are not provided at district hospitals such as Kenepuru or Hutt Hospitals. This necessitates patients travelling from far afield to reach specialised services.

It was estimated that there could be up to 1000 patients at the hospital in any one day for all sorts of purposes and clinics. Those arriving for day surgery and some being admitted must arrive early in the morning. Some clinics e.g. diagnostic testing, often necessitate an early start (people not being allowed to eat first etc). It is doubtful whether there is any flexibility in these, however where possible, arrival times could be arranged to avoid peak periods. Other services such as radiation therapy require daily attendance for several weeks.

A further issue concerning hospital patients is their frequent reliance on private transport because they are ill or frail – this was perceived as another reason why patients who have early hospital appointments may not be able to avoid charges.

It was generally concluded during discussions that road pricing could benefit the hospital if it reduced city congestion and led to improved public transport services to the hospital but there was concern about the impact on staff and patients.

4.3.2 Kenepuru Hospital

Kenepuru Hospital in Porirua is an important destination and an important employer. There are a lot of both white collar and lower paid jobs at the hospital. A recent survey conducted among hospital staff indicated that 90% of hospital employees came to work by car, with only 2.5% walking and 2.7% using the train despite there being a good rail station nearby. The survey also showed that only 21% of employees at the hospital lived within 5 km of their workplace, while 7% came from the Hutt Valley, 8% from Wellington's southern and eastern suburbs and 22% from the Kapiti Coast area.

Analysis of the top 10 origin zones in the AM peak for trips to the hospital zone shows that most of the trips originate from areas which would not be subjected to the pricing cordons proposed to the south of the hospital. Some coming from the Kapiti Coast would experience a charge at the Pukerua bay screenline. It does not appear that road pricing would have a substantial social impact on people using the Kenepuru Hospital.

4.3.3 Hutt Hospital

Hutt Hospital in Hutt City is located such that trips from Hutt City would not incur a charge for access to the Hospital. There are no 24 hour medical services in Upper Hutt, necessitating travel to the hospital in Hutt City outside normal hours. These trips are unlikely to incur a charge as they would occur outside the charged peak periods. The Hutt Hospital itself does not cater for all medical services e.g. eye services and people need to travel to Wellington Hospital for these.

4.3.4 Wellington Airport

Wellington airport is located about 5 km south east of Central Wellington. Analysis of the main origins of trips to the airport zone in the AM peak indicates that these are mainly located in the vicinity of the airport and would not be affected by any of the pricing options. However, all trips from north or west of the city would have to pass through central Wellington to access the airport including vehicles travelling on the Inner City Bypass.

Taxi fares to the airport from the City are about \$25. Short term parking at the airport costs between \$18 and \$ 25 per day. Long term parking costs \$25 for the first day and \$8 thereafter. In general it seems that the cost of road pricing charges would be a small addition to the already high cost of a taxi or parking for most passengers, and when considering the costs of air travel, very small. International passengers would be unlikely to be affected because of the timing of flights. Only domestic passengers being brought or collected by car by friends or family during peak hours should be materially affected by the charges.

Discussions with airport planners indicated that between 1500 and 1800 people work at the airport - a large percentage are shift workers arriving and leaving throughout the day. Airport workers cover a large range of employee types from pilots to flight attendants, security personnel, check in staff, baggage handlers, catering staff and those working in the retail stores as well as cleaners etc. The airport itself employs about 75 staff of whom about 30 work 'normal' hours. The airport shuts down between 1am and 6am, but outside those hours staff would be arriving and leaving. Information on the main times that workers arrive and leave was not available, nor was there information on modes of travel to work for airport workers. It was however suggested that many workers live locally and walk to work, which corresponds with our analysis of trip origins.

It is likely that a number of airport workers will be affected by the various options. The main impact will be on lower paid shift workers who arrive or leave during peak periods and who live north of central Wellington. Charges of up to \$4.50 could apply with the CBD cordon options and \$5 for the YI option.

4.3.5 Educational Facilities

Victoria University has its main campus located in Kelburn, with satellite campus spread across the Wellington CBD. Massey University has campuses at Buckle and Tasman Streets.

Analysis of the extent to which trips to the main Victoria University campus would be impacted by the various road pricing options indicates that some areas of relative disadvantage could be affected by the CBD and south of CBD cordons. These areas are to the south of Wellington hospital and include Berhampore and Kilbirnie as well as the Mount Cook area. Charges of between \$4.00 and \$2.00 could apply to these trips.

The student population centres around the Aro Valley, Kelburn, and Mount Cook. Students primarily rely on passenger transport, walking and cycling because of the high cost of car parking. Therefore they are unlikely to be largely affected by the proposed charges.

The schools complex of Wellington College, Wellington East Girls College, Wellington High School is located near Massey University and in close proximity to the proposed CBD Cordon. Care would be required during the detailed design of a CBD cordon or southern screenline to reduce the need for the cordon to be crossed for school trips and to address any routing issues around the boundary that may occur as drives attempt to avoid the charges.

4.4 Social Impacts without Road Pricing

It must be acknowledged that there will also be social impacts if road pricing is not put in place. These could include:

- i. routes becoming more congested which will impact on peoples ability to travel and the economic performance of the region; or
- ii. residents having to fund large scale infrastructure and service improvements through rates and taxes

Road pricing has the potential to have a positive social impact by reducing congestion without the need to place a financial burden on the community through increased rates and taxes. This means that some people may be disadvantaged one way with road pricing but gain in others.

4.5 Social Impact Conclusions

Because of the modest charges proposed, significant social impacts are only likely to fall on very particular segments of the community who are most vulnerable because of their particularly deprived socio economic status and lack of flexibility in their trip making – either because they have to travel in the peak time or public transport is not available.

Our investigations into the social impacts of road pricing has focused on identifying socially deprived groups which could be unfairly impacted by road pricing and consideration of trips from these areas to key employment and community facilities.

The number of trips from these socially deprived areas which would face a charge is in most cases small, with the exception of trips into the Wellington CBD where employment is more likely to be in higher paying “white collar” jobs. Good PT links are provided from most locations into central Wellington and therefore a viable alternative to the charges is provided.

Schemes which impose high charges adjacent to the CBD have the greatest potential to have an adverse social impact because of the high level of charge and the potential to charge shorter local trips.

Road pricing schemes would need to be designed to ensure that they had minimal adverse social impacts. Mitigation measures could be required to minimise adverse social impacts. Potential measures that could be desired by the community include:

- Exempting people travelling from particular areas or to particular destinations from paying the toll - this would have to be by way of a form of concession card or tag. Exemptions can prove difficult to implement fairly
- Reimbursing socially deprived groups through reductions in rates (funded by road pricing revenues). It should be noted that disadvantaged groups are most likely to rent and therefore not pay rates directly. Some mechanism would need to be developed to ensure that the disadvantaged groups received these reimbursements
- Diverting excess revenues into improved PT
- Improving opportunities for walking and cycling especially from areas close to the Wellington CBD. This could target those living close to the CBD or those who could drive to a point and then walk or cycle
- Obtaining community ‘buy in’ and acceptance of the scheme and its rationale – involve the community in discussing how the revenue raised would be spent. Work to ensure the political acceptability of the proposal and towards overcoming public scepticism about the outcomes

If road pricing is to be considered further in Wellington, detailed investigations into the social impacts of particular road pricing schemes would need to be undertaken and would need to involve detailed public consultation and survey. From the investigation undertaken to date, we conclude that road pricing could have an adverse social impact on relatively small numbers of individuals. Through more detailed design and development of mitigation measures, it should be possible to reduce these impacts so that they would impinge on a minimal number of people.

5. Other Considerations

5.1 Legislation and Privacy Review

5.1.1 Legislative Issues

The LTMA introduced legislative provisions to establish road tolling schemes. Tolls are however intended to fund the planning, design, supervision, construction, maintenance or operation of new roads and there is currently no legislative mandate that would allow for road pricing of existing infrastructure. Therefore, new or modified legislation would be required before any road pricing scheme could be implemented.

In general terms, the legislation would be required to provide for the *ability to implement a charge* and the *ability to enforce the charge*.

Key issues with the *ability to charge* include:

- The procedure for recommending that charges be established;
- Ensuring that relevant transport strategies are considered;
- Who owns the revenue collected (whether the revenue collected is “land transport revenue” and whether it has implications for levels of appropriation);
- To what purpose the revenue collected is to be applied/spent;
- Which entity is imposing the charge, how that entity interacts with the Road Controlling Authorities and/or delegates to third party collectors
- Legally restricting access to roads (to those who pay the charge);
- Establishment of legal contract between users and operation authority;
- Fixed/mobile charge points – method of charging (procedure & basis);
- Details of the charge(s):
 - The basis on which charge(s) can be set (taking into account that coercive powers will be used and there is not a normal market through which prices are determined)
 - A description of the area covered and charge points
 - Any exemptions such as land owners abutting the boundary of the area that is to be charged, emergency services vehicles etc.
 - Hours of application
 - Refunds
 - Differential charges (classes of vehicle or person, direction of travel, different times or days etc)

- Maximum charge per day (in case of multiple entry/exit from charge zone)
- Time and date of ability to begin charging
- Process for notifying changes to charge levels/structures and termination.

Key issues with the *ability to enforce the charge* include:

- The entity that can enforce the charge(s);
- The entity that has the ability to collect debts;
- The legal status for equipment used, to allow for enforcement of charges and penalties for failure to pay (e.g. speed cameras);
- Powers to retain details of vehicles entering cordons or crossing screenlines (i.e. proof that it did enter / cross);
- Penalty structures;
- Procedure for dealing with disputes over application of penalties.

While not allowing for charging of existing roads, the LTMA does provide an indication of the framework that new road pricing legislation could take. Assuming that the framework was similar, even with legislative provisions in place, direct approval for a road pricing scheme would still be required from the Minister of Transport. It is likely that a road pricing scheme would need to be established by the Governor-General by Order in Council (OIC), on recommendation by the Minister.

The legislation would provide for issues that the Minister must consider in making his / her recommendation. These are likely to be similar to those set out in the LTMA for tolling, however may include a wide range of other issues such as use of the revenues, governance and contractual structures. In practice the Minister would receive advice from the Ministry of Transport officials after they had evaluated the scheme.

A more detailed review of the legislation and policy issues associated with road pricing was undertaken and is contained in Appendix C.

5.1.2 Privacy Issues

Road pricing schemes work by detecting when a person makes a particular trip at a particular time and charging them for doing so. This requires the collection of some types of private information and could result in some privacy issues. However, these issues could be addressed through the appropriate design and management of a road pricing system including a carefully formulated privacy policy.

The privacy of individuals can be impacted by a road pricing scheme through both the *payment* and *enforcement* processes.

5.1.2.1 Payment

Potentially private information is collected during the payment process. In the case of offline payment whereby the payment is separated from the charged event (by phone, SMS, retail outlet, internet and on-street payment machine), payment is linked to an identifiable aspect of the vehicle such as the VRM (number plate). For tag (DSRC) or GPS based charging schemes, payment is linked to a device fixed to, and associated with the vehicle. These types of charging have the potential to collect information on people's movements and therefore potentially have wider ranging privacy implications.

Pre-payment would make it possible for users to transact anonymously, especially if linked to smart card technology. An anonymous account could be set up with transaction records using only a smart card serial number, and an extra layer of protection is afforded by ensuring the serial number cannot be easily cross referenced to other databases.

5.1.2.2 Enforcement

Enforcement is where a check is undertaken to ensure that payment has been made for travel. In practice, the only method that has been found to be practical involves the use of the VRM. This is unique to a vehicle, is normally linked to the vehicle keeper via a central Vehicle Licence Database and is relatively easy to read automatically using an Automatic Number Plate Reader (ANPR) camera (particularly if, as in New Zealand, retro reflective number plates are used). VRMs are used extensively for enforcement of motoring offences and hence their use for this process is well understood.

The overall aims of the enforcement system are to read the number plates of passing vehicles and to collect sufficient data that can be used to form an evidential record for issue of a Penalty Charge Notice (PCN) and, if necessary further prosecution. An overview image together with the number plate image, ANPR output, time stamps and location data forms an evidential record that is sufficient to prove that the vehicle was present.

The enforcement process starts with the capture of an 'evidential record' at the enforcement site. To reduce transmission costs, the records would probably be stored at site and details of the VRM only sent to the centre. These would be stored in a database and compared with the 'Current Payments' database in the payments system. Evidential records for those vehicles that had not paid would then be transmitted to the central system and unrequired records deleted at site. In parallel, access will be necessary to the Vehicle Licensing database to obtain keeper details of vehicles where an offence is suspected. Manual checking of the records would be undertaken and a PCN could then be issued.

The process detailed above raises privacy issues with collecting data about a particular trip, storing of that data and access to private information kept in the vehicle licensing database.

5.1.2.3 Legislation

There are two pieces of legislation that give guidance as to the likely privacy requirements that would need to be put in place for a road pricing scheme:

5.1.2.3.1 New Zealand Privacy Act 1993

The New Zealand Privacy Act of 1993 sets out a series of principles (12 in total) for information privacy which would need to be considered. These principles relate to issues of collecting, storing and disclosing information. To address these principles any road pricing scheme would need to have transparent and clearly articulated privacy policy in operation.

5.1.2.3.2 Land Transport Management Act 2003

The issue of privacy is dealt with under the section related to tolling in the Land Transport Management Act. It states, *inter alia*, that the toll operator must not use the personal information for other purposes, and that the operator and enforcement authorities should each have a privacy statement and policy document freely available to the public. It requires road users to be given an option for payment that does not record personal information.

Using this as an indication of the requirements which may be placed on a road pricing scheme it would seem likely that there would be a requirement for a detailed privacy policy and for users to be able to establish confidential accounts.

5.1.2.4 Legislation and Privacy Conclusions

There is currently no legislative mandate that would allow for road pricing of existing infrastructure. Therefore, new or modified legislation would be required before any road pricing scheme could be implemented. In general terms, the legislation would be required to provide for the *ability to implement a charge* and the *ability to enforce the charge*.

Assuming that the legislative framework was similar to the LTMA, even with legislative provisions in place, direct approval for a road pricing scheme would still be required from the Minister of Transport. It is likely that a road pricing scheme would need to be established by the Governor-General by OIC, on recommendation by the Minister.

Road pricing relies on gathering and matching data of a personal nature, however through a carefully designed scheme with an appropriate privacy policy, privacy issues should be able to be addressed.

