SAHA

NZ Transport Agency

# Roads of National Significance

# Economic Assessments Review

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FINAL REPORT (SUPERCEDED)

SAHA

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# 1 Executive Summary

## Introduction

This report constitutes the findings of an economic assessment undertaken at the portfolio level for the Roads of National Significance (RoNS).

The assessment includes consideration of the total economic benefits and costs for the seven RoNS taking into account traditional road user benefits, externalities, and potentially broader productivity and economic growth associated with the implementation of the RoNS.

The purpose of undertaking the assessment is for NZTA to be able to answer two fundamental questions, namely:

1. Are there quantifiable wider economic benefits associated with the portfolio of RoNS projects?
2. If such benefits exist and are quantifiable, are they of sufficient scale to justify accelerating the implementation of the RoNS as a portfolio?

## Methodology

An economic assessment on a portfolio basis which takes into account both conventional and wider economic benefits requires a methodical construct to ensure the approach used is readily understood, and to ensure it is useful for undertaking necessary sensitive testing and scenario analyses.

The series of steps undertaken in this assessment is summarised as follows:

1. Research approaches used in other jurisdictions in relation to program level economic assessment and/or the application of Wider Economic Benefits (WEBs) identification and quantification.

2. Assess WEBs associated with the implementation of the RoNS. Two approaches were used (one essentially used as a comparison for the other):
    - Computable General Equilibrium model (CGE) to estimate the size of the economy-wide effects – this assessment was undertaken by Infometrics Ltd; and
    - A regionally-specific WEBs assessment of the regional impacts of each of the RoNS in relation to agglomeration effects and land use changes – this assessment was undertaken by Richard Paling Consulting Ltd.
3. Development of an economic assessment framework, incorporating existing conventional CBA results and profiles together with WEB results for each of the RoNS projects into a portfolio economic evaluation framework.

4. Undertake a funding investment assessment by modelling the cost of borrowing to determine whether the broader economic benefits associated with accelerating implementation of the RoNS offsets the cost of borrowing funds to enact that acceleration.

5. Preparation of the results in a 'building block' approach (conventional + WEBs, sensitivity testing) so that the specific impacts of both broader economic impacts and acceleration of funding for earlier implementation can be quantified and reported.

## Approaches taken in other jurisdictions

The following conclusions were drawn from four Australian case studies and a body of UK research:

- Robust, transparent and justifiable conventional cost benefit analysis (CBA) is essential, and is the 'bedrock' of project evaluation;
- Where multiple projects comprise a program, it is necessary to ensure that CBA is applied consistently. This includes consistent transport modelling, assumptions, unit values, discount rates, and sensitivity testing;
- Determining project linkages is essentially an empirical test – i.e. interdependencies between projects, if identified, may drive sequencing decisions;
- There are no simple or widely used methods to quantify interdependencies between projects;
- Application of standard evaluation methods, transport modelling, along with subjective analysis remains the key approach;
- Infrastructure Australia has introduced WEBs as a potential benefit stream, with its prioritisation guidelines specifying the inclusion of agglomeration impacts as a monetised benefit in economic evaluations submitted to it. Anecdotally, through the IA process WEBs have been incorporated into economic benefit streams in the order of 20-30% over and above conventional CBA benefits – however, it appears there has been a lack of detailed data collection, and there has been heavy reliance on one or two reference projects where such benefits have been identified;
- In terms of CGE, Infrastructure Australia acknowledge the usefulness of CGE as a tool for measuring macroeconomic effects, but have taken a clear stance to the treatment of the outcomes of CGE modelling in relation to conventional CBA:

  *"Infrastructure Australia will primarily use CBA data for measuring the benefits of an initiative and will not consider CGE (Computable General Equilibrium) benefits as additive to CBA benefits"*[1]
- There is still considerable work to be undertaken in developing the approach in Australia further.
- Work undertaken in the UK by Sir Ron Eddington on behalf of the UK Treasury in 2006 made a number of conclusions regarding the long-term links between transport and the UK's economic productivity, growth and stability. In relation to wider macro and regional economic benefits the report concluded, amongst other things:
  - A comprehensive and high-performing transport system is an important enabler of sustained economic prosperity: a 5 per cent reduction in travel time for all business and freight travel on the roads could generate around £2.5 billion of cost savings – some 0.2 per cent of GDP..
  - Transport's contribution to the agglomeration effects of economic activity is most significant within large, high-productivity urban areas of the UK. London is the most significant example, adding 30 per cent to the time saving benefits of some transport schemes.[2]
- It should however be noted when evaluating effects borne by other economies, such as the UK, of the differences in scale and population densities between these other economies and the New Zealand economy, particularly with regard to the urban environments.

[1] Infrastructure Australia, Prioritisation Guidelines 2008

[2] HM Treasury, The Eddington Transport Study, 2006

## Wider Economic Benefits

The national significance assigned to the RoNS program presents an opportunity to test an approach where a national road building program may indeed have a materially quantifiable impact on the national economy, and therefore the benefits in terms of justifying the program, should be identified and quantified as part of the economic assessment.

Wider economic costs and benefits have not traditionally been included in conventional CBA. However, recent developments in Europe and Australia have indicated that conventional approaches overlook benefits such as agglomeration and employment effects, and there are increasing moves to include these impacts in some way, at least for large schemes. Standard approaches to the assessment of agglomeration impacts are evolving and are being included in the formal guidance for economic evaluation, although there is still a range of opinion with regard to the inclusion of employment impacts, in part related to the difficulties associated with their estimation. Also some concerns remain more generally as to the level of accuracy of the measures provided.

Therefore, while a cautious approach is appropriate, WEBs should not be overlooked and excluded for projects with high impact and significant scope such as the RoNS.

In this regard, the definition of WEBs for this purpose was agreed by NZTA to be:

> *"Second order effects on wider economic activity, with examples of WEBs covering agglomeration benefits, labour productivity and supply, and the impacts of imperfect competition. In addition effects at a macro-economic level resulting in GDP changes or more specifically changes in Real Gross National Disposable Income (RGNDI) have been considered."*

Conventional assessments and WEBs are based upon two different fields in economics. The former is based on a project-specific standpoint, with an emphasis on changes in traffic movements and time savings. The latter takes a broader perspective, looking at regional and, in the case of CGE, national benefits.

The results of the two methods of economic appraisal are not simply additive, and careful consideration must be taken when putting the two sets of results together.

After discussions with NZTA, it was determined that conventional CBA be used as the primary measure of benefits, and the two approaches to WEBs evaluation results be added to the CBA separately in the form of sensitivity tests, using high and low estimates.

The regionalised WEBs assessment was undertaken by Richard Paling Consulting. The methodology primarily focused on looking at quantifying benefits arising from agglomeration and employment impacts.

Infometrics Ltd evaluated national economic and productivity benefits using the ESSAM CGE model. CGE is based on an economy benchmark based on databases of input-output tables comprised of interactions between economic agents including firms, workers, households, the government and overseas markets. By "shocking" the model, the changes in terms of GDP, employment and wages can be observed.

## Conclusions of RoNS portfolio assessment

Key conclusions from the economic assessment were:

**Conventional and wider economic evaluation approaches**

i. Each RoNS has been subject to a conventional economic assessment considering traffic benefits, travel time savings, accident reductions, vehicle operating cost savings, and associated benefits and costs;

ii. WEBs have also been identified and quantified at both a regional level and a national level for each RoNS;

iii. **These WEBs are generated by the RoNS program beyond those estimated through conventional economic assessment, and are of relatively considerable scale;**

iv. **The approach used to estimate WEBs is relatively new and as such it produces results which vary considerably – it is likely the approach will be subject to ongoing refinement for some time;**

v. While precedents exist in program evaluation in Australia – specifically Infrastructure Australia's consideration of WEBs in its economic assessment considerations – the estimated benefits applied have been broadly in the order of 20-30% benefits over and above conventional assessment;

vi. It is noted that the quantum of WEBs are a function of size and population density and the UK Eddington Report estimates that agglomeration benefits alone may provide additional benefits in the order of 30% for large, high density urban areas such as London.;

vii. While the above estimates provide a comparator with which to place WEBs in some context for the New Zealand environment, they should be treated as indicators only, and not used as a substitute for thorough and robust WEB modelling and analysis using regionally specific data;

viii. In relation to the use of General Equilibrium approaches, Infrastructure Australia does not use the outputs in an additive capacity, though it remains an instructive tool when considering potential national effects associated with significant infrastructure projects. The inclusion of one component of WEBs, agglomeration benefits, is accepted (and expected) by Infrastructure Australia as being additional to conventional CBA, and it is also becoming more widely recognised in New Zealand and in the UK;

ix. **While WEBs have been considered, there have not been any interdependency (synergy) benefits associated with the portfolio of projects** – that is, the sum total of all RoNS is not greater than the individual RoN benefits – NZTA confirmed that there is simply too great a dispersement of the projects across New Zealand to realistically consider them as truly linked for the purposes of benefit streams;

**Economic assessment framework**

x. Conventional assessments undertaken for each RoNS were provided for by NZTA – these have been broadly assessed to ensure consistency in terms of economic parameters (time horizon, starting year, discount rate, amongst other parameters);

xi. To investigate the economic impacts of accelerating the implementation of the RoNS, the evaluation results of the accelerated program must be compared against the "base case" (pre-RoNS) construction dates. As the conventional evaluations provided by NZTA were based on the accelerated RoNS program (being the aspirational program as defined by the NLTP), the construction profile of each was extrapolated back to generate a base case construction program based broadly on the program for each of these roads as defined in the Government Policy Statement (GPS) 2006;

xii. **The impact of accelerating the RoNS compared to the 'base case' delivery timeline is a reduction in the Benefit Cost Ratio for the program as a whole – this is directly related to the bringing forward of funds which outweighs the additional benefits of doing so;**

xiii. **Notwithstanding this, the results indicate that the total benefits remain larger than total costs for the accelerated program, albeit to a lesser extent than the base case, as noted above;**

xiv. As a 'midpoint' scenario, an alternative accelerated program was tested (slower implementation than proposed acceleration, but more rapid implementation than the base case) which provided a result closer to the base case benefits stream – and again, total benefits are greater than total costs;

xv. Sensitivity tests have been applied adding the WEBs and CGE results to the CBA. Noting concerns and lack of precedents in using such an approach (particularly in relation to CGE) the results have been as an indicative proxy with which to assess a single net present value (NPV) and benefit cost ratio (BCR) result that can be used to inform decision making with regards the acceleration of the RoNS program.

xvi. The application of WEBs (regional and/or national level) changes the quantum of benefits across all scenarios (including the base case), but it does not change the overall outcome – in that, while the benefit cost ratio is greater than 1, the accelerated program costs outweigh the additional benefits of doing so;

xvii. A summary of results is provided in Table E1 below.