A review of privacy issues and appropriate legislation highlights the following areas of particular importance when considering the collection and use of private information:

- The time information is kept for, and how and when records are deleted
- Sharing information or sourcing/ matching up details from other data bases (addresses from the Vehicle Registry for instance)
- Checking records for accuracy and correctness before action is taken
- Using the information for a specific, stated reason
- Storing and using the information safely
- The potential to collect useful additional information but the need to ensure that information is used lawfully

Data will typically be stored in a 'back office' management system, and the function and design of this back office system must be carefully considered in relation to privacy. The back office storage system would need to be secure, and also provide the type or assurances the Acts require. Any use of the data must also be in compliance with the relevant Act. This could be ensured by the drafting of a well considered privacy policy. Provision of anonymous prepaid accounts would allow people to make payments without having personal data recorded.

5.2 Public Acceptability Review

A key factor in the successful introduction of road pricing within the greater Wellington region will be the level of public acceptability for the general principle of road pricing.

The principle of public sector tolling to fund new infrastructure is well understood with experience of tolling schemes such as the Lyttelton Tunnel, the Auckland Harbour Bridge and the Tauranga Harbour Bridge. The options being investigated in this study however, involve tolling existing roads for the purposes of reducing congestion, not tolling as a funding mechanism for new infrastructure. The public is likely to have substantially different opinions on this form of road user charging. It is therefore critical that the response to road pricing be investigated and evaluated.

There can be social and political barriers to the introduction of almost any road pricing scheme. These issues have resulted in otherwise well justified road pricing schemes failing to be implemented elsewhere. This was the case with the Edinburgh Congestion charge, which was defeated by adverse public opinion.

Given that any road pricing scheme is unlikely to enjoy majority acceptability initially, and that schemes can be designed to promote acceptability, it is appropriate that we look at the factors that influence acceptability.

A review of available local and international literature was undertaken in Stage 1 and identified the following major factors that can affect the acceptability of road pricing measures:

- Alternatives to the car and their perceived effectiveness
- Use of the revenues generated
- Scale of the congestion problem
- Understanding the purpose of road pricing
- Considerations of equity and fairness of the pricing
- Form, technology, complexity and privacy
- Political leadership and public trust

A number of recent studies and strategies have investigated the issue of road pricing in New Zealand. These include the GWRC Regional Travel Demand Management Strategy and the Auckland Road Pricing Evaluation Study.

5.2.1 GWRC Regional Travel Demand Management Strategy

The Strategy states that “Non-pricing ‘soft’ TDM mechanisms, such as travel planning, are only anticipated to influence travel demand at the margins. While this is enough to realise some noticeable benefits, it is important to send very strong signals to the community that use of single occupied cars for commuter trips is an inefficient use of the network. This is why the introduction of ‘hard’ TDM mechanisms in the form of road pricing must be considered, in conjunction with the soft measures since they support the mechanisms by which individuals can make more informed travel choices. Once introduced, it is anticipated that road pricing would significantly influence peak travel demand on the region’s network, with the added benefit of generating revenue for transport improvements.”

The strategy committed to further investigation of road pricing and advocacy to central government for the introduction of legislation allowing for road pricing of existing routes.

Thirty-one Submissions were received and 10 mentioned road pricing, which is a very small response to the issue. These were generally supportive of road pricing or further investigation into road pricing. The importance of understanding the social and economic impacts as well as achieving public acceptability was noted. One submission felt that the congestion in Wellington was not bad enough to warrant road pricing at present.

5.2.2 Auckland Road Pricing Evaluation Study

The ARPES undertook some qualitative and quantitative research looking at the issue of public acceptability of road pricing in Auckland. While Auckland is quite different to the Wellington context because of its differing geographic make up and trip making patterns, it nevertheless provides some insight on the issue in New Zealand.

The qualitative research involved focus groups and interviews while the quantitative research was undertaken via telephone interviews. Some of the key issues in relation to acceptability in Wellington included:

- Auckland is a different situation to Wellington. 94% of people in Auckland see congestion as an important or very important issue. However, surveys in Wellington in 2003⁶ showed that only 63% of respondents felt that Wellington had a significant congestion problem.
- Roughly half of Auckland respondents think a \$2.50 charge is a good thing. This reduces quickly as costs increase (23% at \$5 and only 13% at \$10).
- Responses were based on personal cost and a sense of the greater good. What appears to drive attitudes is whether they would pay a charge and the quality of public transport options available. Parking levies and strategic network charges were both the most popular on average when people were asked about their most preferred schemes and the least popular when people were asked about their least preferred schemes. This shows that there were no clear winners because some people thought they would benefit and others thought they would lose from different types of schemes.
- Cordon schemes were more acceptable because they target areas of congestion and were perceived as likely to be more effective overall.
- Support for road pricing increased if revenues were hypothecated towards the types of improvements the individual supported (44% to 60%). Noticeably, Aucklanders also wanted road improvements as well as PT improvements.
- The findings from the Auckland research show similar levels of support to studies undertaken in London prior to implementation of the Congestion Charge scheme there. Those remained stable until after implementation when support increased significantly.

5.2.3 Acceptability Conclusions

Any form of road pricing is unlikely to gain widespread public support in Wellington initially. Therefore, a clear strategy would need to be developed to build support for a road pricing scheme, before during and after implementation. This would include the following:

⁶ *Community Attitudes to Road Pricing in the Wellington Region*, gravitas, 2003

Well-articulated vision and strategy - At the officer level a well-articulated vision and strategy would need to be developed to promote public acceptability. This would involve building on the TDM Strategy to document and promote targeted steps to gain political support and identify the steps required to build public acceptability. It should set out the purpose of road pricing, and identify the congestion problems it is intended to address.

Strong political leadership – At the elected representative level a strong political champion would be needed to support the introduction of road pricing. This would be essential in building support and public trust.

Hypothecation of revenues – The use of the revenues would need to be clearly hypothecated. Excess revenues would need to be ring fenced and clearly earmarked for particular transport improvements to build public confidence that there will be flow on benefits from the scheme and that road pricing is not simply an additional form of tax.

Transparency and accountability – Suitable institutional structures would need to be considered to provide the public with transparency in the way the scheme was operated and the way that charges collected are used, and accountability for the operation of the system.

Fair and equitable – The scheme developed must be clearly seen to be fair and equitable.

Education and information – At an early stage a programme of public education about road pricing informing them of the options, benefits and impacts would need to be developed. This would need to continue through the investigation, implementation and post implementation periods.

5.3 Impacts on Passenger Transport

5.3.1 Impacts on Bus and Rail Patronage

In order to assess the potential impact on PT services, percentage changes in patronage in key corridors for the AM peak were extracted from WTSM at the following screenlines (Table 5-1) which were located to intersect the main PT corridors:

- Between Petone and Ngauranga
- Between Paekakariki and Pukerua Bay
- South of Glenside
- South of the Wellington CBD

Table 5-1: Percentage Change in AM Peak PT Patronage on Key Corridors

	Base	CC		NS		YI		YM		YMS		CY	
	Patronage	Patronage	% diff	Patronage	% diff	Patronage	% diff	Patronage	% diff	Patronage	% diff	Patronage	% diff
Petone-Ngauranga sb rail	4620	4578	-1%	4500	-3%	4505	-2%	4300	-7%	4305	-7%	4421	-4%
Petone-Ngauranga nb rail	305	338	11%	300	-2%	265	13%	276	-10%	286	-6%	314	3%
Petone-Ngauranga sb bus	1064	1602	50%	1607	51%	1788	68%	1488	40%	1489	40%	1697	59%
Petone-Ngauranga nb bus	517	551	6%	519	0%	552	7%	593	15%	620	20%	547	6%
Paekakariki-Pukerua sb rail	1582	1683	6%	1666	5%	1650	4%	1685	7%	1685	6%	1694	7%
Paekakariki-Pukerua nb rail	324	328	1%	324	0%	325	0%	323	0%	324	0%	325	0%
Sth of Glenside sb rail	5687	6211	9%	6138	8%	6066	7%	5940	4%	5938	4%	6111	7%
Sth of Glenside nb rail	486	518	7%	485	0%	491	1%	488	0%	500	3%	504	4%
Sth of Glenside sb bus	525	592	13%	589	12%	539	3%	513	-2%	513	-2%	556	6%
Sth of Glenside nb bus	78	81	5%	78	1%	76	-2%	76	-3%	76	-2%	78	1%
South CBD in bus	3078	4583	49%	3029	-2%	3045	-1%	3137	2%	4245	38%	3824	24%
South CBD out bus	840	857	2%	862	3%	859	2%	840	0%	802	-5%	856	2%



These changes are relative to the no pricing case and are additional to general forecast growth.

From this table we can see a number of important impacts:

- Southbound bus patronage has increased considerably between Ngauranga and Petone, while the rail patronage in the same direction has remained relatively steady or decreased. This indicates that there is increased demand for PT along this corridor, however improved travel times and reduced congestion on the road network are making the bus services more attractive than the rail and patronage is going onto the bus services. While the bus increase is substantial as a percentage of the base case bus patronage because of the small base bus patronage, even the highest increase for the Y inner option relates to only an 11% increase in all PT trips (or approximately 700 trips in the peak 2 hours).
- Similarly, northbound (counter peak) bus patronage between Ngauranga and Petone increases, particularly for the options which impose a counter peak charge at Petone (i.e. YM and YMS). However, in total number terms, this is only minor (< 100 trips in the 2 hour peak).
- Southbound rail patronage increase by up to 7% between Paekakariki and Pukerua Bay for some options, however the increase in terms of the total number of trips is only minor (in the order of 100 trips). The Waikanae electrification combined with new rolling stock will see improvements to peak period frequency along this section.
- Moderate increases in southbound rail patronage of between 4% and 9% are forecast in the corridor south of Glenside (300 – 550 trips in the 2 hour peak). This increase would appear to be in the order of 2–3 years forecast general growth.
- Only bus services cater for trips from the south of the Wellington CBD, so only bus patronage figures are shown. The CBD cordon, Y + southern screenline and the CBD + Y screenline are the only options which impose charges on trips from the south of the city, so are the only options that show significant impacts (24 – 49% patronage increases). These are significant increases in bus patronage in the order of 1,500 trips over the 2 hour peak for the Wellington CBD cordon option. This increase is due to the high single point charge imposed on all trips means that public transport becomes much more attractive for short distance trips across the screenlines.

Increases in rail patronage are generally small in the AM peak (in the order of 7%), however as there are reports of overcrowding on current rail services during peak periods these small increases could exacerbate the problem. In order to cater for increases in rail patronage, the following types of improvements would need to be considered:

- Improvements to the Wellington Station Approach / Throat (to provide additional capacity)
- Signalling improvements to accommodate shorter headways
- Provision of additional rolling stock

- Other infrastructure enhancements such as track duplication in the Pukerua Bay area
- Additional Park 'n' Ride facilities.

These types of improvements are currently required to improve services to cater for future demand and are substantially planned for in the GWRC Rail Business Case and the Western Corridor Plan. It is therefore unlikely that the additional demand (maximum 700 trips in 2 hour peak), forecast as a result of introducing road pricing, would trigger the need for significant further investment in the rail network by itself.

For most bus corridors (especially with the non-CBD cordon or southern screenline options), the changes in bus patronage are marginal and readily catered for by minor capacity increases. The options which involve charges to the south of the CBD would result in significant increases in bus patronage from the south and east of the CBD. Because the majority of bus services use the existing roading infrastructure, the provision of additional capacity could be catered for through the procurement of additional bus services with new or larger buses. As road pricing is intended to reduce congestion, buses would experience reduced travel times after implementation, improving service performance. It is assumed that as part of a package of complementary measures, bus priority improvements such as bus lanes and signal pre-emption could be provided to improve services.

The Ngauranga to Airport Strategic Study is currently investigating the provision of PT services and the mix of infrastructure along the important Wellington CBD corridor. GWRC have advised that this study will provide an important input into the solutions developed for the CBD corridor.

This review indicates that there are unlikely to be any fundamental constraints to introducing a road pricing scheme due to additional demand for PT provided that planned improvements are made.

5.3.2 Impacts on Park n Ride

In order to assess the impact on park 'n' ride facilities, the rail patronage immediately downstream of key park 'n' ride sites was extracted for the no pricing case and for the pricing options being investigated (Table 5-2). Assuming that the proportion of park 'n' ride access to rail remains constant, the percentage change in trips gives an indication of the increase in park 'n' ride demand.

Table 5-2: Percentage Change in AM Peak Rail Patronage Near Key Park ‘n’ ride Sites

Park ‘n’ Ride Site	Base	CC		NS		YI		YM		YMS		CY	
	Patronage	Patronage	% diff	Patronage	% diff	Patronage	% diff	Patronage	% diff	Patronage	% diff	Patronage	% diff
Paraparaumu	1450	1541	6%	1526	5%	1512	4%	1543	6%	1543	6%	1551	7%
Paekakariki	1582	1683	6%	1666	5%	1650	4%	1685	7%	1685	6%	1694	7%
Paremata	2978	3190	7%	3158	6%	3127	5%	3113	5%	3113	5%	3172	7%
Porirua	4639	5014	8%	4955	7%	4902	6%	4831	4%	4832	4%	4950	7%
Tawa	5342	5821	9%	5751	8%	5685	6%	5576	4%	5576	4%	5731	7%
Redwood	5643	6160	9%	6088	8%	6017	7%	5894	4%	5892	4%	6062	7%
Takapu Rd	5687	6211	9%	6138	8%	6066	7%	5940	4%	5938	4%	6111	7%
Upper Hutt	647	673	4%	665	3%	676	5%	659	2%	659	2%	673	4%
Silverstream/Heretaunga	1325	1359	3%	1344	1%	1354	2%	1334	1%	1346	2%	1352	2%
Taita	2100	2157	3%	2130	1%	2152	3%	2140	2%	2152	3%	2154	3%
Lower Hutt/Waterloo	3802	3884	2%	3824	1%	3835	1%	3704	-3%	3715	-2%	3779	-1%
Melling	220	200	-9%	198	-10%	205	-7%	183	-17%	182	-17%	195	-11%
Petone	4620	4578	-1%	4500	-3%	4505	-2%	4300	-7%	4305	-7%	4421	-4%
Johnsonville	32	27	-14%	34	7%	30	-6%	28	-11%	28	-10%	28	-12%



All options show increases in patronage between 4% and 9% for park ‘n’ ride sites to the north of Wellington on the SH1 corridor, with small growth or reductions on other lines.

The options with charges imposed to the north and at Pukerua Bay showed the largest increases to sites furthest to the north, while options with charges focused closer to the Wellington CBD showing greatest increases at southern stations. In terms of total numbers of trips, the maximum increases are in the order of 500 trips.

There are currently approximately 1600 park ‘n’ ride parks provided to the north of the CBD on the Western Line. It is understood that there are currently proposals for approximately:

- 300 at Raumati Station (with room for an additional 300);
- 600 at Lindale Station;
- 40 at Paraparaumu; and
- small capacity improvements at Paekakariki.

Assuming the same proportion of park ‘n’ ride usage as at present, and a maximum 10% increase in patronage, this would indicate that overall approximately 160 additional parks would be required as a result of road pricing. This would require the construction of additional parks at a number of sites that could potentially be funded through any excess scheme revenues. The quantum of additional parks required does not appear to be substantial given existing proposals.

5.4 Complementary and Competitive Measures

The analysis of the road pricing options has been undertaken on the basis of an assumed future transport network. This was agreed with GWRC at the beginning of this study and the improvements which have been assumed are included in the modelled scenarios are detailed in Section 2.5.

It is important to understand that road pricing would not stand on its own, but would be an integral part of the future transport strategy for the region. It would need to be implemented as part of a package of measures and would need to be considered in the wider context of transport infrastructure investment as a whole. Some measures could be put in place which would support road pricing schemes and we have referred to these as “complementary measures”, while equally there are measures which would reduce the effectiveness of a road pricing scheme which we have referred to as “competitive measures”.

5.4.1 GWRC Regional Travel Demand Management Strategy

The objective of the GWRC TDM strategy is to “use Travel Demand Management initiatives in achieving sustainable outcomes for the greater Wellington land transport system”. Road pricing is itself a TDM tool, however the strategy focuses on “soft” or non-pricing measures which include:

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- Travel planning
- Travel behaviour change
- Network management (inc. Advanced Traffic Management Systems (ATMS), ramp metering etc.)
- Awareness campaigns
- Integrated land use and transportation planning

These measures could be designed to be complementary to road pricing and can achieve effective gains against the NZTS and RLTS objectives on their own but have the ability to be strengthened by road pricing. TDM measures could also reduce the efficiency of road pricing by reducing congestion and therefore limiting road pricing benefits.

5.4.2 Network Optimisation

Network optimisation measures designed to make the best use of the existing infrastructure will be complementary to a road pricing scheme. This might involve localised intersection improvements, local traffic management schemes, tidal flow arrangements etc. which will make the network operate more efficiently without creating significant additional capacity.

5.4.3 Scheme Specific Measures

These measures are generally small scale and relate to mitigation of impacts of a road pricing scheme itself. These could include:

- Local traffic management schemes to stop “rat running” around cordon boundaries by people trying to avoid charges
- Implementation of controlled parking zones to deter parking on residential streets around the screenlines
- Improvement to specific PT services where additional demand has been created or where people would be disadvantaged through the lack of alternatives to the car
- Consideration of rating relief, exemptions etc. for specific groups disproportionately disadvantaged by a road pricing scheme
- Improved walking and cycling facilities

The measures above are complementary to road pricing and address some of the negative impacts of the road pricing schemes themselves. In development of the cordons and screenlines consideration was given to minimising the options for “rat running” (rerouting) by locating them efficiently and it is not envisaged that significant local traffic management work would be required for any of the schemes.

5.4.4 PT Service Improvements

Service frequency improvements along with upgrades of vehicles and station, waiting areas and interchange facilities will increase the attractiveness of PT. These PT service improvements could be complementary to road pricing as they provide a more viable and attractive alternative to the car, improving the effectiveness of road pricing. Alternatively they could be competitive by reducing congestion to levels where road pricing viability is compromised.

5.4.5 Additional Infrastructure

Road pricing will not necessarily avoid the need for further infrastructure. It is not a stand-alone measure but should be seen as one element in an integrated package of measures.

Road pricing used in a singular fashion will require high charging regimes to address network wide issues which will lead to inefficiencies in the use of some infrastructure, significant equity issues, and adverse impacts on the regional economy. Similarly, road construction on its own cannot be as effective as road pricing over a network experiencing congestion. Further, road construction on a network wide scale would not be affordable and brings unacceptable community and environmental problems.

An integrated package of measures is required that includes road pricing, investment in PT, walking and cycling, road construction, and complementary measures. These measures are not independent but need to be brought together in an optimised package to generate best effect. Further, it should be recognised that a natural outcome of road pricing is to facilitate investment in transport infrastructure, not avoid it. As this report has highlighted the allocation of surplus revenues to reinvest in efficient transportation infrastructure has potential to significantly enhance network outcomes.

It is difficult to see how a toll road similar to the proposals for Transmission Gully could operate in tandem with a road pricing scheme. This type of scenario has not been implemented elsewhere and the charging focus for the two schemes would be fundamentally different. Tolling has the objective of maximising the number of vehicles using the tolled route to generate revenues and recover the investment costs. Road pricing however attempts to increase the cost to a point where trip making is reduced or retimed out of the charged period.

5.4.6 Timing of Implementation and Impact on the Transport Infrastructure Investment Programme

Road pricing impacts on congestion in peak periods and therefore provides opportunities to defer investment in future infrastructure on an economic basis. However, under the current transport funding framework, there are other considerations in deciding the mix of schemes that are progressed. In this respect, road pricing is not a solution in itself but one of a range of tools that can be used to shape the future transport strategy for the region.

It is clear from the investigations undertaken to date that road pricing would have real benefits if implemented in Wellington in the near future. It was assumed that implementation would occur in 2011 and this analysis showed that there would be clear benefits if road pricing was implemented then. As discussed above, the optimal timing of implementation is largely related to the future infrastructure investment programme and how that would impact on the effectiveness of the schemes developed. Road pricing will need to be considered in the strategic planning for transport in the region. This will take place through the RLTS review, where the package of transport infrastructure investment will need to be assessed with road pricing as part of the mix.

5.4.7 Complementary and Competitive Measures Conclusions

As discussed in section 5.4.5, road pricing should not be seen as a stand-alone measure but as part of a wider package of measures that have been collectively optimised. These other measures will include road construction, investment in PT, walking and cycling and implementation of TDM measures.

Other Travel Demand Management measures include a wide range of techniques such as travel plans, carpooling, telecommuting etc. These will be assisted by road pricing.

5.5 Risks

5.5.1 Risk Management Process

The Risk Management Process adopted for the Study is based on the AS/NZS4360 standard and Transit's Risk Management Process Manual. The approach adopted is a "General Approach" as defined in the Process Manual. The General Approach is a qualitative approach, which is acceptable for a strategic study of this nature.

The approach consists of establishing the context of the risk management process, the identification of risks, analysis and evaluation of the identified risks in a qualitative manner and an assessment of applicable treatments. It is important to note that a Risk Management Process will necessitate proper communication and consultation as well as monitoring and review, which will form part of the detailed design, implementation and operational phases of the project, on an ongoing basis.

5.5.2 The Context

The study stems from the need to consider other measures to address the existing and future congestion problems in the greater Wellington region. At this stage, it is unclear who is going to take ownership of a Wellington Road Pricing System (WRPS), although it is likely to be an organisation with over-arching planning and administrative duties, such as GWRC. However, it is possible that the project will be run either by another public sector agency altogether, by a private sector company or by a "consortium" of several public sector agencies and/or private companies. The agency/ company taking ownership of the WRPS will need to develop internal controls at the

appropriate time. We have not looked at the internal risk management process any further at this stage.

There is also a need to consider the relationship of the WRPS with external parties and agencies. In this regard, we have identified the following external parties who will be involved in the WRPS in one way or another:

- The MoT
- LTNZ
- Transit NZ
- Local authorities

There is also a linkage to the legislative process, as undertaken through Parliament, as we do not believe there is adequate legislation in place at present to allow for the implementation of a Road Pricing Scheme.

The relationships between these organisations and the WRPS Owner are unknown at this stage, but there is a risk that a breakdown in the relationship may cause delay in implementation or even suspension of the WRPS. Because the nature of these relationships is not yet known, it is best addressed during the detailed design and implementation phase of the scheme. However, it is useful to note this external context at this early stage.

Because this is a new scheme, we have not explicitly analysed any existing controls, although one might argue that there are existing controls in place in some instances, eg. when it comes to passing legislation enabling Road Pricing in Wellington.

5.5.3 Risk Criteria

The strategic nature of the study means that the risk criteria cannot be highly detailed at this stage. We have considered the following risk criteria and parameters when completing the risk assessment:

Image/ Reputation:	Likely effect on the image of GWRC and other associated agencies, if the implementation of Road Pricing does not work. Also considers the effect on the image of Road Pricing as a scheme. The criteria considers the type and level of media coverage to establish the consequences of the various risks identified. This can range from sustained international media coverage to brief local media coverage.
Stakeholder interest:	Likely level of inquiry into road pricing if something went wrong. This can range from a Commission of Inquiry to a minor complaint.

Cost implication: Likely level of cost implication because of an event. Ranges between less than \$10K to more than \$10M.

Time implication: Likely level of delay if an event occurs. Ranges between a few days to several years.

5.5.4 Risk Identification

5.5.4.1 Legislative

New legislation will have to be passed for the road pricing scheme to be introduced.

- a) There is a risk that the Government will not support the scheme. If this happens the scheme will be delayed for several years or delayed indefinitely.
- b) There is a further risk that, even if Government supports the scheme, the legislation will not get through the House of Parliament. This would cause the scheme to be abandoned.
- c) Even if the legislation is passed, there is a risk that the legislation will be ineffective or unworkable. If this happens the scheme will not operate as it should, and will be ineffective. This will likely cause sustained media coverage, possible Ministerial Inquiries and several million dollars of taxpayer's money to address.

5.5.4.2 Technological

There are numerous technological risks associated with this scheme. At this stage of the project, we are only concentrating on the high level strategic risks associated with technology. When the scheme is designed in more detail, it will be appropriate to investigate a far larger number of technological risks associated with the detailed design and implementation of the scheme.

- a) There is a risk that the cost of the technology will be unaffordable. This will cause the implementation of the scheme to be delayed. It will cause some national media coverage, Ministerial questions and may cause the scheme to be delayed for a year or more, or even abandoned if the affordability issue cannot be addressed.
- b) There is a further risk that the technology will not meet its functional requirements. This will reduce the effectiveness of the scheme. It will cause some national media coverage, likely questions in Parliament and cost several millions to rectify.
- c) Even if the technology is adequate when introduced, there is a risk that it will become outdated. In that case the scheme will become less cost effective to operate in future. It will not however cause substantive delays or be the subject of Ministerial inquiries. There may be some short term media coverage.
- d) There is a risk that the cost effectiveness of the scheme will be compromised if a single supplier gains a monopoly on future upgrades. This will however not cause substantive delays or substantial media coverage.

5.5.4.3 Implementation and Enforcement

a) There is a risk that the infrastructure consents would be difficult to obtain. This would have substantial impacts on the process, as it could result in several years' delay or even the possible cancellation of the project.

5.5.4.4 Financing, Funding and Revenues

- a) There is a risk that the promoter of the scheme will be unable to find a source of initial capital investment. The result will be that the scheme may no longer be viable, and this will have a substantial effect on the project, as it may cause the project to be cancelled.
- b) It is possible that Land Transport New Zealand will reduce the regional funding contributions because of the revenues of the scheme. If this happened, it could delay the implementation of some infrastructure projects.
- c) Interest rate or currency fluctuations are always possible, and would have a financial impact, albeit that this impact is likely to be small compared to the overall cost of the scheme.
- d) It is unclear how Government will treat the revenues, and if they are perceived as a tax, Government may “hijack” these revenues. Government may also choose to reallocate the additional resources to other areas of expenditure not related to transportation. If this happens the overall attractiveness of the scheme will be affected, especially if the revenues were earmarked as a return on operating the scheme.

5.5.4.5 Forecasting

- a) Forecast traffic growths may not eventuate, and this may cause the revenues collected to be less than anticipated, impacting on the financial viability of the scheme. This may have a serious impact on the future of the scheme.
- b) It is also possible that the revealed elasticities to price are different from the assumed elasticities. If the revealed elasticities are less than anticipated, more traffic will use the roads and this will actually increase the viability of the scheme. If the elasticities are more than anticipated, the result will be similar to that in the point above, namely a reduction in revenues and a negative effect on the viability of the project.

5.5.4.6 Public and Political Acceptability

A scheme of this nature is likely to evoke an emotional response from the public and other stakeholders. It is uncertain how easily people will accept being charged to drive into Wellington, especially if no alternative road is provided (compared to the case for tolling proposals).

The general public may boycott the use of the roads, or turn to vandalism. They may also form lobby groups to pressure decision makers into scrapping the scheme. This will result in the scheme becoming less attractive, and may cause political fallout if elected officials feel that they have a

mandate from their constituents to lobby for change. Politicians may also try to veto legislation, or obstruct or delay implementation through eg filibustering.

Local government agencies may oppose the scheme and obstruct legislation or implementation, try to limit access to sites for infrastructure by passing bylaws, and delay the whole process by requiring numerous technical reviews or obstructing funding applications.

Stakeholders such as businesses may object to the proposed changes, and could even go so far as to relocate, either to an area just outside the congestion charging zone, or in more extreme cases to alternative locations further afield. It could also impact on businesses' decisions on where to establish new offices/ stores and could lead to the centre of Wellington becoming a less attractive business location compared to other centres such as Petone, Hutt City etc.

Labour organisations who feel their members are being disadvantaged may call for industrial action.

There could also be potential Iwi claims that would need to be addressed.

5.5.5 Risk Assessment

The risks identified above were assessed, based on the likelihood of it occurring, and the consequence of it occurring.

The likelihood is rated as follows:

- Rare: The event will only occur in exceptional circumstances, or a very good state of knowledge has been established about the threat.
- Unusual: The event will only occur infrequently, or a good state of knowledge has been established about the threat.
- Unlikely: The event will only occur occasionally, or a moderate state of knowledge has been established about the threat.
- Quite common: The event will commonly occur, or a poor state of knowledge has been established about the threat.
- Likely: The event can be expected to occur, or a very poor state of knowledge has been established about the threat.

The consequence is rated as follows:

- Negligible: Short term damage, low cost implications, minor complaints.
- Minor: Some local media cover, a few weeks' delay, up to \$100k cost implications.