**Table E1. Program Results for Conventional and Accelerated Scenarios**

| Criteria | Base Program | Accelerated Program | *Alternative Program* |
|---|---|---|---|
| **Total Undiscounted Capital Costs ($m)** | 9,770 | 9,787 | *9,779* |
| **Total Project Costs (PV, $m)** | 4,268 | 5,948 | *4,901* |
| **Total Project Benefits (PV, $m)** | 8,248 | 9,025 | *8,667* |
| Conventional CBA Economic Evaluation Measures: | | | |
| **Net Benefits (NPV $m)** | 3,980 | 3,076 | *3,766* |
| **Benefit-Cost Ratio** | **1.9** | **1.5** | ***1.8*** |
| Economic Evaluation Measures with WEBs (agglomeration + employment): | | | |
| **Net Benefits (NPV $m)** | 6,832 | 6,777 | *7,258* |
| **Benefit-Cost Ratio** | **2.6** | **2.1** | ***2.5*** |
| Economic Evaluation Measures with WEBs (agglomeration only): | | | |
| **Net Benefits (NPV $m)** | 5,177 | 4,527 | *5,170* |
| **Benefit-Cost Ratio** | 2.2 | 1.8 | *2.1* |
| Economic Evaluation Measures with GE (high estimate): | | | |
| **Net Benefits (NPV $m)** | 11,982 | 12,231 | *12,390* |
| **Benefit-Cost Ratio** | **3.8** | **3.1** | ***3.5*** |
| Economic Evaluation Measures with GE (low estimate): | | | |
| **Net Benefits (NPV $m)** | 3,702 | 2,838 | *3,511* |
| **Benefit-Cost Ratio** | 1.9 | 1.5 | *1.7* |

xviii. Sensitivity testing shows that certain parameters, such as capital cost increases, impact considerably on the economic assessment outcomes, indicating that costings need to be at a high

order of accuracy to ensure the assessments can remain as robust as practical through the individual project feasibility and approvals phases;

xix. NZTA now must consider the issues associated with accelerating the RoNS, an outcome which while retaining a benefit to cost ratio outcome greater than one, may not be the optimal investment and funding outcome when considered in its broadest context against other roading projects and/or other government portfolio areas,. While this is somewhat outside the scope of this report, it is noted here as it is a key issue to be considered in taking the outputs from this assessment forward.

# 2 Introduction

This report constitutes the findings of an economic assessment undertaken at the portfolio level for the Roads of National Significance (RoNS).

The assessment includes consideration of the total economic benefits and costs for the seven RoNS taking into account traditional road user benefits, externalities, and potentially broader productivity and economic growth associated with the implementation of the RoNS.

The purpose of undertaking the assessment is for NZTA to be able to answer two fundamental questions, namely:

1. Are there quantifiable wider economic benefits associated with the portfolio of RoNS projects?
2. If such benefits exist and are quantifiable, are they of sufficient scale to justify accelerating the implementation of the RoNS as a portfolio?

## 2.1 Background

The New Zealand Government has announced seven Roads of National Significance, which have been identified as essential routes that require priority treatment to achieve economic growth and productivity.

The RoNS, from north to south, are:

- Puhoi to Wellsford – SH1
- Completion of the Auckland Western Ring Route – SH20/16/18 (including Waterview)
- Victoria Park Tunnel – SH1
- Waikato Expressway – SH1
- Tauranga Eastern Corridor – SH2
- Wellington Northern Corridor (Levin to Wellington) – SH1
- Christchurch motorway projects

The RoNS have been identified as the most essential routes from a nation-wide perspective that require significant development to reduce congestion, improve safety and support economic growth.

The purpose of the Government nominating these roads as "nationally significant" is to ensure they are given priority by NZ Transport Agency (NZTA) in developing the National Land Transport Program (NLTP).

NZTA is required to develop plans to substantially advance these roads over the next ten years alongside other State highway projects in the NLTP, which must be developed in accordance with the Government Policy Statement 08/09-18/19 (GPS).

Amongst other things, in developing the NLTP the NZTA must:

- Ensure funding allocations are consistent with the impacts the government wishes to achieve as set out in the GPS;
- Ensure funds allocated and spent within each activity class are within the range specified for that activity class as given in the GPS;

- Take account of the Government's priority to increase national economic growth and productivity, which includes the national roading priorities set out in the RoNS;
- Consider networks from a national perspective; and
- Achieve value for money.

## 2.2 Project objectives

The RoNS are each significant projects in their own right. Each has been progressed to a certain extent on an individual basis. The funding for each in a traditional approvals and procurement approach would be assessed and sought in isolation from other major roading projects within NZTA's portfolio.

Due to the priority required for the RoNS, NZTA has considered an approach which seeks to justify, on economic assessment grounds, the seven projects on a portfolio basis taking into account their expected benefits.

NZTA is then seeking to undertake certain scenario analyses which:

- Seek to accelerate the implementation of the projects through increased funding in the short term;
- Seek alternative sources of funding (compared to Government funding) for certain RoNS projects.

The objective from the process is a 'proof of concept' that quantifies:

1. The benefits of the RoNS on a portfolio basis; and
2. The benefits from accelerating the implementation of the RoNS.

This report represents the findings from the economic assessment which responds to those objectives.

It is important to note from the outset that the assessment approach adopted extends beyond conventional project level benefit-cost analyses alone, and incorporates broader second order macroeconomic effects. Similar approaches to evaluation have been made to varying degrees primarily overseas, and while there is growing agreement that the concept of including wider economic benefits in the appraisal of projects is appropriate (as evidenced by the inclusion of one component of these, agglomeration benefits, in the most recent versions of the NZTA Economic Evaluation Manual), the details of the approach in general is still embryonic and evolving, and some of the components are not broadly agreed.

It is therefore important that the results be considered within this context and, to respond in a robust manner to the likely challenge of the purported benefit streams, that a range of sensitivity tests be incorporated which seeks to respond to some of those challenges.

Notwithstanding this, it is generally acknowledged that broad benefits may accrue to a project beyond those undertaken in a conventional assessment, and this report simply seeks to outline a framework for identifying those benefits and then reporting on the results of quantifying those benefits in a coherent and transparent manner.

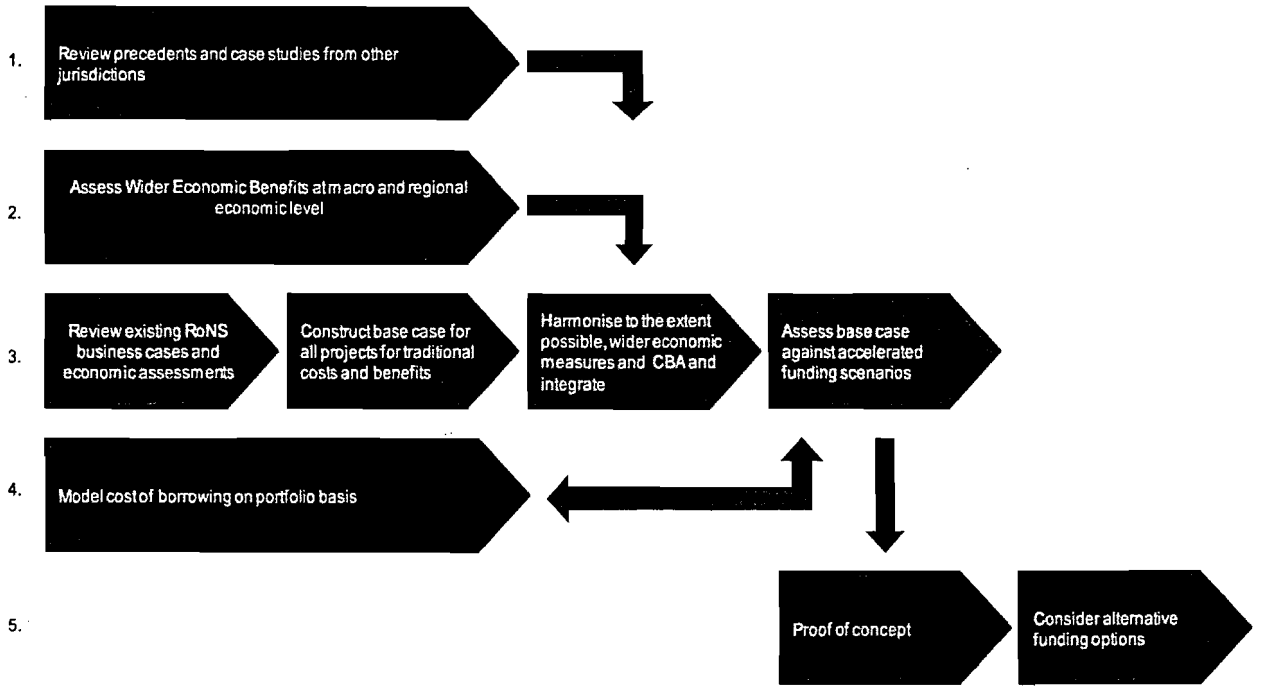
# 3 Methodology

## 3.1 Introduction

An economic assessment on a portfolio basis which takes into account both conventional and wider economic benefits requires a methodical construct to ensure the approach used is readily understood, and to ensure it is useful for undertaking necessary sensitive testing and scenario analyses.

The approach used is summarised in Figure 3.1 below.

**Figure 3.1: RoNS portfolio economic assessment methodology**




The workstreams outlined in the figure are further described in the following pages. The actual assessments undertaken in certain workstreams has been undertaken by various external advisers on behalf of NZTA. Those responsible for certain workstreams are also outlined in the following pages.

## 3.2 Workstream 1: Approaches used in other jurisdictions

This step was undertaken as a broad level review of economic assessment methodologies used in Australia to determine whether there were any learnings which could be applied in relation to program level economic assessment and/or the application of WEBs identification and quantification.

Reviews undertaken include:

- National infrastructure priorities - Infrastructure Australia, nation-wide
- Metro Rail Economic Assessment (MREP) – NSW Government, Sydney
- City Loop and Inner Core – Victorian Government, Melbourne
- Other infrastructure assessment processes and funding schemes

The specific aim was to consider the approach taken to assessing (and justifying) the individual projects as a holistic program in the context of costs and benefits at the level of the national economy

## 3.3 Workstream 2: Assess wider economic benefits

This workstream was undertaken to assess the WEBs impacts associated with the implementation of the RoNS. In this regard, two approaches were used (one essentially used as a comparison for the other):

Assess the potential for wider economic benefits (WEBS) using two different measures:

- The first approach used a Computable General Equilibrium model (CGE) to estimate the size of the economy-wide effects, on the basis that the RoNS are of a scale to have nation-wide impacts including the potential to impact gross domestic product (GDP) – this assessment was undertaken by Infometrics Ltd (Infometrics); and
- The second approach used a regionally-specific WEBs model which individually assessed the regional impacts of each of the RoNS in relation to agglomeration effects and employment changes – this assessment was undertaken by Richard Paling Consulting Ltd.

## 3.4 Workstream 3: Economic assessment framework

This workstream involved the review of available project-specific economic analyses undertaken by NZTA or other external advisers. The specific steps proposed included:

- A review of each of the seven RoNS in terms of business case and conventional economic evaluations;
- Construction of an economic assessment framework for the RoNS portfolio of projects;
- Construction of the 'base case' (ie. the original, 'unaccelerated' program of works) which incorporates the conventional benefits and costs over a 40 year time horizon, and the WEBs impacts distributed over that 40 year horizon to develop a profile of total benefits;
- Undertake a broad assessment within the economic assessment framework of total program benefits and costs – comparing the 'base case' against the accelerated program; and
- Undertake a range of sensitivity tests to determine key variables and influencers and the veracity of results.

It should be noted that the initial approach was intended to undertake a peer review of existing economic evaluations at a detailed level to ensure the results for each RoNS were 'normalised (i.e. assessment was on the same basis for each project – travel time savings, traffic modelling assumptions, vehicle operating cost parameters, amongst other checks). However, due to time constraints and the unavailability of certain data and reporting, it has not been possible to undertake this level of review and the results as provided by NZTA have had to be adopted without a sanity check at the detailed level.

As a consequence the accuracy of the integrated Benefit Cost Analysis modelling remains a function of the accuracy of the raw data provided. Notwithstanding, NZTA has advised that the conventional economic evaluations provided have been the subject of NZTA's internal peer review process.

A discount rate of 8% real has been used throughout the evaluation in accordance with the NZTA Economic Evaluation Manual (EEM) guidelines.

While the EEM stipulates that project life-spans of 30 years should be used for the evaluation of individual projects, the EEM is silent on the treatment of programs of works. To reflect the portfolio effect of the RoNS

program and the staggered nature of construction start dates for each of the projects, an evaluation period of 2009-2049 (i.e. 40 years) has been used for this exercise.

All dollars are represented in 2009 dollars unless otherwise stipulated.

## 3.5 Workstream 4: Model cost of borrowing

This step considers the consequential 'financing/funding investment assessment' as opposed to the broader public interest assessment associated with the Benefit Cost Analysis.

The workstream completes the full scope of NZTA's assessment in reaching a conclusion regarding whether the broader economic benefits associated with accelerating implementation of the RoNS offsets the cost of borrowing funds to enact that acceleration. This workstream is documented separately and is not included in this report.

## 3.6 Workstream 5: Economic assessment reporting

This workstream involved preparation of the results in a 'building block' approach (conventional + WEBs, sensitivity testing) so that the specific impacts of both broader economic impacts and acceleration of funding for earlier implementation could be quantified and reported.

## 3.7 Workstream responsibilities

NZTA engaged a mix of internal resources and external advice to undertake the various workstreams which have been combined to form the evaluation results outlined in this report. External advisers have undertaken specific workstreams as follows:

| | |
|---|---|
| 1. International case studies: | Saha International |
| 2. Wider Economic Benefits: | Richard Paling Consulting Ltd– Regional WEBs assessment for each RoNS |
| | Infometrics Ltd –General Equilibrium model assessments for each RoNS and for the sets of RoNS combined |
| | Booz & Co – Peer review and graphical representation of GE outputs |
| 3. Assessment framework: | Saha International |
| 4. Cost of borrowing: | Deloitte (reported separately) |
| 5. Proof of concept report: | Saha International (this report) |

# 4 Approaches taken in other jurisdictions

## 4.1 Introduction

To assist in the validation of approach taken to evaluating the RoNS as a portfolio, a small body of research was undertaken to review portfolio project approaches and evaluation undertaken by various agencies in Australia and internationally. The focus of this research sought to understand the treatment of two key premises:

1. Multiple projects evaluated as portfolios and the treatment of project interdependencies; and
2. The role of alternative measures of economic benefits beyond the conventional economic analyses.

The research profiled the following agencies:

- Infrastructure Australia's Assessment Framework (2008)
- City Loop and Inner Core, Melbourne (2007)
- Metropolitan Rail Expansion Program, Sydney (2007)
- AusLink, National (2007)

These examples were selected to highlight where wider economic benefits have been considered, interdependencies between projects have been identified and quantified, and the need for assessments to be based on rigorous transport demand modelling and economic concepts.

In addition reference is made to work undertaken in the UK.

## 4.2 Key findings

The following conclusions were drawn from the case studies researched:

- Robust, transparent and justifiable conventional cost benefit analysis (CBA) is essential, and is the 'bedrock' of project evaluation;
- Where multiple projects comprise a program, it is necessary to ensure that CBA is applied consistently. This includes consistent transport modelling, assumptions, unit values, and discount rates, and sensitivity testing;
- Determining project linkages is essentially an empirical test – interdependencies, if identified, may drive sequencing decisions;
- There are no simple or widely used methods to quantify interdependencies between projects;
- Application of standard evaluation methods, transport modelling, along with subjective analysis remains the key approach;
- Infrastructure Australia has introduced WEBs as a potential benefit stream, with its prioritisation guidelines specifying the inclusion of agglomeration impacts as a monetised benefit in economic evaluations submitted to it (though not CGE). Anecdotally, through the IA process WEBs have been incorporated into economic benefit streams in the order of 20-30% over and above conventional CBA

benefits – however, it appears there has been a lack of detailed data collection, and there has been heavy reliance on one or two reference projects where such benefits have been identified;

- In terms of CGE, Infrastructure Australia acknowledge the usefulness of CGE as a tool for measuring macroeconomic effects, but have taken a clear stance to the treatment of the outcomes of CGE modelling in relation to conventional CBA:

  *"Infrastructure Australia will primarily use CBA data for measuring the benefits of an initiative and will not consider CGE (Computable General Equilibrium) benefits as additive to CBA benefits"*[3]

- There is still considerable work to be undertaken in developing the approach in Australia further.
- Work undertaken in the UK by Sir Ron Eddington on behalf of the UK Treasury in 2006 made a number of conclusions regarding the long-term links between transport and the UK's economic productivity, growth and stability. In relation to wider macro and regional economic benefits the report concluded, amongst other things:
  - A comprehensive and high-performing transport system is an important enabler of sustained economic prosperity: a 5 per cent reduction in travel time for all business and freight travel on the roads could generate around £2.5 billion of cost savings – some 0.2 per cent of GDP..
  - Transport's contribution to the agglomeration effects of economic activity is most significant within large, high-productivity urban areas of the UK. London is the most significant example, adding 30 per cent to the time saving benefits of some transport schemes.[4]
- It should however be noted, when evaluating effects borne by other economies, such as the UK, of the differences in scale and population densities between these other economies and the New Zealand economy, particularly with regard to the urban environments.

[3] Infrastructure Australia, Prioritisation Guidelines 2008

[4] HM Treasury, The Eddington Transport Study, 2006

# 5 Wider Economic Benefits

## 5.1 Introduction

Conventional CBA focuses mainly on project specific costs and benefits, and are derived from changes in travel conditions including travel time, safety and vehicle associated costs. However, research in recent years has shown that these savings do not capture wider economic impacts, and thus the exclusion of such impacts might increase the risk of poor investment decisions.

The fundamental issues associated with the conventional approach has been the focus on transport model outputs which transfer existing traffic flows and forecasts between routes and modes. These do not take into account induced or generated traffic which may occur due to the particular impacts of the project or the second order economic effects which might arise in particular in response to changes in transport accessibility.

The extent that the underpinning transport data which 'drives' a conventional approach does not reflect estimates of changed socio-economic activity in terms of new trips or changes in patterns of economic activity, could be considered to be a deficiency with the conventional approach.

Research in recent years has shown that savings in travel time do not capture all wider economic impacts, and thus the exclusion of such impacts increases the risk of sub-optimal investment decisions.

This is where the explicit consideration of WEBs seeks to respond to this deficiency in the conventional approach.

The national significance assigned to the RoNS program presents an opportunity to test an approach where a national road building program may indeed have a materially quantifiable impact on the national economy over and above those captured in a conventional economic appraisal, and therefore the benefits in terms of justifying the program, should be identified and quantified as part of the economic assessment.

In this regard, the definition of WEBs for this purpose was agreed by NZTA to be:

> *"Second order effects on wider economic activity", with examples of WEBs covering agglomeration benefits, labour productivity and supply, and the impacts of imperfect competition. In addition effects at a macro-economic level resulting in GDP changes or more specifically changes in Real Gross National Disposable Income (RGNDI) have been considered."*

Two approaches to the evaluation of WEBs have been undertaken for the purposes of answering the above two questions. These are:

- Changes in RGNDI using a Computable General Equilibrium (CGE) model; and
- WEBs at a regional level using agglomeration and labour market effects.

It should be noted that the outputs from these two methodologies are not considered to be additive but rather demonstrate through different means the potential for additional economic benefits/impacts to be accrued to the RoNS program

The value of alternative measures of wider economic impacts, beyond those provided through conventional means, as noted above are acknowledged. However without the opportunity to undertake a full peer review of the WEBs and GE reports, the inclusion of the WEB and GE results in this evaluation are premised on the basis that a number of concerns with some of the components of the outputs from these reports remain, reflecting the difficulties in identifying impacts which arise over considerable periods of time. These concerns include for example:

- The WEBs results lack substantiation of the difference between new jobs created versus those relocated as a consequence of a project; noting however the potential for displaced jobs to migrate to more productive jobs;
- The absence of substantive induced/generated commercial and freight traffic as a result of these projects;
- The potential for double counting of benefits in both analyses with conventional economic evaluations of saved travel times, although research from overseas has largely discounted this issue;
- The distinction between average and marginal values as applied to agglomeration. The incremental effects of agglomeration could be expected to vary depending on the pre-existing conditions to which they are applied and care must be taken to ensure that there is no implication that continuing benefits accrue with ever-increasing concentration. In other words, the effect of diminishing returns may result in the overstating of agglomeration benefits;
- Not all second order effects should be taken as benefits. There are likely to be second order costs, e.g. as more projects come on stream and if there are diminishing returns to agglomeration, this might lead to more congestion, potentially higher levels of crime and other social dislocation with higher concentration, and therefore higher costs.

## 5.2 WEBs

The regionalised WEBs assessment was undertaken by Richard Paling Consulting. The methodology primarily focused on looking at quantifying benefits arising from agglomeration and employment impacts.

The following is the excerpted Executive Summary from the Paling Consulting report.