- Medium: More sustained media coverage, Ministerial questions and up to \$1 million in cost implications.
- Major: Sustained national media coverage, Ministerial Inquiry, years’ delay in the project and several million dollars in cost implications.
- Substantial: International media coverage, Commission of Inquiry, many years delay to the project and cost implications in excess of \$10 million.

The following table presents a summary of the risk assessment levels.

Table 5-3: Risk assessment table

		Consequence (C)				
		Negligible	Minor	Medium	Major	Substantial
Likelihood (L)	Likely	High	High	Extreme	Extreme	Extreme
	Quite common	Moderate	High	High	Extreme	Extreme
	Unlikely	Low	Moderate	High	Extreme	Extreme
	Unusual	Low	Low	Moderate	High	Extreme
	Rare	Low	Low	Moderate	High	High

The following treatments are recommended:

- Low Risk: Accept and monitor
- Moderate Risk: Accept actively but enhance systems to deal with the threat. Take out insurance, draw up contingency plans etc.
- High Risk: Avoid or transfer risk, take out insurance, draw up contingency plans etc.
- Extreme Risk: Avoid risk, take immediate action.

The following table presents the outcome of the risk assessment:

Table 5-4: Risk table

Risk	Likelihood	Consequence	Risk Score/ Level
1.1 Government does not support scheme	Unusual	Substantial	Extreme
1.2 Legislation does not get through Parliament	Unusual	Substantial	Extreme
1.3 Ineffective/ Unworkable legislation	Unlikely	Major	Extreme
2.1 Cost of technology unaffordable	Unusual	Major	High
2.2 Technology does not meet functional requirements	Rare	Major	High
2.3 Technology becomes outdated	Unusual	Minor	Low
2.4 Single supplier or monopoly	Unusual	Minor	Low
3.1 Consents difficult or unattainable	Rare	Substantial	High
4.1 Cannot find source for initial capital investment	Rare	Substantial	High
4.2 Reduced regional funding from Land Transport New Zealand because of revenues from scheme	Unusual	Medium	Moderate
4.3 Interest rate increase or currency fluctuations	Quite common	Minor	High
4.4 Revenues “hijacked”	Unlikely	Major	Extreme
5.1 Forecast traffic growth does not eventuate	Rare	Major	High
5.2 Revealed elasticities lower than assumed elasticities	Unlikely	Negligible	Low
5.2 Revealed elasticities higher than assumed elasticities	Unlikely	Major	Extreme
6.1 Public boycott use	Rare	Medium	Moderate
6.2 Vandalism	Unusual	Negligible	Low
6.3 Civil disobedience	Rare	Medium	Moderate
6.4 Lobby Groups form to retract scheme	Unlikely	Medium	High
6.5 Agencies obstruct legislation or implementation	Unlikely	Major	Extreme

Risk	Likelihood	Consequence	Risk Score/ Level
6.6 Agencies pass by-laws or restrict access	Rare	Major	High
6.7 Agencies require reviews	Quite common	Medium	High
6.8 Agencies obstruct funding mechanisms	Unusual	Major	High
6.9 Politicians veto legislation	Unusual	Substantial	Extreme
6.10 Politicians are obstructive	Unlikely	Major	Extreme
6.11 Politicians filibuster in Parliament	Unlikely	Medium	High
6.12 Stakeholders commit commercial sabotage	Rare	Major	High
6.13 Strikes	Rare	Medium	Moderate
6.14 Stakeholders form lobby groups	Quite common	Major	Extreme
6.15 Businesses relocate to areas outside charging zone	Rare	Medium	Moderate
6.16 Iwi claims	Rare	Minor	Low

5.5.6 Treatments

Table 5-5: Treatments

Risk	Risk Score/ Level	Treatment
1.1 Government does not support scheme	Extreme	Immediate action needs to be taken, and steps should be taken to gauge Government's view on the scheme, and to investigate ways to canvas for support. This is however always a risk in a contentious issue, and cannot fully be addressed within the scope of our work.
1.2 Legislation does not get through Parliament	Extreme	As above.
1.3 Ineffective/ Unworkable legislation	Extreme	Set up a very good structure to review legislation, with references if possible to successes and failures of similar schemes elsewhere.
2.1 Cost of technology unaffordable	High	Draw up contingency plans by designing the scheme in a way that allows for partial/ staged implementation. Develop a cost/ risk share model.
2.2 Technology does not meet functional requirements	High	Take out insurance against failing technology, underpinned by robust technical functional requirements. Choose proven technologies and suppliers.
2.3 Technology becomes outdated	Low	Low risk; Monitor. Consider interoperability during design.
2.4 Single supplier or monopoly	Low	Low risk; Monitor. Consider interoperability during design.
3.1 Consents difficult or unattainable	High	If legislation identifies it as a traffic management function, it will not require consents.
4.1 Cannot find source for initial capital investment	High	Identify sources of funding early and lock it in through contracting arrangements.

Risk	Risk Score/ Level	Treatment
4.2 Reduced regional funding from Land Transport New Zealand because of revenues from scheme	Moderate	Moderate risk so can be accepted as long as there are some contingencies in place. Review Capital Programme to see how vulnerable it is to reduction in funding.
4.3 Interest rate increase or currency fluctuations	High	Insure against negative effects of fluctuations by taking out forward contracts.
4.4 Revenues “hijacked”	Extreme	Immediate action needs to be taken, and steps should be taken to gauge Government’s view on the scheme, and to investigate ways to canvas for support. This is however always a risk in a government funding environment, and cannot fully be addressed within the scope of our work.
5.1 Forecast traffic growth does not eventuate	High	Undertake sensitivity testing and evaluate effects. Review modelling and update regularly.
5.2 Revealed elasticities lower than assumed elasticities	Low	Low risk, monitor. Undertake sensitivity testing and evaluate effects.
5.2 Revealed elasticities higher than assumed elasticities	Extreme	Undertake sensitivity testing and evaluate effects.
6.1 Public boycott use	Moderate	These risks all relate to public and political acceptability. At this stage the risks range from extreme to low. A comprehensive plan of action of required to address acceptability, and will have to be developed in parallel with the future stages of this study process. The treatment plan may need to include identification of a political champion, clear and early public relations campaigning. Information campaigns and possible mitigating techniques such as rates compensations.
6.2 Vandalism	Low	
6.3 Civil disobedience	Moderate	
6.4 Lobby Groups form to retract scheme	High	
6.5 Agencies obstruct legislation or implementation	Extreme	
6.6 Agencies pass by-laws or restrict access	High	
6.7 Agencies require reviews	High	
6.8 Agencies obstruct funding mechanisms	High	
6.9 Politicians veto legislation	Extreme	
6.10 Politicians are obstructive	Extreme	

Risk	Risk Score/ Level	Treatment
6.11 Politicians filibuster in Parliament	High	
6.12 Stakeholders commit commercial sabotage	High	
6.13 Strikes	Moderate	
6.14 Stakeholders form lobby groups	Extreme	
6.15 Businesses relocate to areas outside charging zone	Moderate	
6.16 Iwi claims	Low	

6. Conclusions

All road pricing options considered in this report have positive impacts on:

- Safety and Personal Security (generally small impacts);
- Access, Mobility and Network Reliability (strong impacts);
- Public Health (slight impacts and all options the same);
- Environmental Sustainability (slight impacts and all options the same);
- Efficiency and Affordability (generally moderate impact).

The analysis shows that road pricing in the greater Wellington context is economically and fiscally viable. Excess revenues, in the order of \$20 to \$40M per annum, would provide a funding stream for investment in transport infrastructure and services.

Further, road pricing at the relatively low charging levels proposed is likely to generate useful travel benefits through reducing congestion and travel time. These travel benefits are likely to lead to improved regional economic performance through enhanced accessibility, particularly for vehicles which have a high value of time such as commercial vehicles. This evaluation concludes that the social impacts of road pricing are likely to be able to be managed so that they are small.

While the YMS option appears to provide the best overall performance, all the options tested perform similarly under the objectives of the RLTS. This indicates that a simple road pricing system could be implemented in greater Wellington which would attract a large proportion of the benefits that a more comprehensive scheme would generate and could be expanded in the future, as acceptability and available technology improved. The options do however perform differently under some specific measures and a decision on a preferred scheme would be dependant on which particular issues were considered the most important by decision makers.

It is important to see road pricing as one component of the overall regional transport strategy, rather than a stand-alone initiative. The next stage of developing a road pricing scheme for the greater Wellington region will need to involve consideration of road pricing as part of the mix of future transport investment projects in the RLTS.

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Appendix A Financial and Economic Analysis



This note describes the economic and financial evaluation undertaken as part of the overall KPI assessment for the WRPS.

The benefits and charges paid (revenues) for each option were extracted from the corresponding WSTM runs and the cost estimates were developed as detailed in Section 2.9.7 of the Wellington Region Road Pricing Study - Stage 2 - Technical Report

Benefits and Charges/Revenues

The WTSM was run in years 2016 and 2026 for the do minimum (no pricing case) and each option, and benefits were extracted for each modelled period using the rule-of-a-half for variable trip matrices¹.

For private vehicles/LCV and HCV for each modelled period (AM, IP, PM) these were:

- Travel time benefits, and
- Operating cost benefits, with resource cost correction².

The above does not account for increased values of time in congested conditions, so the time benefits were factored by 1.2 to account for both congestion and reliability. The same process and factor value was used in the recent Auckland road pricing study, based on experience of evaluating local projects.

For PT, for the AM and IP periods, this was:

- Benefits as generalised costs (min), encompassing time (in-vehicle, walk, wait, transfer) and cost (fare) benefits.

The charges (revenues), which include any GST, were extracted for each option separately for car/LCV and HCV for the two charging periods (AM and PM).

The values of time (VOT) and operating costs used based on the PEM and are given in Table 1. In the evaluation the VOT was assumed to increase with GDP/capita (0.8 elasticity), affecting both revenues and benefits.

■ Table 1 Values of Time and Operating Cost (2005)

Period	Car/LCV		HCV		PT
	Time (\$/hr)	VOC (\$/km)	Time (\$/hr)	VOC (\$/km)	Time (\$/hr)
AM	7.80	0.154	20.10	0.505	6.00
IP	6.90	0.154	20.10	0.505	6.00
PM	7.80	0.154	20.10	0.505	6.00

¹ Refer to LTNZ Project Evaluation Manual Section A11

² Refer to LTNZ Project Evaluation Manual Section A11



Annualisation of benefits and charges was based on:

- 245 of the modelled AM and PM peak periods per year
- Other periods being:
 - For time, 1959 of the modelled 2-hour IP periods per year,
 - For operating costs, 2145 of the modelled 2-hour IP periods per year.

The stream of benefits and charges was established by straight line interpolation and extrapolation of the 2016 and 2026 data.

The NPV of benefits and charges was determined assuming:

- A start date of 2011,
- Time zero of 1 July 2005,
- 25 years of benefits and charges,
- 10% per annum discount.

Scheme Costs

The capital and operating costs of the schemes were estimated as detailed in Section 2.9.7 of the Wellington Region Road Pricing Study - Stage 2 - Technical Report.

The NPV of the scheme costs were determined assuming:

- Full capital costs at 2011 and replacement costs of 75% at 10-year intervals,
- Constant annual operating costs,
- 10% per annum discount over 25 years.

Economic and Financial Evaluation

For the economic evaluation the user benefits, excluding charges, have been used to calculate the ratio of user benefits to scheme costs. This is consistent with the Auckland approach.

The financial viability of the schemes is based on the ratio of revenues gained to the scheme costs.

Some aspects have not been considered in the evaluation, such as taxation, nor has a detailed financial assessment been carried out allowing for inflation, funding, debt, etc.



Appendix B Regional Economic and Land Use Impact Assessment



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1.0 Regional Economic Issues

This section reviews the potential effects on the regional economy of imposing the range of cordon and other road pricing measures proposed in this report. This section indicates the relevant features of the current regional economy and discusses the implications of road charges and reduced congestion. The information is based on desktop research and a brief site visit.

2.0 Greater Wellington Regional profile

The Wellington economy provided some 12.8% of the national economic activity of New Zealand in the year to March 2004. This compares with some 11.3% of the total population. The regional GDP in the same year was \$17.5 billion with a per capita nominal GDP of some \$36,700 (year to March 2003). Wellington's per capita GDP is the highest of the twelve regions covered by the NZIER's regional economic data sets.

Wellington's economic growth between March 2000 and March 2004 averaged 3.9% per annum compared with growth in the national economy of 3.5%. However, Wellington's real per capita growth averaged 1.6% between 1998 and 2001 below the national per capita growth rate of 2.3%¹.

The NZIER report also indicates the structure of the regional economy. The industries that account for higher proportions of the regional economy than they do of the national economy include transport and communications, business services, other services and government. These tend to be sectors that:

- Could benefit from a less congested road network, particularly transport and communications
- Do not necessarily need a fixed work location including opportunities to work from home
- Either do, or could, operate with more flexible working hours, or
- With the exception of some areas of government, tend to be located at the various regional centres and potentially closer to the employees' homes.

The two service sectors and the transport and communication sector are fast-growing sectors at the national and regional level. The two service sectors and government probably place average reliance on transportation with many national government employees using public transport or with a heavier than average reliance on walking and cycling. In addition, as these are sectors that are, or could be, relatively flexible in terms of service location and/or business hours they are unlikely to be impacted significantly by the proposed congestion pricing model. Government employees with

¹ New Zealand's regional economic performance NZIER Report to MED September 2004



working locations inside the cordon but who live outside, could face some additional travel costs if they are required to travel in the peak. However, as noted, many of these may use public transport.

The tourism and trade sector is also a significant and growing part of the regional economy although marginally less significant than the sector's national significance. However, tourists are less likely to need to travel at peak times and many are more likely to be staying in the Wellington City area so that a peak pricing system for roads should have limited if any effects.

The region also has a relatively high proportion of residents with formal qualifications and a low unemployment rate.

The region has a number of sub-regional centres including the Kapiti Coast on the west coast north east of the Wellington CBD, Porirua City accessed by State Highway 1, the main western link of the 'Y' broadly north of the CBD and en route to the Kapiti Coast, and Lower Hutt in the Hutt Valley on State Highway 2, the eastern branch of the 'Y'. These centres have significant retail, commercial and community hubs and some industrial operations particularly in Lower Hutt.

Kapiti Coast²

The Kapiti Coast had a total population of 42,447 at the 2001 census a rise of some 1.93% per annum over the 1996 census. This compares with some 0.47% for the Wellington Region as a whole and some 0.65% per annum nationally.

Kapiti has approximately double the proportion of its population over 65 (22.3%) compared with New Zealand as a whole (12.1%), with similar proportions of people under 15 (21% in Kapiti and 22.7% nationally) and 56.7% in the 15 to 64 years age bracket compared with 65.2% nationally.

A slightly higher proportion of Kapiti residents have post school qualifications (33.6% compared with 32.2% nationally) with a significantly higher proportion belonging to the European ethnic group (91.9% compared with 80.1% nationally). The median income level per person, at some \$17,900 in 2001, was a little lower than the national median of \$18,500 broadly reflecting the higher proportion of older retirees in the population.

The most popular occupational group in the Kapiti Coast was Service and Sales Workers (17.2% in Kapiti compared with 14.8% nationally), this was followed by Professionals (15.8%) and Legislators, Administrators and Managers (15.4%).

Slightly more households in the Kapiti Coast had access to:

² Information taken from 2001 Census of Population and Dwellings, 2001 Household Expenditure Survey and the New Zealand Business Demographics Statistics



- The telephone (97.8%) than nationally (96.3%)
- The Internet (38.9%) than nationally (37.4%)
- A motor car (90.3%) than nationally (89.9%).

Internet access is likely to have increased significantly since 2001 providing opportunities to mitigate any additional travel costs by such aspects as working wholly or partly from home.

Average household expenditure per Household on transport was \$7,310 which was some 17.8% of total household expenditure. This compared with \$7,358 and 16.8% nationally.

There were 3,192 business locations in the Kapiti Coast District compared with 309,749 for New Zealand as a whole in 2002. On this basis the number of business locations is a little under represented in Kapiti compared with population (1.03% of the national business units compared with 1.14% of the national population). This again may reflect the higher number of older residents and the lower household income and expenditure.

Porirua City

Porirua had a total population of 47,387 at the 2,001 census a rise of some 0.32% per annum over the 1996 census. This compares with some 0.47% for the Wellington Region as a whole and some 0.65% per annum nationally.

Porirua has approximately half the proportion of its population over 65 (6.8%) compared with New Zealand as a whole (12.1%), with a higher proportions of people under 15 (28.1% in Porirua and 22.7% nationally) and almost identical proportion of its population (65.1%) in the 15 to 64 years age bracket compared with 65.2% nationally.

A slightly lower proportion of Porirua residents have post school qualifications (30.8% compared with 32.2% nationally) with a significantly lower proportion belonging to the European ethnic group (63.9% compared with 80.1% nationally) and significantly higher Maori and particularly Pacific Peoples proportion. The median income level per person, at \$20,500 in 2001, was higher than the national median of \$18,500 partly reflecting the higher proportion of working age and lower number of retirees in the population.

The Porirua district has some significant areas of disadvantage as measured by the New Zealand Deprivation index particularly communities to the north east of the City Centre.

The most popular occupational group in the Porirua was Clerks (17.2% in Porirua compared with Sales Workers at 14.8% nationally), this was followed in Porirua by Professionals (16.2%) and Service and Sales Workers (15.2).



In Porirua City there is a:

- Slightly lower proportion of the population had access to the telephone (94.8%) than nationally (96.3%)
- Slightly higher proportion of the population had access to the Internet (40.7%) than nationally (37.4%)
- Slightly lower proportion of the population had access to a motor car (85.6%) than nationally (89.9%).

Internet access may reflect the relatively high proportion of professionals in the City. As access is likely to have increased significantly since 2001 there may be opportunities to mitigate any additional travel costs by such aspects as working wholly or partly from home.

Average household expenditure per Household on transport was \$8,573 which was some 17.8% of total household expenditure. This compared with \$7,358 and 16.8% nationally.

There were 2,614 business locations in the Porirua City compared with 309,749 for New Zealand as a whole in 2002. On this basis, the number of business locations is considerably under represented in Porirua compared with population (0.84% of the national business units compared with 1.27% of the national population).

Lower Hutt

Lower Hutt had a total population of 95,478 at the 2,001 census a fall of some 0.08% per annum in the period from 1996 to 2001. This compares with some 0.47% growth for the Wellington Region as a whole and some 0.65% per annum nationally.

Lower Hutt has a slightly lower proportion of its population over 65 (10.5%) compared with New Zealand as a whole (12.1%), with a higher proportions of people under 15 (24% in Lower Hutt and 22.7% nationally) and almost identical proportion of its population 65.5% in the 15 to 64 years age bracket compared with 65.2% nationally.

A slightly higher proportion of Lower Hutt residents have post school qualifications (33.6% compared with 32.2% nationally) with a slightly lower proportion belonging to the European ethnic group (76.7% compared with 80.1% nationally) and slightly higher Maori and Pacific Peoples proportions. The median income level per person, at \$22,000 in 2001, was higher than the national median of \$18,500 partly reflecting the higher proportion of working age and lower number of retirees in the population.

The most popular occupational group in the Lower Hutt was Clerks (18.3% in Lower Hutt compared with Sales Workers at 14.8% nationally), this was followed in Lower Hutt by Professionals (16.3%) and Service and Sales Workers (14%).

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In Lower Hutt there is a:

- Slightly higher proportion of the population had access to the telephone (96.8%) than nationally (96.3%)
- Slightly higher proportion of the population had access to the Internet (40.0%) than nationally (37.4%)
- Slightly lower proportion of the population had access to a motor car (86.8%) than nationally (89.9%).

Internet access may again reflect the relatively high proportion of professionals in the City. As access is likely to have increased significantly since 2001 there may be opportunities to mitigate any additional travel costs by such aspects as working wholly or partly from home.

Average household expenditure per Household on transport was \$8,341 which was some 18.1% of total household expenditure. This compared with \$7,358 and 16.8% nationally.

There were 7369 business locations in the Lower Hutt compared with 309,749 for New Zealand as a whole in 2002. On this basis, the number of business locations is slightly under represented in Lower Hutt compared with population (2.38% of the national business units compared with 2.55% of the national population).

3.0 Transport costs as a share of business costs

The national economy wide average proportion of transport costs compared with total costs for businesses is some 4.4%. A survey of 50 of the larger businesses and business organisations in New Zealand³ found that transport rated as one of the top four constraints to business, along with demand, compliance costs and access to labour/skills. The survey noted that for the businesses interviewed transport accounted for 9% of total costs. However, this study was biased towards the large export businesses. The Wellington Region is likely to have a smaller proportion of these larger export industries and the ones it has in the services sectors are likely to be less reliant on transport.

The STCC report prepared for the Ministry of Transport⁴ estimated the national total user resource cost of transportation (vehicle operations and ownership costs) at \$30.4 billion per annum (2001-02), broken down as follows:

³ Generating Growth: Infrastructure, Infometrics for the Growth and Innovation Advisory Board, May 2003.

⁴ STCC Report, Booz Allen Hamilton for the Ministry of Transport, March 2005.



- Vehicle operating and ownership costs **\$16.8 billion**
 - Cars \$11.7 billion
 - LCVs \$2.9 billion
 - MCV/HCVs \$2.2 billion
- Travel time **\$11.0 billion**
 - Cars \$7.4 billion
 - LCVs \$ 2.4 billion
 - MCV/HCVs \$1.2 billion
- Parking costs CBD areas **\$0.4billion**
- Costs of accidents (covered directly by users) **\$2.2 billion**
- Total user resource cost **\$30.4 billion**

Based on these estimates the direct vehicle operating and ownership costs of commercial vehicles, if taken as a measure of the cost of transportation to business is relatively small at some \$5.1 billion or around 3.7% of GDP. The inclusion of travel time increases this estimate to \$8.7 billion.

4.0 Transport elasticities

Economists measure price sensitivity using elasticities, defined as the percentage change in quantity demanded or consumed of a good or service caused by a one percent change in price. The price elasticity is therefore a ratio with no units but with a negative sign to show the relationship that as price rises, demand or consumption falls. If the measure is less than one the good or service is said to be ‘inelastic’, that is price changes cause a less than proportional change in demand/consumption. Values over one indicate that the demand for the good or service is elastic, that is the proportional change in demand or consumption is greater than the change in price.

The elasticity reflects the number and closeness of substitutes for any good or service. The demand for goods and services with a large number of reasonably close substitutes will usually be elastic. Unique products will usually have an inelastic demand. Demand for any good or service tends to become more elastic over time as substitutes are developed. Conversely businesses will try to brand its products to increase its perceived uniqueness and reduce the elasticity of demand and, therefore, increase its opportunities to increase revenue and profitability.

Transport services tend to be relatively inelastic. This is particularly true of specific transport price components such as fuel, parking and tolls because they represent a small proportion of the user’s total cost and have limited substitutes in the short run. However, if all vehicle user costs were variable the total cost would tend to be elastic in terms of price changes. In practice all cost components of driving are not variable and prices do not usually move in consort.



As with most goods and services the price elasticities of driving components increase over time with long run elasticities greater than short run by factors of 2 to 3. This reflects the ability of users to impact on prices in the medium to longer term through such factors as the purchase of more fuel efficient vehicles, location choices for homes relative to work and services and for technology to reduce the cost of vehicle cost components including lighter vehicles and changes in fuel including the use of hybrid and renewable energy vehicles.

Elasticities will vary for other reasons including:

- Type of trip-commuter trips tend to be less elastic than recreational trips
- Type of traveller-trips by higher income drivers and business trips tend to be less elastic
- Trip time-weekday trips may have different elasticities to weekend trips. Which is more elastic may depend on the time of day and the type of trip. Trips getting children to weekend sports commitments could be inelastic while weekday off peak trips might be relatively elastic
- Trip location-urban peak trips tend to be price inelastic because congestion discourages lower value trips
- Availability of alternative routes, modes and destinations-tolls will tend to be more price sensitive if there are:
 - Alternative untolled routes that provide the same journey service at a lower cost than the tolled road
 - Cost effective substitute modes
 - Alternative destinations that provide similar services that are nearer or outside the toll system and therefore either incur a lower toll or no toll.

Changes in travel component prices will have an impact on travel patterns including reducing the overall amount of travel in term of trips and VKT. The following Table 1.1 summarises the estimated long run transportation elasticities from a number of transport elasticity studies.

**Table 1.1 Estimated Long Run Transportation Elasticities**⁵

Estimated Component	Fuel Price	Income	Taxation (Other than Fuel)	Population Density
Car Stock (vehicle ownership)	-0.20 to 0.0 (-0.1)	0.75 to 1.25 (1.0)	-0.08 to -0.04 (-0.06)	-0.7 to -0.2 (-0.4)
Mean Fuel Intensity (fuel efficiency)	-0.45 to -0.35 (-0.4)	-0.6 to 0.0 (0.0)	-0.12 to -0.10 (-0.11)	-0.3 to -0.1 (-0.2)
Mean Driving Distance (per car per year)	-0.35 to -0.05 (-0.2)	-0.1 to 0.35 (0.2)	0.04 to 0.12 (0.06)	-0.75 to 0.0 (-0.4)
Car Fuel Demand	-1.0 to -0.40 (-0.7)	0.05 to 1.6 (1.2)	-0.16 to -0.02 (-0.11)	-1.75 to -0.3 (-1.0)
Car Travel Demand	-0.55 to -0.05 (-0.3)	0.65 to 1.25 (1.2)	-0.04 to 0.08 (0.0)	-1.45 to -0.2 (-0.8)

These show the range of elasticities from various studies. Numbers in parenthesis indicate the original authors' "best guess" values.

Table 1.2 indicates average elasticities of various measures of demand with respect to fuel prices.

Table 1.2: Overall Results: Elasticities of various measures of Travel demand⁶

Dependent Variable	Short term	Long term
Fuel consumption (total)		
Mean elasticity	-0.25	-0.64
Standard deviation	0.15	0.44
Range	-0.01, -0.57	0, -1.81
Number of estimates	46	51
Fuel consumption (per vehicle)		
Mean elasticity	-.08	-1.1
Standard deviation	N/A	N/A
Range	-.08, -.08	-1.1, -1.1
Number of estimates	1	1
Vehicle kilometres (total)		
Mean elasticity	-0.10	-0.29
Standard deviation	0.06	0.29
Range	-0.17, -0.05	-0.63, -0.10
Number of estimates	3	3

⁵ Johansson & Schipper, 1997, Measuring the long run fuel demand of cars: separate estimations of vehicle stock, mean fuel intensity and mean annual driving distance, Journal of Transport Economics and Policy XXXI.

⁶ Hanly, Dargay and Goodwin, 2002, Review of Income and Price Elasticities in the Demand for Road Traffic, ESRC TSU publication 2002/13.



Dependent Variable	Short term	Long term
Vehicle kilometres (per vehicle)		
Mean elasticity	-0.10	-0.30
Standard deviation	0.06	0.23
Range	-0.14, -0.06	-0.55, -0.11
Number of estimates	2	3
Vehicle stock		
Mean elasticity	-0.08	-0.25
Standard deviation	0.06	0.17
Range	-0.21, -0.02	-0.63, -0.10
Number of estimates	8	8

The authors conclude that:

- Fuel consumption elasticities are greater than traffic elasticities, mostly by factors of 1.5 to 2
- Long run elasticities are greater than short run, mostly by factors of 2 to 3
- Income elasticities are greater than price elasticities by factors of 1.5 to 3.

Table 1.3 indicates elasticities by type of trip.

Table 1.3: Elasticity estimates for various trip types⁷

Trip Type	Elasticity of Road Travel with Respect to Out of Pocket Expenses
Urban shopping	-2.7 to -3.2
Urban commuting	-0.3 to - 2.9
Inter-urban business	-0.7 to -2.9
Inter-urban leisure	-0.6 to -2.1

The findings in the table indicate that urban shopping trips as indicated above are significantly elastic while urban commuting ranges from being quite inelastic to being significantly elastic. Other studies have tended to confirm that urban peak travel is inelastic.

Table 1.4 indicates parking elasticity estimates.