### 5.2.1 Paling Consulting report

*The conventional economic analysis of the impacts of transport schemes primarily focuses on changes in travel conditions for journeys that would be made whether or not the new scheme was in place. It does not therefore include the impacts that road building might have on the level and patterns of economic activity and employment. However, a wide range of evidence suggests that road building may indeed have these wider economic impacts but to date there have only been limited attempts to quantify these. While the desirability of including the full range of impacts is recognised, in practice their assessment has been constrained by the lack of quantified data on these, particularly on the employment effects. In part, this reflects the length of time over which these impacts might emerge and the difficulty of distinguishing the effects of road building from other possible influences over that period.*

*One approach to assessing the wider impacts is the use of a GE model which has been described earlier. An alternative bottom up approach has also been developed, which considers the wider economic benefits for*

*each component of the RoNS separately. While as acknowledged above, there are limitations with the data used to support this, it does provide a broad estimate of the wider economic benefits which might result.*

*This bottom up approach takes into account both the agglomeration impacts, the productive advantages that arise from close spatial concentration of economic activity, which are likely to arise within major urban areas, and the impacts on employment levels experienced both within the urban areas and more widely throughout the area of influence of the road. These are effects which are not included in the conventional economic analysis and which can therefore be added into the scheme appraisal.*

*For the agglomeration impacts, in general the broad approach set out in the Economic Evaluation Manual (EEM) has been followed, with some simplification. This uses the most recent numbers on agglomeration elasticities recently developed by NZTA.*

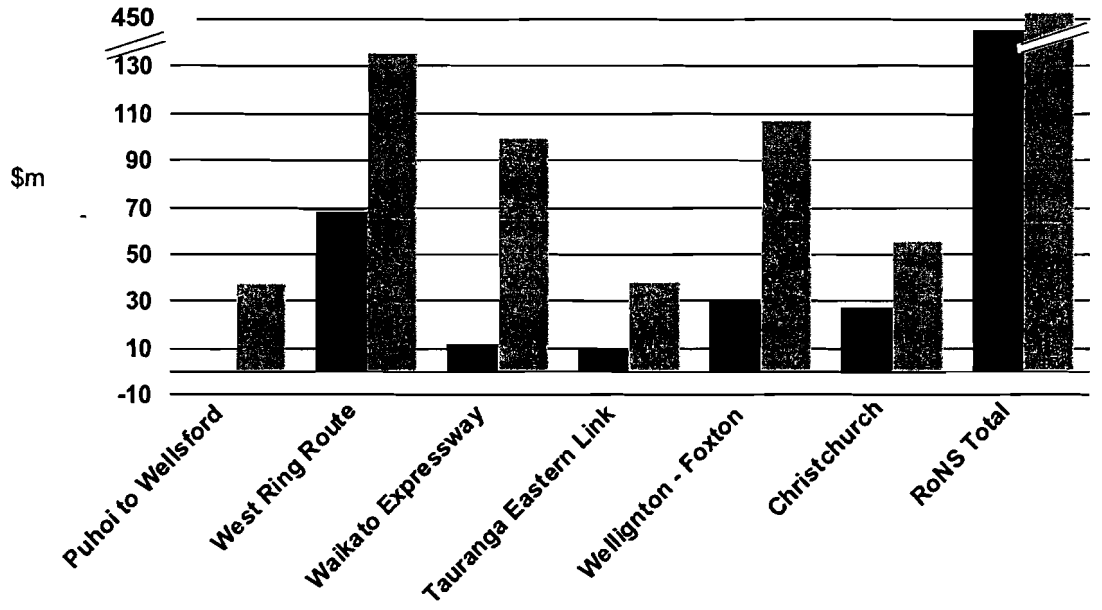
*For the employment effects, for interurban schemes use has been made of the results of studies from overseas which have suggested that new roads can increase the numbers employed in the broad area of influence of the road by between 0.4 per cent and 4 per cent. A conservative approach has been used for the analysis, based on the figures at the lower end of this range. For urban schemes, use has been made of the relationships between employment impacts and agglomeration derived from earlier work in Auckland on the Waterview Connection, and which suggests that the employment effects .*

*On the basis of this approach, the wider economic benefits generated by the RoNS amount to about 65 per cent of the benefits derived from the conventional economic analysis. For the schemes where they have been estimated, the agglomeration benefits typically amount to 20 per cent or less of the conventional economic benefits, a figure that is within the range typically found overseas. The employment impacts are larger but for these there is no typical range. The results from the bottom-up approach give slightly lower benefits from those derived from the GE modelling, in part reflecting the more comprehensive spatial assessment in the GE modelling. However taking both the conventional economic benefits and the wider economic benefits together, both approaches give results of a similar order of magnitude.*

*While there are issues with the limited data available and with the use of results from different schemes and countries, the findings suggest that the wider economic benefits from the RoNS are likely to be substantial in relation to the benefits traditionally calculated. This indicates the importance of these schemes in improving productivity and raising economic output in New Zealand.*

### 5.2.2 Summary of results

**Figure 5.1 WEBs Forecast Results – PV Annual Benefits in 2016**




The results generated by Richard Paling Consulting are based on a the position as might occur in 2016, assuming all roads are completed at that point in time and all ramp-ups to the full forecasts have been achieved. Note that WEBs for Victoria Park Tunnel (VPT) were not assessed given that the purpose of this assessment is to look at the effects of accelerating the RoNS, and as VPT is actually under construction at the time of writing there would be no incremental effect.

The WEBs estimated amount to about 65 per cent of the benefits derived from the conventional economic analysis, with agglomeration benefits component amounting to around 20 per cent or less of the conventional economic benefits (refer figures 5.4 and 5.5 below for this comparison). A separate annualised figure was provided for each of the base and accelerated programs of the RoNS which were used for integrating WEBs and conventional CBA findings.

For a more detailed description of the methodology and results, please refer to the full Richard Paling Consulting report in the appendices.

### 5.2.3 Peer review of WEBs

Booz and Co conducted a peer review of the Richard Paling Consulting WEBs report. A copy of this report is provided in the appendix.

## 5.3 General Equilibrium

Infometrics was commissioned by NZTA to evaluate national economic and productivity benefits. The ESSAM computable general equilibrium (CGE) model was used to estimate these benefits. CGE is based on an economy benchmark based on databases of input-output tables comprised of interactions between economic agents including firms, workers, households, the government and overseas markets. By "shocking" the model, the changes in terms of GDP, employment and wages can be observed.

The main measure of economic welfare used in the GE modelling is Real Gross National Disposable Income (RGNDI). RGNDI measures the total incomes New Zealand residents receive from both domestic production and net income flows from the rest of the world and adjusts for changes in the terms of trade. The inputs for the GE model for RoNS includes change in work related travel time, vehicle operating costs and repairs and accident related costs.

A GE to net market benefits ratio was calculated using these inputs to measure the magnitude of macro-economic benefits (as measured by RGNDI) to conventional market benefits as a result of the RoNS program. As the results generated by Infometrics are based on a static output as at 2022 (assuming all roads are completed at that point in time), the ratio of GE to market benefits has been applied to the market benefits of conventional cost-benefit analysis to estimate a temporal view of change in RGNDI.

The following is an extract of the Executive Summary of the report undertaken by Infometrics Ltd on the outputs of the CGE model.

### 5.3.1 Infometrics report

*[The Infometrics workstream used] a computable general equilibrium model to estimate the wider economic benefits of the Roads of National Significance.*

*Standard benefit-cost analysis is a partial equilibrium technique; well-suited to the analysis of investment projects that will not have significant national effects. The RONS projects, however, have the potential to change New Zealand's gross domestic product. A general equilibrium model is one tool that can be used to estimate the size of the economy-wide effects. As well as incorporating the changes in productive efficiency that are addressed in partial equilibrium analysis, a general equilibrium model also captures flow-on effects and the effects of changes in allocative efficiency – the gains in economic welfare that emanate from improvements in the allocation of resources between industries in accordance with consumer preferences.*

*For the RONS projects our analysis suggests that the generation of wider economic benefits can be substantial, amounting to about $1200m, compared to around $400m using standard benefit-cost analysis. Non-market benefits (such as lives saved) which are not included in the general equilibrium modelling, add another $600m. Thus overall benefits increase by about 80%.*

*However, the existence of flow-on economic benefits depends crucially on whether there is an investment response to the potentially higher rates of return that would result from the productivity improvements generated by the RONS. Without such investment the model produces no increase in the value of benefits over that estimated in traditional benefit-cost analysis. Indeed the value of market benefits at about $370m is 7% less than estimated by benefit-cost analysis.*

*International practice in general equilibrium modelling leans towards allowing investment to respond to rates of return. Ultimately, though, this is a judgement call that we as modellers do not claim to be any better at making than anyone else. Still, if investment does not respond to profitable opportunities then much analysis of economic growth policy is flawed.*

*Some limitations of the modelling approach should be noted.*

- *The estimates of the wider economic benefits still contain whatever error margins exist in the standard benefit-cost analysis.*
- *The consumption of petrol and diesel may be a poor proxy for the allocation of benefits if the RONS users are not representative of all road users.*
- *Agglomeration benefits are sometimes cited as a type of wider economic benefit from investment in transport infrastructure. The relationship between such benefits and those encompassed by GE model is unclear. They are not necessarily additive.*[5]

### 5.3.2 Peer review of CGE

Booz and Co conducted a peer review of the Infometrics CGE report. A copy of this report and Infometrics response is provided in the appendix.

### 5.3.3 Graphical representation of CGE

Booz and Co have developed a series of graphical representations of the CGE outputs to assist in the demonstration of industry and regional distribution of outcomes. A copy of this report is provided in the appendix.

### 5.3.4 Summary of results

Figures 5.2 and 5.3 demonstrate the GE output results at an individual project and the portfolio level. The high and low scenarios are based on the capital closure assumptions, i.e. whether or not there is an investment response to the potentially higher rates of return that would result from the productivity improvements generated by the RONS.

As noted above, with such investment (high scenario) the total value of benefits of the RONS increases by almost 80% over that estimated by traditional benefit-cost analysis. However without such investment (low scenario), the model produces no increase in benefit value. Indeed the total benefit value is 3% less than estimated by traditional benefit-cost analysis.