⁷ Button, Transport Economics, Second Edition, Edward Elgar (Aldershot), 1993

Table 1.4: Parking price elasticities⁸

Term/Purpose	Car Driver	Car Passenger	Public Transport	Slow Modes
Trips				
Commuting	-0.08	+0.02	+0.02	+0.02
Business	-0.02	+0.01	+0.01	+0.01
Education	-0.10	+0.00	+0.00	+0.00
Other	-0.30	+0.04	+0.04	+0.05
<i>Total</i>	<i>-0.16</i>	<i>+0.03</i>	<i>+0.02</i>	<i>+0.03</i>
Kilometres				
Commuting	-0.04	+0.01	+0.01	+0.02
Business	-0.03	+0.01	+0.00	+0.01
Education	-0.02	+0.00	+0.00	+0.00
Other	-0.15	+0.03	+0.02	+0.05
<i>Total</i>	<i>-0.07</i>	<i>+0.02</i>	<i>+0.01</i>	<i>+0.03</i>

Slow Modes = Walking and Cycling

The estimates in the table suggest that parking prices are inelastic for all users but particularly so for transport users who are least affected by parking costs such as car passengers, public transport passengers and people walking and cycling. Parking price changes are also relatively inelastic for commuting and business users. Parking price elasticity is higher for other users which includes various more discretionary uses. Other studies have suggested that increases in parking in one area will shift cars to park in other locations.⁹

A recent summary¹⁰ of estimates of toll road elasticities suggests that demand depends on a number of factors including economic activity, tourist activity, fuel prices and travel conditions on parallel roads. Short term toll road price elasticities ranged from -0.21 to -0.83 which was higher at the top end and a broader range than previous studies indicated. Elasticities were greater where there are uncongested parallel roads.

The London experience has been that the congestion pricing fee (initially 5 pounds and raised to 8 pounds in 2005) has reduced private car traffic in the area by 38% and total vehicle traffic by 18%. This reduction is more than expected indicating a higher price elasticity than predicted.

Other studies have indicated that:

- Schemes that provide discounts off tolls for off-peak travel result in a modest shift from peak to off-peak travel¹¹

⁸ Trace, 1999, Elasticity Handbook, Elasticities for Prototypical Contexts

⁹ Hensher and King 2001

¹⁰ Matas and Raymond 2003

¹¹ Holguin-Veras, Ozbay and de Cerreno, 2005



- Congestion pricing at peak times is most likely to encourage route and time changes for commuter trips with lower likelihood of shifts to public transport and working at home¹². However, the latter shifts are probably affected by the relative substitutability of public transport and the type of work undertaken by commuters which may not lend itself to the flexibility of working from home.

Table 1.4 indicates the elasticity of vehicle travel with respect to travel time.

Table 1.4: Elasticity of vehicle travel with respect to travel time¹³

	Short Run	Long Run
Urban Roads	-0.27	-0.57
Rural Roads	-0.67	-1.33

Another study concludes that the elasticity of travel volume with respect to travel time is -0.5 in the short term and -1 in the longer term.¹⁴ This means reducing travel times will increase traffic volumes. On this basis the results of approaches such as congestion tolls that reduce travel times will be partially off-set by increased road use so that measured road toll elasticities will be a mix of both effects.

The price elasticity of freight transport (measured in ton miles) in Denmark was calculated to be -0.47, while the elasticity of freight traffic (measured in truck-kilometres) was -0.81¹⁵. On these estimates a 10% increase in freight costs would reduce truck traffic by some 8% but total freight volume by just under 5%. This suggests some freight is transferred to rail and others is shipped using the existing truck capacity more efficiently.

Table 1.5 summarises the price elasticity of freight transport from a range of studies.

Table 1.5: Freight transport elasticities¹⁶

Aggregate Mode Split Model, Price	-0.25 to -0.35	-0.25 to -0.35
Aggregate Mode Split Model, Transit Time	-0.3 to -0.7	-0.3 to -0.7
Aggregate Model from Tanslog Cost Function, Price	-0.37 to -1.16	-0.58 to -1.81
Disaggregate Mode Choice Model, Price	-0.08 to -2.68	-0.04 to -2.97
Disaggregate Mode Choice Model, Transit Time	-0.07 to -2.33	-0.15 to -0.69

These elasticities vary depending on commodity group.

¹² Arentze, Hofman and Timmermans, 2004

¹³ Goodwin, 1996

¹⁴ SACTRA, 1994

¹⁵ Bjorner, 1999

¹⁶ Small & Winston, 1999



4.1 Conclusion of transport elasticities

In the medium to longer term transport elasticities increase due to the scope for consumers to take into account expected price changes in making longer term purchasing decisions and for the scope for greater substitution opportunities to be developed.

In the short term price effects are likely to be inelastic and limited. The effects of tolls will be relatively limited in the short term and will be partially off-set by the increase in demand caused by reduced travel times. Parking charges have the scope to influence parking location but, again, the impact is likely to be limited. This conclusion seems to be in line with the predicted trip/VKT estimates in this study.

In the long term, tolls could influence vehicle purchase choices, residential and workplace location choices and impact on regional land use and development. The extent of this is likely to be governed by the expected level of tolls. The relatively small tolls proposed to date for Wellington are unlikely to have more than a marginal effect.

5.0 Potential regional economic impact

The overall potential economic impact on the region will depend on the level of the total tolls charged and the use made of the money. A tolling system could collect a very large amount of money with a significant proportion exported from the region. This might happen with a system operated by an off shore private company particularly with an automated tolling process. In this case a range of funds such as interest and debt repayment charges, management fees, dividends and possibly specialised operating and maintenance charges could leave the region. This export of funds would be compounded by a negative multiplier effect.

Alternatively, an operation by the local authority where the tolls are tightly targeted by time, modest in level and with potential for motorists to avoid them through changing their work times or locations would collect lower total funds. If these funds were then largely spent within the region directly on operating costs and where the surplus is allocated to regional activities, the impact would be small and potentially insignificant. The total impact would depend on the change in use of the toll net income and any difference in the multiplier effect.

The current proposal effectively meets the latter scenario. The six options are estimated to cost between \$37 and \$42 million to install and some \$3 to \$18 million to maintain and operate (O&M). The capital cost equates to between some 0.21% and 0.24% of the regional GDP and the O&M cost some 0.02 % to 0.10 % of the regional GDP.

The highest total toll income under the six options is estimated at just over \$47 million or some 0.27% of regional GDP. In addition to the toll providing a small amount in terms of the total regional GDP even this amount will be partially offset by the estimated user benefit.

SINCLAIR KNIGHT MERZ



The user charges are between 3 and 5.6 times the operating costs. A proportion of the operating cost for each option is likely to leave the region although much if not most of operations and maintenance could be carried out by regional entities. If the bulk of the operations and maintenance including administration, are undertaken from within the region and the net toll income after O&M costs, is allocated to transport projects or other uses within the region, the net impact on the region could be negligible. In this case any impact would only relate to any outflow of funds from the region for such aspects as debt servicing, taxes, imported spare parts and/or specialist technical services.

In theory, if the surplus toll funds are spent in the on projects that generate higher than average multipliers the project could generate a positive regional economic impact.

Based on the above and on the changes to transport patterns explored, it is likely that the direct economic impact on the region as a whole of road pricing will be at worst marginal.

While the overall impact is likely to be marginal, consideration needs to be given to whether there could be differential impacts across the region, with more significant adverse impacts at a local level. A brief comment on the potential economic issues follow and the broader possible social impacts are assessed in the main report.

Payment of the maximum toll proposed (between \$4 and \$5 depending on option) every working day would add significantly to the annual expenditure on travel. In mitigation of this, less than 4% of travellers would pay the maximum toll and those paying this level would tend to be the commuters from furthest away who would have higher than average transport costs at present and who could gain higher travel time benefits. In most cases there would be a public transport alternative and potentially options to avoid the peak period by varying working patterns.

Despite this there could be some individuals and groups who are unable to change their travel patterns at least in the short term and could be significantly disadvantaged. The number of these is likely to be small. In the longer term even these individuals and groups may be able to change travel patterns to reduce any disadvantage. Consideration could be given to compensation for any such disadvantage separately from the road user charging scheme including addressing the issue of avoiding any disincentive to change.

In most districts outside Wellington City there is already a reasonably high level of employment self containment, That is, a relatively high proportion of people work in the same area as they live and relatively few who travel into the centre of Wellington as shown by the following data taken from journey to work data as part of the Census:



- Current level of self containment reasonably high (2001) eg in:
 - Kapiti 43% of workers and 38% who travel to work by car, live and work in the District
 - Porirua the figures are 32% and 31% respectively
 - Lower Hutt 32% and 31% respectively.
- Low proportion of journey to work travel to Wellington including:
 - Kapiti 17% of workers and 15% who travel to work by car
 - Porirua 28% and 23% respectively
 - Lower Hutt 27% and 18% respectively.

Based on the 2001 journey to work data only 5% of work trips would have been affected by 3 or more cordons. Given that not all this travel would have been at peak times or by car this number supports the traffic modelling findings that less than 4% would be affected by the maximum toll.

Clearly there will be many people paying more for their peak hour travel. However, few will pay the maximum charge and in all cases there will be direct time-savings due to reduced congestion to offset the cost. In addition depending on the use of the surplus toll funds there may be additional travel benefits for these individuals.

6.0 Assessment of impacts on the economy using the NZTS Framework

Economic development is one of the five objectives outlined in the New Zealand Transport Strategy (NZTS). The NZTS concludes that a coherent and efficient transport system contributes to national and regional quality of life and economic development.

Under NZTS the government will incorporate social, economic and environmental costs and benefits of transport into transport decision making to ensure that the access and costs of different transport modes are fair and transparent to users.

The key indicators that are used to determine transport's contribution to economic development have been reported in the main report. They show the proposed toll schemes:

- Improve average trip time (e.g. 35% less time from Porirua to Ngauranga, 18-35% Ngauranga to CBD, 43-62% Lower Hutt to Ngauranga and over 10-15% inbound average)
- Reduce peak congestion across the key routes (e.g. reduction in v/c at key bottlenecks)
- Reduce travel times to key centres.

7.0 Use of the revenues generated

How the revenues raised from road pricing are used will be important in determining which groups will benefit from the scheme as well as the flow on effects to the economy. This issue also impacts on the acceptability of any scheme.

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Revenue could be used for:

- Road investment-allocating the funds raised back to motorists although not necessarily the same motorists who paid the road charges
- Public transport-retaining the funds in the transport sector and in theory assisting in providing substitution opportunities and increasing transport elasticities in the longer term
- Consolidated revenue- extending the use of the funds generated to meet government and community priorities but not necessarily transport related
- Lowering taxes and charges or repayment of debt. Lowering taxes and charges could include road user charges, vehicle registration fees or more general charges that could benefit the groups that incur the road pricing charges but could include others in the community
- A combination of the above.

Consideration of equity suggests that the funds could be channelled back to benefit either the groups who paid the charges (vertical equity) or the people who are most disadvantaged (horizontal equity).

Given that the total amount likely to be collected is modest the overall impact is likely to be marginal.

The acceptability of road pricing in Wellington could be improved by hypothecating revenues to transport improvements such as traffic restraint measures and infrastructure and service provision. A review of a large number of international surveys was undertaken for the UK DfT and “reveals quite clearly that once investment to improve public transport is offered in return for charging the motorist, acceptance of charging increases. This shift is substantial in all these cases and in some instances marks a swing from net opposition to net support” (UWE, 2004).

This was also highlighted in interviews undertaken for Greater Wellington Regional Council, which indicated that when Wellingtonians “consider road pricing a little further it tends to become more acceptable if the revenue is spent on improving/developing public transport or expanding the road network” (Forcyte 2001).

Hypothecating of revenues would include allocating specific budgets from the revenues generated to bus, rail, road safety and road network improvements. Where possible, allocation should be specific to particular projects and will involve marketing road pricing as part of a package of measures not as a stand alone solution.

An alternative is to hypothecate revenues to maintenance and operation of the road network, allowing other road user charges such as fuel taxes and registration or access charges to be reduced, such that there is no net increase in overall charges, but a more efficient allocation.



8.0 Regional economic opportunities and issues

While assessment of the full impact of road pricing at a regional level would bear further work, given the relatively modest proposals and revenue raised it is questionable whether significant additional analysis is necessary. In summary the benefits of improved peak travel times offers scope to improve productivity for freight transport and other workplaces and increase leisure time for individuals there is also scope for other potential regional economic benefits based on:

- Opportunities for some limited support for urban consolidation policies and programs including some higher value land uses at specific locations
- Encouragement for increased regional self containment of employment and economic activity including:
 - More home based employment
 - Increased establishment of regional enterprises
 - More intensive use of the regional activity centres (eg: Lower Hutt, Porirua, Kapiti)
- Increasing optimisation of the provision of road infrastructure reducing transport input costs
- Encouragement for the use of public transport options
- Encouragement for more flexible working arrangements.

In addition there are a number of issues that could be addressed including:

- The scope to change the CBD retail offering and ancillary services to address any potential reduction in commuter generated CBD activity and to cater for increases in tourism and other destination markets
- Issues generated by people encouraged to live further out created by improved travel times. For example this could lead to:
 - Increased congestion at peak times including Friday evening and over the weekend
 - Increasing property prices
 - Reduced urban consolidation
 - Changes in the location of economic activity
- Ways to encourage more use of public transport
- Consideration of complementary measures to reinforce the net benefits of road pricing.



9.0 Possible land use effects

The proposed road pricing options are unlikely to have a significant impact on land use. However there is some potential for limited effects including:

- Opportunities for some limited support for urban consolidation policies and programs including some higher value land uses at specific locations. These include possible opportunities to develop specific service centres on one side of a cordon to service the community on that side to enable them to avoid payment of the road user charge. Given the type and level of charges proposed it is unlikely that there will be many, if any, of these opportunities
- More intensive use by the relevant sub-regional population of the regional activity centres (eg: Lower Hutt, Porirua, Kapiti) to avoid incurring road user costs
- Increased residential development within a regional commercial centre's catchment that avoids road use charging points e.g. increased development in areas that allow 'free' access to regional centres. This is linked to the more intensive development of the regional centres above
- Possible marginal change in retail and commercial mix to reflect changed demand from customers who are avoiding some or all road user charges.

As noted while these land use opportunities are possible they are likely to be limited.

10.0 Results in the context of GDP

As noted above, the total road user charges collected are likely to be modest and the bulk, if not all, of the income collected will be reallocated within the Wellington region. As a proportion of the regional GDP, the maximum estimated toll revenue is some 0.27% of regional GDP. Table 1.6 indicates the proportion by option.

Table 1.6: Car and HCV road charges revenue as a proportion of the Wellington Region GDP

	CC	NS	YI	YM	YMS	CY
Annual user charges (\$m)	47	21	26	29	43	43
Percent GDP	0.27%	0.12%	0.15%	0.16%	0.25%	0.25%

As such the impact on the regional GDP is likely to be marginal at worst.



11.0 Regional economics and land use summary

As noted, on a basis of the changes to transport patterns explored, it is likely that the direct regional economic effect of road pricing will be marginal at worst. If, as assumed, the surplus revenue from the tolls is spent in the region the net impact on the region as a whole could be insignificant although there may be a limited number of individuals or groups who are disadvantaged particularly in the short term.

Analysis of 2001 Census journey to work data indicates that only around a third of the journeys to the CBD are by car. The traffic modelling suggests that under the CC and NS options 14% and 6% of trips will pay the highest charge respectively (a flat charge of \$4). Under all other options, less than 4% of trips will pay the highest charge. While it could be argued that this puts an uneven burden on a small section of the community rather than spreading it widely across the whole community, it is noted that those who would pay the highest charges tend to be travelling the longest distances and are therefore incurring higher travel costs already and have the opportunity to obtain the higher time savings. This said, there could be a very small number of members of the community who would be adversely affected and are unable to change their travel patterns. Consideration could be given to compensating them in a way that does not impact on the beneficial effects of road charges.

In terms of overall regional economic growth, while the impacts will be small, road pricing is likely to contribute positively, based on the estimated benefits from reduced congestion and improved travel times at the peak, identified in the study. However, there could be differential impacts by location, although these are likely to be small based on the marginal overall impact.

In addition, a number of characteristics of the regional economy offer scope to complement the peak period travel improvements in supporting further regional economic growth, such as:

- the relatively high self-containment of employment in the individual local authority areas
- the relatively highly qualified regional workforce
- The strength of the Wellington regional economy in some of the faster growing industry sectors such as business and other services and transport and communications.

There may be some limited opportunities for more intensive land use and development in specific areas of the region within road user charging cordons to reflect changes in road use related to user charges. While it is unlikely that there would be major development opportunities there could be some opportunities for incremental minor development of regional commercial centres and associated residential areas and possibly some changes in retail and commercial tenancies.



Appendix C Legislation Review

Andrew Bell
Senior Traffic & Transportation Engineer
Sinclair Knight Merz
PO Box 10 283
WELLINGTON

26 June 2006

Dear Andrew

Wellington Regional Road Pricing Study - Stage 2

In accordance with our engagement letter dated 7 March 2006, we have undertaken a review of the legislation and policy issues associated with road pricing.

Background and Purpose

Sinclair Knight Merz (SKM) is undertaking a road pricing study for the Greater Wellington Regional Council (GWRC) to address a number of road pricing options aimed at reducing traffic congestion within the Wellington region. Various charging mechanisms have been examined including network charges, parking charges, area charges and cordon charges. The area and cordon charging options, in particular, are the focus of further investigation and analysis.

You have asked us to provide an assessment of the hurdles (i.e. what needs to happen) that need to be addressed, in a legislative/policy sense, to enable the introduction of cordon or area charges. Such charges aim to reduce congestion on roads; they are different from tolls which generally are aimed at recovering part or all of the cost of building and/or maintaining roads.

We understand that our advice will form part of wider advice being provided by SKM to GWRC. We note that, consistent with our engagement letter dated 7 March 2006, our comments are not intended to be, nor should be construed as, legal advice.

We will not accept responsibility to any party other than to SKM, to whom our report is addressed, unless specifically stated to the contrary by us in writing. We will accept no responsibility for any reliance that may be placed on our report should it be used for any purpose other than that for which it is prepared.

Our report has been prepared with care and diligence and the statements and opinions in the report are given in good faith and in the belief on reasonable grounds that such statements and opinions are not false or misleading. No responsibility arising in any way for errors or omissions (including responsibility to any person for negligence) is assumed by PricewaterhouseCoopers or any of its partners or employees for the preparation of the report to the extent that such errors or omissions result from PricewaterhouseCoopers' reasonable reliance on information provided by others or assumptions reasonably taken as implicit.

Andrew Bell

26 June 2006

We reserve the right, but are under no obligation, to revise or amend our report if any additional information which exists on the date of our report, but was not drawn to our attention during its preparation, subsequently comes to light.

Legislative Requirements

There is no legislative mandate that would currently allow for congestion charging on roads. New or modified legislation would be required before any cordon or area charging scheme could be implemented.

In general terms, the legislation would be required to provide for the ability to implement a charge and the ability to enforce the charge.

The extent to which legislation details the requirements for a charging scheme could vary substantially from being very general to very specific. Placing a charge on a road that is otherwise generally accessible to road users is likely to need direct approval from the Minister of Transport ("the Minister"), as is currently the case for proposed road tolling schemes.

Hurdles to Address

A list of matters/issues that will need to be addressed is detailed below. This list is intended to be indicative rather than exhaustive. It is an example of the detail that will need to be considered either directly through legislation or indirectly through a proposal to the Minister. In compiling this list, we have had regard to:

- requirements relating to toll roads (notwithstanding that tolls are intended for a different purpose, nevertheless, there is some overlap in terms of the matters that a Minister is likely to want to consider);
- previous work we have undertaken in the context of Transmission Gully (and tolls in relation to this project);
- general discussions with the Ministry of Transport in light of the recently published Auckland Road Pricing Study; and
- the Auckland Road Pricing Study.

Andrew Bell

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Example of Issues to be Addressed	
Ability to charge	<ul style="list-style-type: none"> • The procedure for recommending that charges be established. • Ensuring that relevant transport strategies are considered. • Who owns the revenue collected (whether the revenue collected is “land transport revenue” and whether it has implications for levels of appropriation). • To what purpose the revenue collected is to be applied/spent. • Which entity is imposing the charge, how that entity interacts with the Road Controlling Authorities and/or delegates to third party collectors. • Legally restricting access to roads (to those who pay the charge). • Establishment of legal contract between users and operation authority. • Fixed/mobile charge points – method of charging (procedure & basis). • Details of the charge(s): <ul style="list-style-type: none"> – The basis on which charge(s) can be set (taking into account that coercive powers will be used and there is not a normal market through which prices are determined). – A description of the area covered and charge points. – Any exemptions such as land owners abutting the boundary of the area that is to be charged, emergency services vehicles etc. – Hours of application. – Refunds. – Differential charges (classes of vehicle or person, direction of travel, different times or days etc). – Maximum charge per day (in case of multiple entry/exit from charge zone). – Time and date of ability to begin charging. – Process for notifying changes to charge levels/structures and termination.

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Ability to enforce charge(s)	<ul style="list-style-type: none"> • The entity that can enforce the charge(s). • The entity that has the ability to collect debts. • The legal status for equipment used, to allow for enforcement of charges and penalties for failure to pay (e.g. speed cameras). • Powers to retain details of vehicles entering cordon area (i.e. proof that it did enter). • Penalty structures. • Procedure for dealing with disputes over application of penalties.
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Road Tolling Legislation

The Land Transport Management Act 2003 (LTMA) introduced legislative provisions to establish road tolling schemes. Tolls are intended to fund the planning, design supervision, construction, maintenance or operation of **new** roads. Area and congestion charges are aimed at reducing vehicle movements on existing roads. While, therefore, there is a distinction between the purposes behind the different charges, nevertheless we consider that the framework of this legislation could be applied to congestion charging as some of the policy issues for congestion charging are similar to, but not identical with, those for road tolling. For example, tolls and congestion charges can improve social and environmental responsibility in land transport funding, planning, and management and contribute to the sustainability of the land transport system (all of which are part of the purpose of the Land Transport Management Act).

The tolling legislation is relatively general and is primarily covered in two sections of the LTMA, sections 46 and 48.

Section 46 addresses the authority to establish a road tolling scheme. A road tolling scheme may be established by the Governor-General by Order in Council (OIC), on recommendation by the Minister. The Minister needs to address the form of the tolling scheme (e.g. how it will operate in practice, the level of the tolls, how they are to be collected, the process for changing their level and so on). The form of the tolling scheme will give rise to conditions that will attach to the tolling scheme. An OIC in respect of a tolling scheme may include conditions (and there are no specific limits on the conditions that may be set).

Section 48 sets out the various matters that the Minister must take into account if an OIC is to be recommended. This includes considering whether the recommendation:

- Contributes to the purpose of the LTMA .
- Considers the objectives of the New Zealand Transport Strategy.

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- Considers other relevant strategies.
- Considers the availability of other land transport options.
- Considers the options and alternatives that have been considered by the road controlling authority.
- Is consistent with current priorities for land transport expenditure.
- Considers the outcome of consultation undertaken by the road controlling authority.
- Is included in the current national land transport programme or has a high degree of support from affected communities.
- If an existing road or part of it is being tolled, is physically or operationally integral to the new road in respect of which the tolling revenue will be applied.
- Has a feasible, untolled, alternative route (which could not be applicable in the case of area/cordon charging).

In practice, the Minister receives advice from Ministry of Transport officials (“the Ministry”) after the Ministry has evaluated the tolling proposal against evaluation criteria.

Congestion Charging

If the basis for legislation to approve congestion charging was similar to that of road tolling schemes, the Minister would recommend the making of an OIC. The Minister would be required to consider a number of things similar to those listed above in relation to road tolling. In addition, there may be other matters that the Minister may wish to consider. While such matters cannot be anticipated with complete certainty, some thought needs to be given to likely issues. Examples include:

- The objectives of the congestion charge. Ministers will want to understand these and how they align with wider government transport strategies.
- Whether the revenue collected from congestion charges may:
 - Reduce the requirements for funding approved land transport projects in the region from the NLTF.
 - Enable additional land transport projects to be put forward and approved by Land Transport New Zealand (LTNZ).
 - Enable land transport projects put forward to LTNZ to be reprioritised.

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- Provide funding for alternative land transport projects such as Passenger Transport.
- Implementation costs and risks. Even though these are matters that the Council will need to manage, Ministers will nonetheless want to form a view on the benefits of the proposed scheme and evaluate these against the costs and risks involved.
- Contractual arrangements, if any, around collection of charges.
- Governance and management of the proposed scheme.
- Duration of the approval to begin charging.

In respect to a number of the matters identified above, it may also be necessary for LTNZ to evaluate any congestion charge proposal as part of the LTNZ's funding allocation process.

Conclusion

New or modified legislation would be required before any cordon or area charging scheme can be implemented. It is likely that even with legislative provisions in place direct approval for a charge scheme will be required from the Minister, as is currently the case with road tolling schemes.

The framework of road tolling legislation could be applied to congestion charging as the policy issues for congestion charging are similar to those for road tolling. This would result in general provisions allowing for congestion charging to be implemented on recommendation of an OIC from the Minister. The legislation would provide for issues that the Minister must consider in making his or her recommendation however, there may also be a number of other issues that the Minister may wish to consider.

General

If you have any questions in relation to this letter, please do not hesitate to contact me on (04) 462 7452 or Chris Gould on (04) 462 7455.

Yours sincerely



Bruce Wattie
Partner



Appendix D Privacy Review



1. Introduction

This File Note is prepared as part of the Wellington Region Road Pricing Study – Stage 2 SKM is undertaking on behalf of Greater Wellington Regional Council. Several technologies exist to implement such a scheme, but all of the technologies have the potential to gather sensitive and personal information from road users. If a road pricing scheme is to be implemented, it is important that adequate consideration is given to the handling of potentially sensitive personal information.

This file note summarises the sort of technologies available, how and what type of private information could be obtained, and briefly describes steps that may be considered when protecting private information. This File Note should not be considered to be a detailed assessment of the technical and legal considerations of privacy issues.

The legislative barriers to implementation have not been considered in this File Note. These were considered in a separate File Note.

2. Privacy and personal information

The OECD principles for privacy and use of personal information contain three themes. First, that the information collection system should be transparent; second, that there should be limits on the collection and use of personal information; and third, that the personal information that is collected should be accurate and secure.

2.1 New Zealand Privacy Act 1993

The New Zealand Privacy Act of 1993 sets out a series of principles (12 in total) for information privacy. Whilst it is outside the scope of this File Note to interpret and recommend how these principles may be applied, it is considered useful to list the principles as a reference:

The first principle relates to the purpose of collection of personal information. Personal information should only be collected if it is in connection with a function or activity of an agency and should be necessary for that purpose.

The second principle states that the source of the information should be collected from the individual as appropriate, but that the information may be sourced from elsewhere depending on explicitly stated circumstances. These circumstances are listed in detail in the Act.

The third principle deals with how information is collected, and mentions that people should be reasonably informed that information is being collected.

The fourth principle states that information should not be collected unlawfully or unfairly.

The fifth principle deals with the storage and security of personal information. The information should be protected against loss, misuse and access or disclosure.



The sixth principle relates to how the information may be accessed, and it states that individuals, subject to specific detailed conditions, should be given access to their personal information.

The correctness of the information is described in the seventh principle, and includes provisions that agencies should ensure information they collect is correct. .

The eighth principle states that details should be reasonably checked for accuracy before being used.

The ninth principle states that an agency should not keep the information for longer than necessary.

The tenth principle limits the use of the information to specific and detailed applications, and that the information should only be used for the purpose for which it was collected in the first place.

Limits on the disclosure of personal information are detailed in the eleventh principle.

The twelfth principle deals with uniquely identifying individuals. Unique identifiers should only be used when necessary.

2.2 Land Transport Management Act

The issue of Privacy in the Land Transport Management Act is dealt with under the section related to tolling. It states *inter alia* that the toll operator must not use the personal information for other purposes, and that the operator and enforcement authorities should each have a privacy statement and policy document freely available to the public.

It also requires road users to be given an option for payment that does not record personal information. This will require schemes to be able to establish confidential accounts for customers.

The legislative requirements for implementing a road charging scheme needs to be carefully considered, and is outside the scope of this File Note.

3. Type of schemes

The charging options being considered in the study include cordon and screenline charging.

The technology required for each of these charging options consists of two main functional components. The first of these is the charging component whereby drivers pay for road usage, based upon the charging option selected. The second is the enforcement component whereby the payment is checked in relation to travel. Both have implications for privacy.