[5] Infometrics, General Equilibrium Analysis of Roads of National Significance, December 2009

**Figure 5.2 GE Modelling Results – ΔRGNDI as at 2022**

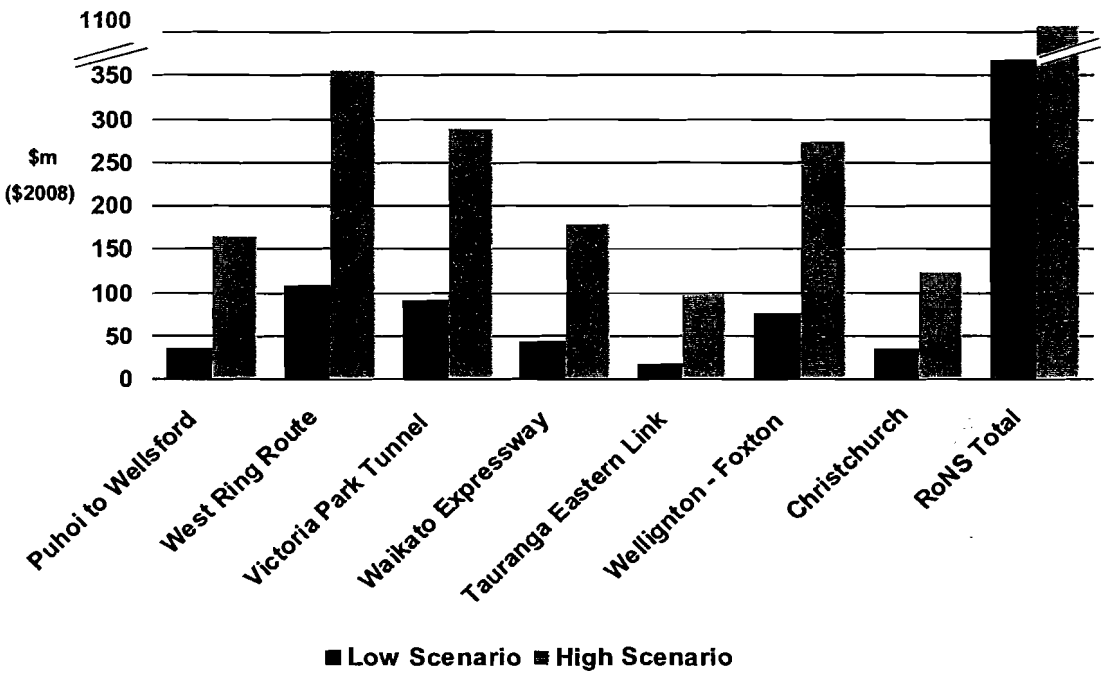
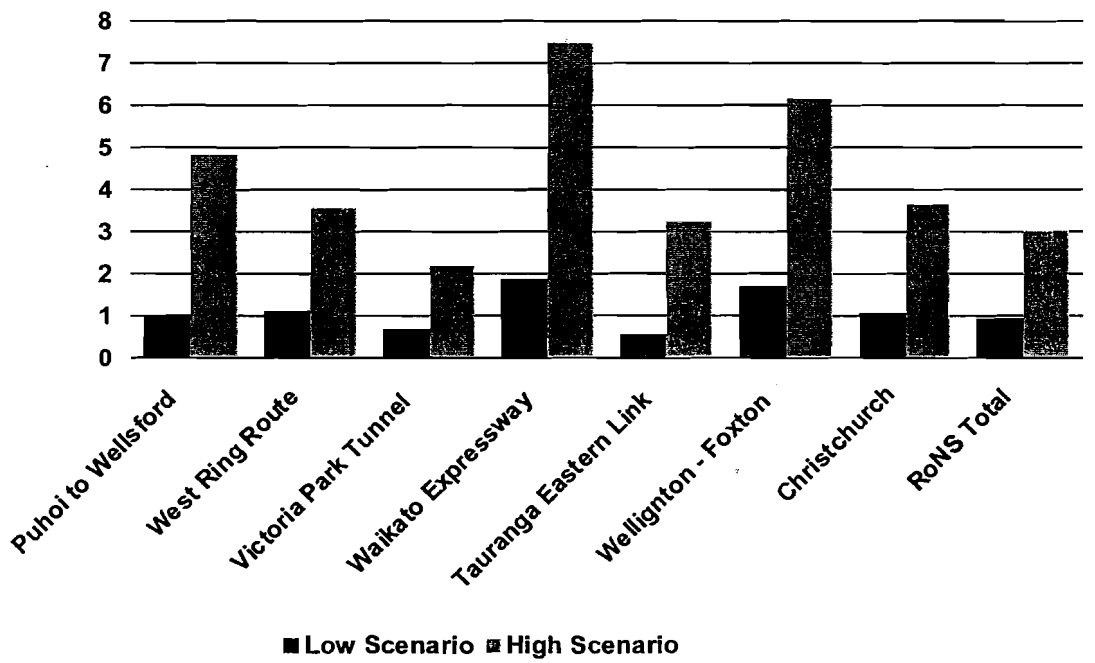



**Figure 5.3 GE Modelling Results – GE to Market Benefits Ratio**



## 5.4 Relativity of benefits generated

Figure 5.4 and 5.5 provides a comparison of the present value of benefits generated by the three evaluation methods using both the high and low estimates of WEB (i.e. with and without employment effects) and low and high estimates of GE (with and without an investment response).

**Figure 5.4 PV of benefits for the Accelerated Program Conventional benefits, WEBs (agglomeration + employment), GE (high estimate)**

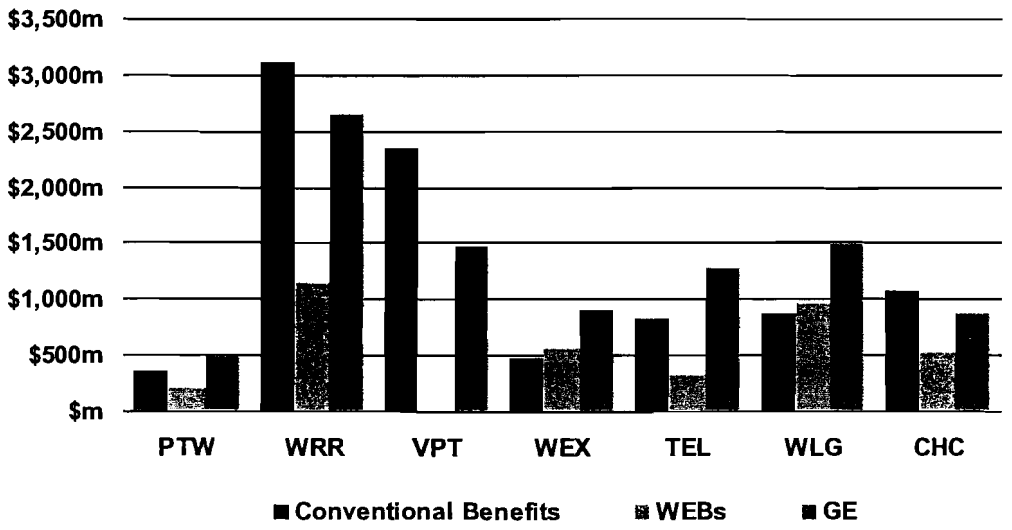
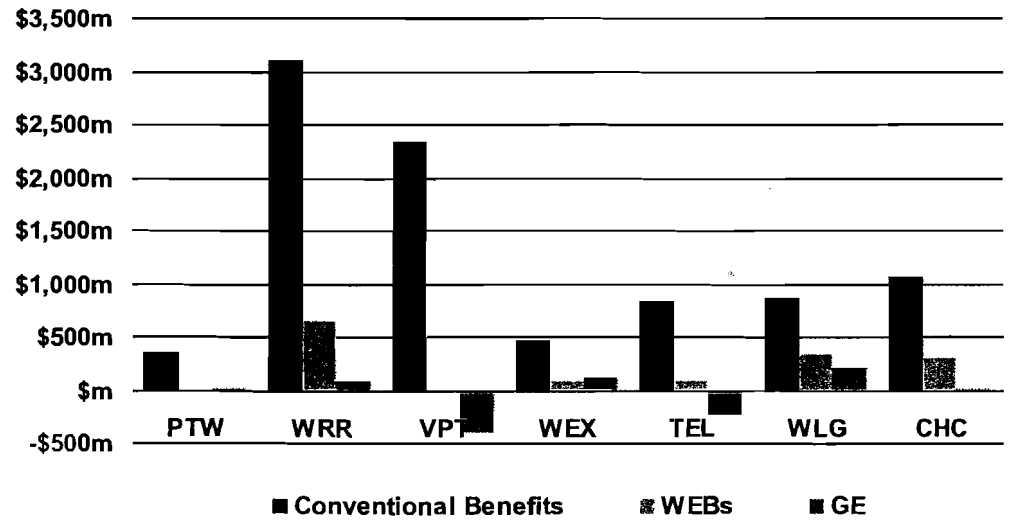



**Figure 5.5 PV of benefits for the Accelerated Program – Conventional benefits, WEBs (agglomeration only), GE (low estimate)**




Noting the negative GE benefit results for two individual RoNS projects in Figure 5.5, the following extract from Infometrics' report serves to explain the negative results that can be produced at the low CGE estimate (i.e. fixed capital stock assumption):

*"The total change in RGNDI from all of the RONS combined is estimated at almost $1200m, compared to about $400m in the B-C analyses; a roughly three-fold increase. However, these benefits are crucially dependent on the capital closure assumption. If investment is not responsive to rates of return, implying a total capital stock that is fixed at the BAU level, the increase in market benefits across all RONS combined is just under $370m; a reduction of 7% compared to the B-C results. The main contributors to this result are TEL and VPT, which have high values for work travel time.*

*Closing off the responsive of investment to rates of return prevents the economy from expanding. That is, there is essentially no opportunity for the benefits that are fed into the model to generate any wider economic benefits through multiplier effects. Not surprisingly then, the output of the model is much the same as what goes in – namely the benefits from the B-C analysis. While one might expect to see some additional benefit from gains in allocative efficiency (as resources flow to where they are most valued), such gains do not seem to be strong enough to offset various negative savings in vehicle operating costs and accident costs under some of the RONS, and of course the annual maintenance costs and financing charge."* [6]

For a more detailed description of the methodology and results, please refer to the full Infometrics report in the appendix.

[6] Infometrics, General Equilibrium Analysis of Roads of National Significance, December 2009

# 6 Economic evaluation framework

This section provides an overview of the methodologies used in undertaking the economic evaluation of the RoNS, including both conventional Cost Benefits Analysis and integration of the WEBs evaluations undertaken for each project.

## 6.1 Conventional economic evaluation

### 6.1.1 NZTA methodology

The conventional economic evaluation of RoNS follows standard methodologies for assessing projects of this nature, broadly in accordance with the Economic Evaluation Manual (EEM) of NZTA.

The evaluation looks at conventional benefits including travel time savings, reduction in accidents and vehicle operating costs, as well as the capital and operation costs associated with each of the RoNS.

The only toll road in this evaluation is the Tauranga Eastern Link, and the estimated toll revenue and collection costs have also been incorporated.

An integrated RoNS assessment was undertaken by the straightforward summing of the annualised (real) benefits and costs for each individual evaluation.

A Net Present Value (NPV) of net benefits (gross benefits less capital and operational costs) was calculated for each of the RoNS and aggregated for the integrated program. A benefit cost ratio (BCR) was also derived by dividing the total benefits by the total costs. Both measures act as primary tools to evaluate the economic feasibility of projects.

An 8% discount rate was used in the evaluation, with an evaluation period of 40 years.

### 6.1.2 Data quality

The primary data for each of the RoNS was provided by NZTA, with annual benefit and cost streams provided from the funding assessment for each RoNS.

The assessments provided to SAHA were principally cost and benefit profiles containing hard coded data. Given the nature of the data provided and without access to the underpinning transport modelled outputs and the generated/induced private, commercial and freight transport movements for each project assessment, it was not possible to better understand the real underlying drivers of benefits and costs at a detailed level.

There were also inconsistencies with data provided, including varying evaluation periods, questions over the year at which benefits should commence post-construction, and operating costs not being provided for all RoNS.

It is noted though that the economic assessments provided by NZTA had been subject to NZTA's normal peer review process, in line with its EEM processes.

Due the lack of detail and quality in data, several adjustments had to be made to provide a more transparent approach in assessing the economic outcomes of the integrated RoNS. For example, the data provided by NZTA was based on the accelerated program (not the original base case program which is to be used to

indeed compare the accelerated program against to assess changes in benefits and costs), in which some of the RoNS' construction has been accelerated.

## 6.2 Project interdependencies

In recent years, different jurisdictions across the world have identified economic benefits arising from interdependencies between closely related infrastructure projects. That is, there will be additional benefits generated by implementing a "package" of projects, which will be greater than the sum of the benefits of the individual projects in the package.

Agencies such as the UK Department of Transport have identified these explicitly, and have implemented a systematic approach for capturing these benefits. The case studies also provide an approach for which interdependencies between projects were identified (Victoria, NSW – rail projects – refer Appendix A).

However, following discussions with NZTA, it was determined that the RoNS do not have any tangible project interdependencies, primarily due to the significant geographical discrepancies between each of the RoNS. Therefore, any additional benefits from potential interdependencies have not been considered further in this assessment framework.

## 6.3 Combining the results

### 6.3.1 Conventional assessment and WEBs

The economic evaluation of the RoNS incorporates conventional benefits and costs specific to each project, as well as WEBs which look at regional and national economic impacts.

Conventional economic appraisal assesses the cost and benefits of a project to the community, which are incurred by different stakeholders such as the project proponents, road users and the government.

Wider economic costs and benefits have not traditionally been included in conventional cost-benefit analysis (CBA). However, recent developments in Europe and Australia have indicated that conventional approaches overlook benefits such as agglomeration and employment effects, and there are increasing moves to include these impacts in some way, at least for large schemes. Standard approaches to the assessment of agglomeration impacts are evolving and are being included in the formal guidance for economic evaluation, although there is still a range of opinions with regard to the inclusion of employment impacts, in part related to the difficulties associated with their estimation. Also some concerns remain, for the reasons noted in Section 4, as to the level of accuracy of the measures provided.

The WEBs analysis undertaken by Richard Paling Consulting at a regionalised level, and General Equilibrium (GE) model by Infometrics for NZTA, attempt to capture these benefits for the RoNS, using two different approaches.

Noting the concerns and lack of precedent (particularly in relation to CGE) of adding WEBs and CGE to conventional CBA, the intention of adopting this approach for the purposes of this review has been to produce an indicative proxy with which to assess a single net present value (NPV) and benefit cost ratio (BCR) result that can be used to inform decision making with regards the acceleration of the RoNS program.

### 6.3.2 Potential double counting of benefits

Conventional assessments and WEBs are based upon two different fields in economics. The prior is based on a project-specific standpoint, with an emphasis on changes in traffic movements and time savings. The latter takes a broader perspective, looking at regional and national benefits.

The results of the two methods of economic appraisal are not simply additive, and careful consideration must be taken when putting the two sets of results together.

In this regard, Infrastructure Australia in their Prioritisation Guidelines (2008), has taken a clear stance to treating the outcomes of CGE modelling:

: *"Infrastructure Australia will primarily use CBA data for measuring the benefits of an initiative and will not consider CGE (Computable General Equilibrium) benefits as additive to CBA benefits."*[7]

Notwithstanding the above, Infometrics refutes Infrastructure Australia's position and has provided a suggested methodology in their report to convert their "one snapshot moment after the investment" into an annualised temporal view to provide an additive approach of CGE to CBA. Infometrics does, however, caveat any reliance on this approach by stating that *"the results can only ever be indicative. The interpretation of CGE results should centre on their direction (up or down) and broad magnitude (small, medium or large), rather than on the precise point estimates that the model produces."*

While Infrastructure Australia has excluded CGE as an additive to CBA, it does support the inclusion of regionalised WEBs in its economic evaluations and specifically, with respect to agglomeration impacts, it *"expects these to be monetised and included in a CBA of any initiative"*[8].

As a result while a cautious approach is appropriate, particularly with regards to the scale of such benefits, WEBs should not be overlooked and excluded for projects with high impact and significant scope such as the RoNS.

After discussions with NZTA, it was determined that conventional CBA be used as the primary measure of benefits, and the two approaches to WEBs evaluation results be added to the CBA separately in the form of sensitivity tests, using high and low estimates.

Another issue identified is the extent to which regionalised WEBs and those produced from a GE model cover similar effects and the potential for over-estimation if they are incorporated simultaneously into a cost-benefit analysis for RoNS.

Due to the lack of detailed data, it has not been possible to determine precisely which component of the benefits from the regionalised WEBs analysis and those from GE modelling are covered by one or the other.

Again, following discussions with NZTA, it was agreed that the two measures can be regarded as substitutes rather than complementary.

Therefore, in the RoNS economic evaluation, the regionalised WEBs and those arising from GE outcomes have been treated as two separate sensitivity tests over and above conventional results.

[7] Infrastructure Australia, Prioritisation Guideline v5, September 2008

[8] Infrastructure Australia, Prioritisation Guideline v5, September 2008 – Appendix D

# 7 Scenarios assessment

## 7.1 Base case implementation

The construct of the above methodology allows the impacts of the introduction of conventional and WEBs to be assessed for the seven RoNS.

To investigate the economic impacts of accelerating the implementation of the RoNS, the evaluation results of the accelerated program must be compared against the "base case" (pre-RoNS) construction dates. As the conventional evaluations provided by NZTA were based on the accelerated RoNS program (being the aspirational program as defined by the NLTP), the construction profile of each was extrapolated back to generate a base case construction program based broadly on the program for each of these roads as defined in GPS 2006. For the base case, it is assumed none of the RoNS have been subject to funding injections which would bring forward their implementation. The accelerated scenario outlined below does just that, and compares the results back against this base case.

The steps below were taken to estimate the base case:

1. Certain project construction and operating costs were moved out a number of years according to the dates of the published base program
2. The years in which benefits start remain consistent for the base and accelerated program. For example, if in the data provided (the accelerated program) the benefits began five years after construction commenced, the same approach was applied to the base program.
3. The benefit realised is dependent on the year, not how many years after construction has started/finished. This means that the base and accelerated scenarios will have equivalent benefits for the equivalent years.

An "alternative" program was also established for the purposes of sensitivity testing the effects of program acceleration, which generally represents a midpoint construction period between the base and accelerated programs.

## 7.2 Accelerated implementation

The table below outlines the different construction start years in the base, accelerated and alternative programs, with the number of years accelerated shown in bold italics:

**Table 7.1 RoNS Construction Starting Year by Program**

| | Puhoi to Wellsford | West Ring Route | Victoria Park Tunnel | Waikato Expressway | Tauranga Eastern Link | Wellington - Foxton | Christchurch |
|---|---|---|---|---|---|---|---|
| **Base Program** | 2026 | 2009 | 2009 | 2009 | 2013 | 2019 | 2013 |
| **Accelerated Program** | 2009 ***17*** | 2009 | 2009 | 2009 | 2009 ***4*** | 2009 ***10*** | 2009 ***4*** |
| **Alternative Program** | 2018 ***8*** | 2009 | 2009 | 2009 | 2011 ***2*** | 2014 ***5*** | 2011 ***2*** |

For the base and alternative program, the costs and benefit values were adjusted according to the steps outlined above.

The results of the accelerated program and alternative program were then compared against the base program.

The incremental differences between the base and accelerated programs illustrate additional benefit/costs of the accelerated programs over the base program, as well as incremental BCRs.

Figure 7.1 and 7.2 illustrates the different cost-benefit profiles of the base and accelerated program:

**Figure 7.1 Cost and Benefit Profile – RoNS Base Program**

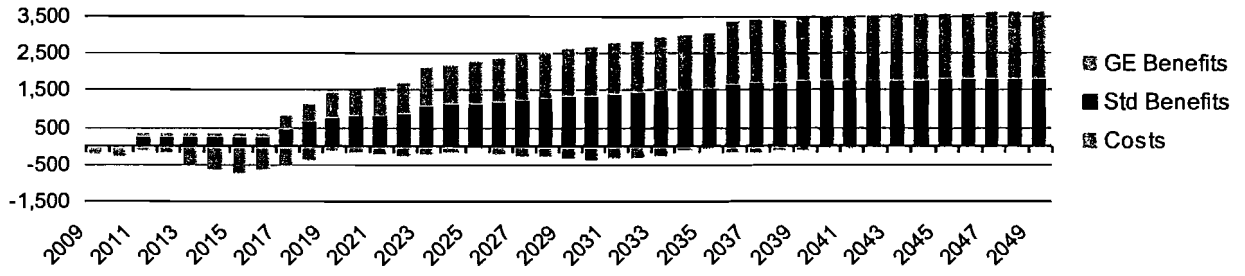
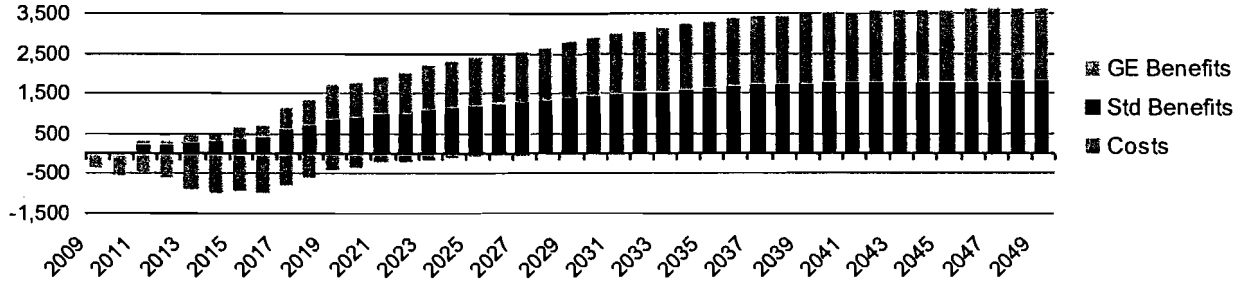



**Figure 7.2 Cost and Benefit Profile – RoNS Accelerated Program**




Source: Saha and Infometrics estimates

The figures show that as construction of the RoNS are accelerated, capital costs are brought forward, and benefits are realised sooner than the base program. The following sections discuss the economic evaluation outcomes of the base and accelerated RoNS programs in more detail.