3.1 Payment Options

The payment options available partly depend upon the charging option being considered. The main ones are:

- a) Offline payment (as used in London Congestion Charging) whereby the payment is separated from the charged event. A payment can be made in a number of different ways including by phone, SMS, retail outlet, internet and on-street payment machine. It must be linked to an easily identifiable aspect of the vehicle that can be used in the enforcement process. In this instance, the transaction will result in an individual providing personal and private information to the operator. The use, access to and storage of this information needs to be monitored. One of the issues that need to be considered in this instance is the period for which the information is stored.
- b) Payment at a 'toll booth' as used for toll roads and as part of the Oslo Toll Ring for example. Payment can be in cash, by using a card or automatically. They are unlikely to have privacy issues but are unlikely to be practical solutions for Wellington.
- c) Payment based upon a device fixed within and associated with a particular vehicle that transacts with a payment site on the road. In the first trial of such technology in Hong Kong in the early 1980s an 'electronic number plate' was welded to the underside of the vehicle. The modern Singapore System used a 'microwave tag' fitted in the vehicle windscreen which communicates with a gantry mounted beacon. Tags are bought for the specific purpose of road user charging, and a Privacy Statement is usually included as part of the information / sign up package. The privacy statement can be phrased in a way that would be acceptable to the road user.
- d) Payment based upon a GPS based module fitted in the vehicle that can be used to detect a passage across a zone boundary, for example, or for measuring distance along a road. The amount of personal information that may be collected by this system is potentially very large. It has the potential to track individual car movements, and therefore potentially has wider ranging applications. This extra information may not be useable however, unless its uses or applications are strictly designed to be in compliance with the relevant Act.

It is apparent that and potentially private information may be collected during the payment of charges. It is important to ensure that the information collected is treated in a way that does not compromise the main principles of protecting privacy as stated in the relevant Act. Disclosure of what information is being collected and how it may be used is important, for instance in the case of linking payment to a Vehicle License Plate. Permission may be needed from the individual to have their license plate details accessed by the enforcement body / operator. It is outside the scope of this Paper to provide a recommendation or opinion on this specific issue however.

Newer technologies also have the potential to allow users to transact more anonymously during ITS transactions. Research undertaken by the University of California in San Diego into the role of technology in privacy of individuals in ITS projects suggested that a lot can be done to ensure individuals have their rights to privacy protected. Pre-payment would make it possible for users to transact anonymously through anonymous accounts, especially if linked to smart card technology. The transaction records the smart card serial number, and an extra layer



of protection is afforded by ensuring the serial number cannot be easily cross referenced to other databases. The issue of enforcement in case of offences is described further on in this Paper.

As people become more accustomed to transacting on the internet, the issue of security and protection of personal information has become broadly acceptable. It is likely that people who believe their privacy is secure on the internet would believe their privacy would be protected when road pricing transactions are performed.

It is important to protect/ regulate/ restrict any secondary use of the information. This includes the use of information for potentially positive commercial applications.

3.2 Enforcement

By far the simplest and most reliable enforcement option is a barrier based system used in many toll plazas. This is linked directly with payment and the barrier prevents passage until the payment is made, and privacy issues are discounted. However, this is unlikely to be a viable option for Wellington.

In practice, the only method that has been found to be practical involves the use of the Vehicle Registration Mark or VRM. This is unique to a vehicle, is normally linked to the vehicle keeper via a central Vehicle Licence Database and is relatively easy to read automatically, particularly if, as in New Zealand, retro reflective number plates are used. VRMs are used extensively for enforcement of motoring offences and hence their use for this process is well understood.

A key issue with using the VRM is the accuracy of the central vehicle licence database and the ease to which access can be obtained. In the UK, varying claims are made about accuracy (including prompt updating when vehicles change hands or owners move). In practice, it seems that it is about 80% accurate, and it is accepted that some vehicle keepers never correctly register their vehicle. Although systems will normally be in place to allow police access, it is likely that road pricing will not involve the police and hence secure on-line access must be made available to the operating or enforcing authority. For the London system, the Driver and Vehicle Licensing Authority developed a separate 'shadow' read only database that is automatically updated from the main database. Access is provided at two levels - firstly when an account is being set up, access is provided so that details of vehicle and keeper can be checked. Secondly, access is provided automatically, normally at night when queries arising because of suspected non payment are dealt with and responses are provided in time for the start of the following working day.

In order to introduce an enforcement system, it is necessary to provide cameras at suitable locations on the road that are able to read number plates. The output from the IR camera is fed into an Automatic Number Plate Reading (ANPR) computer system, normally at the roadside. This reads the number plate in real time and stores the information. It also sends details of the number plate back to the central system.



Enforcement by cameras is used in New Zealand, but at the moment this involves the Police. In the case of a private operator using ANPR, access to the Vehicle Registration database would need to be specifically permitted through the enabling legislation.

The overall aims of the enforcement system are to read the number plates of passing vehicles and to collect sufficient data that can be used to form an evidential record for issue of a Penalty Charge Notice and, if necessary further prosecution. An evidential record requires further evidence of the presence of the vehicle at the site and the second camera used as part of the enforcement system is a colour context camera that takes a colour context overview image of the vehicles that pass. The overview image together with the number plate image, ANPR output, time stamps and location data forms an evidential record that is sufficient to prove that the vehicle was present. Further prosecution (ie after non payment of an infringement notice) is usually handled through the courts, and rules regarding the use of personal information by law enforcing authorities would apply at this stage.

The enforcement process starts with the capture of an 'evidential record' at the enforcement site. To reduce transmission costs, the records would probably be stored at site and details of the VRM only sent to the centre. These would be stored in a database and compared with the 'Current Payments' database in the payments system. Where a record of payment existed, the evidential record stored at site could be deleted. At the end of the allowed period for payment, the enforcement system would have a list of VRMs of vehicles that had been seen by the enforcement system, but where no payment had been registered.

Each enforcement site would be asked to transmit the evidential records of those vehicles with no payment record and these would be stored in an evidential record store. There will probably be procedures in place used by the Police governing the handling of digital evidential records and it would be desirable that these be followed as far as is possible.

In parallel with receipt of evidential records, access will be necessary to the Vehicle Licensing database to obtain keeper details of vehicles where an offence is suspected.

Because the enforcement system will have inaccuracies, it is important that a manual check be made of the evidential records before a Penalty Charge Notice (PCN) is issued. This will involve checking the VRM as read automatically for correctness, checking the overview image to ensure that it is the vehicle as registered and checking the overview image to ensure that it provides the basis of a valid PCN.

When these checks have been completed and an address for the registered keeper has been obtained, a Penalty Charge Notice can be issued. It is expected that an appeals process will be necessary to cater for those that believe that the PCN has been issued in error. This could be combined with a parking appeals system.

The discussion highlights the following areas of particular importance when considering the collection and use of private information, especially in light of the twelve principles highlighted above.



- The time information is kept for, and how and when records are deleted.
- Sharing information or sourcing/ matching up details from other data bases (addresses from the Vehicle Registry for instance)
- Checking records for accuracy and correctness before action is taken
- Using the information for a specific, stated reason
- Storing and using the information safely
- The potential to collect useful additional information exists, but it needs to be ensured that information can be lawfully used.

The method of payment adopted and the charging strategy both rely on gathering and matching data of a personal nature. This data will typically be stored in a back office, and the function and design of this back office system must be carefully considered. The back office storage system must be secure, and also provide the type or assurances the Act requires. Any use of the data must also be in compliance with the relevant Act. This can often be ensured by the drafting of a well considered privacy policy.

4. Auckland Road Pricing Evaluation Study – Privacy considerations

The Auckland Road Pricing Evaluation Study (ARPES) made some references to the issue of privacy.

The privacy issues identified in the report concentrated on the following aspects:

- Collecting information through Video Automated Number Plate Recognition
- Collecting information through Dedicated Short Range Communications

The report states that although private information will be collected and processed, the issues can be mitigated by using the right technologies. This would include the provision of confidential on board units (tags) that uses serial numbers rather than private information, and when payment is made in advance, no personal information would be collected.

5. Summary

This File Note summarised the issues of Privacy around introducing a Road Pricing Scheme in Wellington. It is apparent that both transactions/ payments and enforcement raises issues regarding the use of sensitive private information. Privacy issues can be mitigated by a carefully considered privacy policy, use of appropriate technologies and confidential account options.



Appendix E Key Questions form the Brief

1) What issues can road pricing address?

The road pricing options developed are primarily aimed at addressing congestion. In addition, all road pricing options considered in this report have positive impacts on:

- Safety and Personal Security (generally small impacts);
- Access, Mobility and Network Reliability (strong impacts);
- Public Health (slight impacts and all options the same);
- Environmental Sustainability (slight impacts and all options the same);
- Efficiency and Affordability (generally moderate impact).

2) What is the impact of road pricing on regional land use patterns?

The proposed road pricing options are unlikely to have a significant impact on land use. However there is some potential for limited effects including:

- Opportunities for some limited support for urban consolidation policies and programs including some higher value land uses at specific locations. These include possible opportunities to develop specific service centres on one side of a cordon to service the community on that side to enable them to avoid payment of the road user charge. Given the type and level of charges proposed it is unlikely that there will be many, if any, of these opportunities
- More intensive use by the relevant sub-regional population of the regional activity centres (eg: Lower Hutt, Porirua, Kapiti) to avoid incurring road user costs
- Increased residential development within a regional commercial centre's catchment that avoids road use charging points e.g. increased development in areas that allow 'free' access to regional centres. This is linked to the more intensive development of the regional centres above
- Possible marginal change in retail and commercial mix to reflect changed demand from customers who are avoiding some or all road user charges.

As noted while these land use opportunities are possible they are likely to be limited.

3) Can strategies be developed to acceptably manage the regional and local economic and social impacts of road pricing?

Economic

On the basis of the changes to transport patterns explored, it is likely that the direct adverse regional economic effect of road pricing will be at most marginal. If, as assumed, the surplus



revenue from the charges is spent in the region the net impact on the region as a whole could be insignificant although there may be a limited number of individuals or groups who are disadvantaged particularly in the short term. If revenues are allocated to economically efficient transport infrastructure projects the impact could be positive.

In terms of overall regional economic growth, while the impacts will be small, road pricing is likely to contribute positively, based on the estimated benefits from reduced congestion and improved travel times at the peak, identified in the study.

Social

Because of the modest charges proposed, significant social impacts are only likely to fall on very particular segments of the community who are most vulnerable because of their particularly deprived socio economic status and lack of flexibility in their trip making – either because they have to travel in the peak time or public transport is not available.

Our investigations into the social impacts of road pricing has focused on identifying socially deprived groups which could be unfairly impacted by road pricing and consideration of trips from these areas to key employment and community facilities.

The number of trips from these socially deprived areas which would face a charge is in most cases small, with the exception of trips into the Wellington CBD where employment is more likely to be in higher paying “white collar” jobs. Good PT links are provided from most locations into central Wellington and therefore a viable alternative to the charges is provided.

Schemes which impose high charges adjacent to the CBD have the greatest potential to have an adverse social impact because of the high level of charge and the potential to charge shorter local trips.

Road pricing schemes would need to be designed to ensure that they had minimal adverse social impacts. Mitigation measures could be required to minimise adverse social impacts. Potential measures that could be desired by the community include:

- Exempting people travelling from particular areas or to particular destinations from paying the toll - this would have to be by way of a form of concession card or tag. Exemptions can prove difficult to implement fairly.
- Reimbursing socially deprived groups through reductions in rates (funded by road pricing revenues). It should be noted that disadvantaged groups are most likely to rent and therefore not pay rates directly. Some mechanism would need to be developed to ensure that the disadvantaged groups received these reimbursements.



- Diverting excess revenues into improved PT
- Improving opportunities for walking and cycling especially from areas close to the Wellington CBD. This could target those living close to the CBD or those who could drive to a point and then walk or cycle
- Obtaining community ‘buy in’ and acceptance of the scheme and its rationale – involve the community in discussing how the revenue raised would be spent. Work to ensure the political acceptability of the proposal and towards overcoming public scepticism about the outcomes.

If road pricing is to be considered further in Wellington, detailed investigations into the social impacts of particular road pricing schemes would need to be undertaken and would need to involve detailed public consultation and survey. From the investigation undertaken to date, we conclude that road pricing could have an adverse social impact on relatively small numbers of individuals. Through more detailed design and development of mitigation measures, it should be possible to reduce these impacts so that they would impinge on a minimal number of people.

4) How can the revenues earned by road pricing best be deployed recognising equity issues?

Refer to question 3

5) Does Wellington’s unique network structure require a model for road pricing that would be different from other urban areas?

The options developed for road pricing in the greater Wellington region were developed to match the linear nature of the transport network. Options such as Area and Parking Charges were dismissed after initial investigations because cordon and screenline charges provided better options. These options use the unique network structure to have a minimum number of charging points while addressing the major congestion bottlenecks.

6) What level of road pricing is appropriate for Wellington?

Details of the charge levels considered are included in Section 2.8. All the options developed have peak maximum charges of less than \$5 with at least 79% of people paying nothing in all cases. With these relatively modest charge levels (which are commensurate with PT fares) significant reductions in congestion are achievable.

7) What form of road pricing (cordon tolls, route specific tolls, HOT lanes, distance by time charges etc) best achieves our transport objectives?

Section 2.7 discusses the different forms of road pricing considered. It was concluded that the most appropriate form for road pricing in the greater Wellington region in the medium term is likely to be cordon and screenline charging.



8) What time periods (peak, interpeak, outside peak, weekend) are appropriate for road pricing and at what levels?

Given that the prime objective of road pricing is to reduce congestion (which occurs predominantly during peak periods) it was assumed that charges would be imposed in the periods between 7 to 9am and 4 to 6pm and in the peak travel direction (the exception to this are the YM and YMS options which have an element of counter peak charging on SH2 near Petone). Details of the charge levels considered are included in Section 2.8.

9) When should road pricing be introduced to the Wellington region?

It is considered that given the political process, the need to undertake detailed feasibility and design and the need for legislative changes (refer to Section 5.1.1) a pragmatic programme for implementation of a road pricing scheme would see 2011 as a likely timeframe for implementation. The analysis undertaken therefore assumed implementation in 2011 and showed that there are clear benefits to implementing road pricing at this time. Implementing road pricing after this time will also have clear benefits as congestion will increase and therefore the benefits which could be achieved through road pricing would also increase.

10) What is the impact of road pricing on infrastructure investment and when is it optimal to invest?

Road pricing impacts on congestion in peak periods and therefore provides opportunities to defer investment in future infrastructure on an economic basis. However, under the current transport funding framework, there are other considerations in deciding the mix of schemes that are progressed. In this respect, road pricing is not a solution in itself but one of a range of tools that can be used to shape the future transport strategy for the region.

It is clear from the investigations undertaken to date that road pricing would have real benefits if implemented in Wellington in the near future. It was assumed that implementation would occur in 2011 and this analysis showed that there would be clear benefits if road pricing was implemented then. The optimal timing of implementation is largely related to the future infrastructure investment programme and how that would impact on the effectiveness of the schemes developed. Road pricing will need to be considered in the strategic planning for transport in the region. This will take place through the RLTS review, where the package of transport infrastructure investment will need to be assessed with road pricing as part of the mix.