## 7.3 Economic evaluation results

### 7.3.1 Derived vs NZTA original BCRs

To undertake the evaluation on a portfolio basis (i.e. RoNS considered as one "project") it has been necessary to "normalise" the original economic evaluation data provided by NZTA for each individual RoNS. This has required several adjustments, specifically:

- The extrapolation of the benefit streams across a consistent temporal view taken out to 2049;
- The sourcing of capital cost profiles for Puhoi-Wellsford and Wellington-Levin from GPS4; and
- An approach that does not discount Year 0 (which some of the base evaluations have done).

As a consequence the derived BCRs for the portfolio evaluation for each of the RoNS differ somewhat from NZTA's funding application BCRs. The comparison between the funding BCRs and SAHA's derived BCRs for the accelerated program are summarised in Table 7.2.

**Table 7.2 Comparison of derived vs NZTA funding BCRs**

| | NZTA funding BCR | SAHA derived BCR | Adjustments made to NZTA base data |
|---|---|---|---|
| **Puhoi to Wellsford** | 0.7-1.2 | 0.4 | Benefits truncated to 2049 (from 2059) and capex costs sourced from GPS4 |
| **Western Ring Route** | 2.1 | 2.5 | Benefits extrapolated to 2049 (from 2040), and 2009 treated as Year 0 |
| **Victoria Park Tunnel** | 3.2 | 5.3 | Benefits extrapolated to 2049 (from 2036) , and 2009 treated as Year 0 |
| **Waikato Expressway** | 1.1 | 0.5 | NZTA funding application adjusted to reflect additional impacts of Waikato Expressway. Economic evaluation data used for the portfolio uses unadjusted data |
| **Tauranga Eastern Link** | 1.4-1.6 | 2.0 | Benefits extrapolated to 2049 (from 2040) , and 2009 treated as Year 0 |
| **Wellington Northern Corridor** | 0.9-1.04 | 0.6 | Benefit streams for each section delayed until construction completion and capex costs sourced from GPS4 |
| **Christchurch Motorways** | 2.0 | 1.9 | Minor adjustments made to O&M costs due to some positive numbers in cost columns in base data. |

### 7.3.2 Conventional assessment results

The **conventional** economic evaluation results of each of the individual RoNS are presented in Table 7.3.

**Table 7.3 RoNS Economic Evaluation Results – Conventional Cost Benefit Analysis ($m)**

| | | Puhoi to Wells. | WRR | VPT | Waikato Exp | TEL | Wgtn - Foxton | Chc | RoNS - Total |
|---|---|---|---|---|---|---|---|---|---|
| **Base Program** | **NPV** | -145 | 1,873 | 1,900 | -527 | 394 | -78 | 564 | 3,980 |
| | **BCR** | 0.4 | 2.5 | 5.3 | 0.5 | 2.3 | 0.9 | 2.4 | 1.9 |
| **Accelerated Program** | **NPV** | -595 | 1,873 | 1,900 | -527 | 409 | -490 | 508 | 3,076 |
| | **BCR** | 0.4 | 2.5 | 5.3 | 0.5 | 2.0 | 0.6 | 1.9 | 1.5 |
| **Alternative Program** | **NPV** | -248 | 1,873 | 1,900 | -527 | 413 | -195 | 550 | 3,776 |
| | **BCR** | 0.5 | 2.5 | 5.3 | 0.5 | 2.2 | 0.8 | 2.2 | 1.8 |

Source: Saha estimates

As illustrated in Table 7.3 above, the evaluation outcomes of each of the RoNS varies significantly, with BCRs ranging between 0.37 and 5.33.

For the RoNS in which the construction start has been accelerated, the resulting BCRs reduce, imposing a negative impact on the overall RoNS program BCR compared to the base case, i.e. the incremental benefits of acceleration are offset by the incremental costs.

However, the result for the total RoNS portfolio economic assessment remains above one (that is, total benefits remain greater than total costs for the accelerated program, albeit to a lesser extent than the base case).

### 7.3.3 Conventional plus WEBs results

Table 7.4 summarises the results of the economic evaluation at 8% real discount rate for each of the base, accelerated and alternative program for the RoNS taken together under **three scenarios:**

1. Conventional Cost Benefit Analysis
2. Conventional Cost Benefit Analysis plus regionalised WEBs
3. Conventional Cost Benefit Analysis plus GE benefits

**Table 7.4: Program Results for Conventional and Accelerated Scenarios**

| Criteria | Base Program | Accelerated Program | *Alternative Program* |
|---|---|---|---|
| **Total Undiscounted Capital Costs ($m)** | 9,770 | 9,787 | *9,779* |
| **Total Project Costs (PV, $m)** | 4,268 | 5,948 | *4,901* |
| **Total Project Benefits (PV, $m)** | 8,248 | 9,025 | *8,667* |
| Conventional CBA Economic Evaluation Measures: | | | |
| **Net Benefits (NPV $m)** | 3,980 | 3,076 | *3,766* |
| **Benefit-Cost Ratio** | **1.9** | **1.5** | ***1.8*** |
| Economic Evaluation Measures with WEBs (agglomeration + employment): | | | |
| **Net Benefits (NPV $m)** | 6,832 | 6,777 | *7,258* |
| **Benefit-Cost Ratio** | **2.6** | **2.1** | ***2.5*** |
| Economic Evaluation Measures with WEBs (agglomeration only): | | | |
| **Net Benefits (NPV $m)** | 5,177 | 4,527 | *5,170* |
| **Benefit-Cost Ratio** | 2.2 | 1.8 | *2.1* |
| Economic Evaluation Measures with GE (high estimate): | | | |
| **Net Benefits (NPV $m)** | 11,982 | 12,231 | *12,390* |
| **Benefit-Cost Ratio** | **3.8** | **3.1** | ***3.5*** |
| Economic Evaluation Measures with GE (low estimate): | | | |
| **Net Benefits (NPV $m)** | 3,702 | 2,838 | *3,511* |
| **Benefit-Cost Ratio** | 1.9 | 1.5 | *1.7* |

These results indicate that all three programs recorded positive economic outcomes with NPV of net benefits being positive and BCRs greater than one.

However, while all results provide outcomes greater than one, the base program (i.e. non-accelerated) provides the greatest benefits of the three options evaluated, regardless of the inclusion or exclusion of WEBs, followed by the alternative and accelerated programs.

The result demonstrates that, while accelerating the RoNS program would still result in total benefits being greater than total costs, the base case and alternative programs provide even greater benefits over the assessment period.

### 7.3.4 Incremental benefit and cost results

The section below considers the incremental results of the accelerated programs over the base program.

Table 7.5 summarises the results of the economic evaluation and outcomes for the accelerated and alternative programs incremental to the base program for the RoNS taken together under the three scenarios described previously.

**Table 7.5: Incremental Results**

| Criteria | Accelerated Programs Incremental to Base Program | |
|---|---|---|
| | **Accelerated Program** | ***Alternative Program*** |
| **Total Undiscounted Capital Costs** | - | - |
| **Total Project Costs (PV, $m)** | 1,680 | *663* |
| **Total Project Benefits (PV, $m)** | *777* | *419* |
| Conventional CBA Economic Evaluation Measures: | | |
| **Net Benefits (NPV $m)** | -903 | *-213* |
| **Benefit-Cost Ratio** | **0.5** | ***0.7*** |
| Economic Evaluation Measures with WEBs (agglomeration + employment): | | |
| **Net Benefits (NPV $m)** | -55 | *426* |
| **Benefit-Cost Ratio** | **1.0** | ***1.7*** |
| Economic Evaluation Measures with WEBs (agglomeration only): | | |
| **Net Benefits (NPV $m)** | -650 | *-7* |
| **Benefit-Cost Ratio** | 0.6 | *1.0* |
| Economic Evaluation Measures with GE (high estimate): | | |
| **Net Benefits (NPV $m)** | 249 | *408* |
| **Benefit-Cost Ratio** | **1.2** | ***1.7*** |
| Economic Evaluation Measures with WEBs (low estimate): | | |
| **Net Benefits (NPV $m)** | -864 | *-192* |
| **Benefit-Cost Ratio** | 0.5 | *0.7* |

The following points emerge from the above table:

- Both the accelerated program and alternative program recorded negative economic outcomes relative to the base program, with the alternative program generating a more favourable result
- It is evident that the acceleration of the RoNS leads to a significant increase in costs, offsetting a relatively smaller increase in earlier realisation of project benefits
- When taking WEBs into consideration, both the accelerated and alternative programs became much more favourable, with the alternative program recording a positive result
- When taking GE benefits into account, both programs resulted in positive economic outcomes, again with the alternative program giving a more favourable result
- Overall, the alternative program which has a later construction start date compared to the accelerated program yields better economic outcomes than the accelerated program

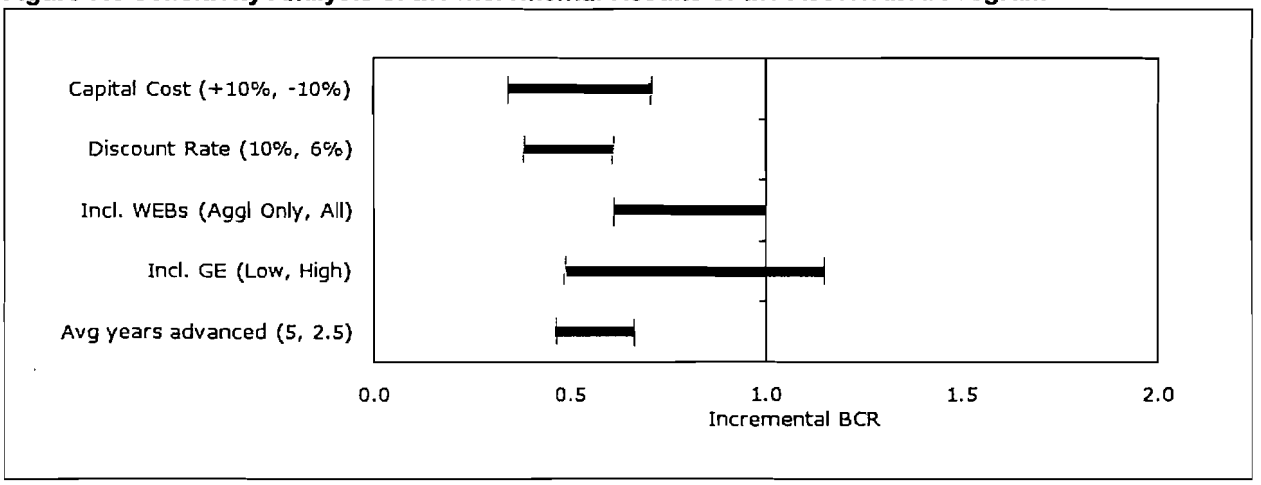
## 7.4 Sensitivity testing

### 7.4.1 Sensitivity testing of inputs

Sensitivity tests performed on the economic evaluation results included:

1. Changes in capital costs of +/-10%
2. Changes in discount rate of 10% and 6%
3. Inclusion of regionalised WEBs – at a low estimate (agglomeration only) and a high estimate (agglomeration and employment effects)
4. Inclusion of CGE results – at a low estimate (capital closure) and a high estimate (capital responsiveness)
5. Advancement period of RoNS program – tested at 5 years advancement from base case and 2.5 years

**Figure 7.3 Sensitivity Analysis of the Incremental Results of the Accelerated Program**




The results indicate that only with the inclusions of the high estimates of WEBs or GE does the incremental BCR of accelerating the RoNS become greater than one.

Table 7.6 below summarises the results of sensitivity tests on both the accelerated and alternative programs.

**Table 7.6: Economic Evaluation Sensitivity Tests ($m)**

| Sensitivity | | Options Incremental to Base Program | |
|---|---|---|---|
| | | Accelerated Program | *Alternative Program* |
| Discount Rate: 8% | NPV | -903 | *-213* |
| (Standard Evaluation) | BCR | 0.5 | *0.7* |
| Discount Rate: 6% | NPV | -624 | *-96* |
| | BCR | 0.6 | *0.9* |
| Discount Rate: 10% | NPV | -1,059 | *-270* |
| | BCR | 0.4 | *0.6* |
| Higher Capital Costs (+10%) | NPV | -1,484 | *-690* |
| | BCR | 0.3 | *0.4* |
| Lower Capital Costs (-10%) | NPV | -323 | *263* |
| | BCR | 0.7 | *2.7* |
| **WEBs Scenario Comparison** | | | |
| WEBs – All | NPV | -55 | *426* |
| | BCR | 1.0 | *1.7* |
| WEBs – Agglomeration Only | NPV | -650 | *-7* |
| | BCR | 0.6 | *1.0* |
| **GE Scenario Comparison** | | | |
| High Scenario GE | NPV | 249 | *408* |
| | BCR | 1.2 | *1.7* |
| Low Scenario GE | NPV | -864 | *-192* |
| | BCR | 0.5 | *0.7* |

Source: Saha estimates, WEBs by Richard Paling Consulting, GE benefits by Infometrics

A more detailed sensitivity test was also carried out on capital costs to demonstrate how changes in the cost component impacts on the overall economic returns of RoNS. Figures 7.4 and 7.5 below illustrate the effects of different level of capital costs on the accelerated and alternative scenarios, across the range of 10% lower capital costs to 10% higher capital costs.

**Figure 7.4 Sensitivity Test of Accelerated Program's Capital Costs**

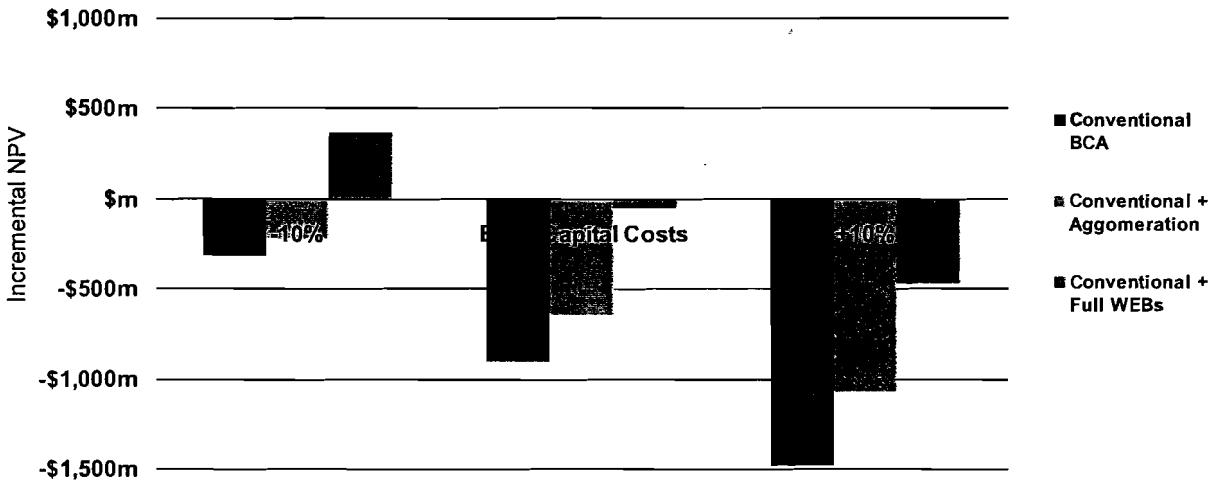
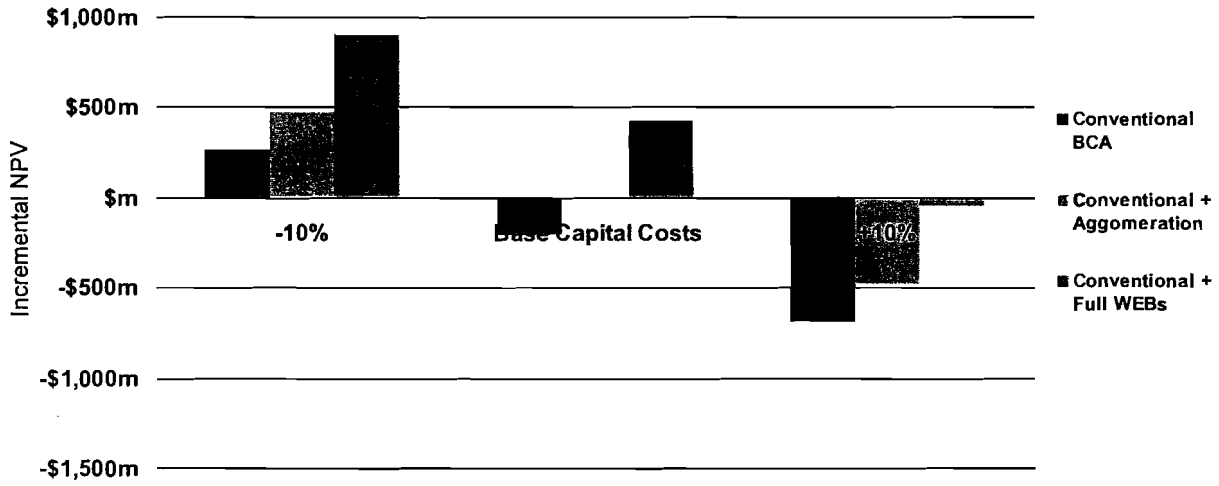



**Figure 7.5 Sensitivity Test of Alternative Program's Capital Costs**




Source: SAHA and Richard Paling Consulting estimates

### 7.4.2 Conclusions of sensitivity testing outputs

As indicated by the sensitivity tests, WEBs and GE benefits provide significant increases in economic return for both programs. However, the inclusion of either WEBs or GE does not alter the fact that the alternative program, with a later construction schedule, yields a more favourable result across all tests. In other words, the inclusion of WEBs and GE benefits increase the quantum of benefits across all scenarios but do not alter the relativities between scenarios.

Majority of the sensitivity tests resulted in negative outcomes, with the exception of the inclusion of full WEBs, and lower program costs (-10%) for the accelerated program. Again, the alternative program yielded more favourable results across all tests.

As shown in Figure 7.4 above, should the current estimates of capital costs prove to be conservative and some refinement of these is possible, the potential exists, with the inclusion of some value from WEBs, to demonstrate a somewhat positive result from advancement. Any review of capital costs should however also take into consideration any pressures on construction resources from the additional activity in the sector created by the RoNS over the next ten years, and the potential impact this may have on construction prices.

# 8 Conclusions

## 8.1 Report purpose

The purpose of this economic assessment is to assist NZTA to answer two fundamental questions:

1. Are there quantifiable wider economic benefits associated with the portfolio of RoNS projects, over and above conventional project-specific economic benefits?
2. If such benefits exist and are quantifiable, are they of sufficient scale to justify accelerating the implementation of the RoNS as a portfolio?

This assessment has been undertaken respond to those two questions and the following conclusions can be drawn:

## 8.2 Conventional and wider economic evaluation approaches

i. Each RoNS has been subject to a conventional economic assessment considering traffic benefits, travel time savings, accident reductions, vehicle operating cost savings, and associated benefits and costs;

ii. WEBs have also been identified and quantified at both a regional level and a national level for each RoNS;

iii. **These WEBs are generated by the RoNS program beyond those estimated through conventional economic assessment, and are of relatively considerable scale;**

iv. **The approach used to estimate WEBs is relatively new and as such it produces results which vary considerably – it is likely the approach will be subject to ongoing refinement for some time;**

v. While precedents exist in program evaluation in Australia – specifically Infrastructure Australia's consideration of WEBs in its economic assessment considerations – the estimated benefits applied from all WEBs have been broadly in the order of 20-30% over and above conventional assessment.

vi. It is noted that the quantum of WEBs are a function of size and population density and the UK Eddington Report estimates that agglomeration benefits alone may provide additional benefits in the order of 30% for large, high density urban areas such as London.;

vii. While the above estimates provide a comparator with which to place WEBs in some context for the New Zealand environment, they should be treated as indicators only, and not used as a substitute for thorough and robust WEB modelling and analysis using regionally specific data;

viii. In relation to the use of General Equilibrium approaches, Infrastructure Australia does not use the outputs in an additive capacity, though it remains an instructive tool when considering potential national effects associated with significant infrastructure projects. The inclusion of one component of WEBs, agglomeration benefits, is accepted (and expected) by Infrastructure Australia as being additional to conventional CBA, and it is also becoming more widely recognised in New Zealand and in the UK;

ix. **While WEBs have been considered, there have not been any interdependency (synergy) benefits associated with the portfolio of projects** – that is, the sum total of all RoNS is not

greater than the individual RoN benefits – NZTA confirmed that there is simply too great a dispersement of the projects across New Zealand to realistically consider them as truly linked for the purposes of benefit streams;

## 8.3 Economic assessment framework

x. Conventional assessments undertaken for each RoNS were provided for by NZTA – these have been broadly assessed to ensure consistency in terms of economic parameters (time horizon, starting year, discount rate, amongst other parameters);

xi. To investigate the economic impacts of accelerating the implementation of the RoNS, the evaluation results of the accelerated program must be compared against the "base case" (pre-RoNS) construction dates. As the conventional evaluations provided by NZTA were based on the accelerated RoNS program, these were extrapolated back to generate a base case construction program based broadly on the program for each of these roads as defined in GPS 2006;

**xii. The impact of accelerating the RoNS compared to the 'base case' delivery timeline is a reduction in the Benefit Cost Ratio for the program as a whole – this is directly related to the bringing forward of funds which outweighs the additional benefits of doing so;**

**xiii. Notwithstanding this, the results indicate that the total benefits remain larger than total costs for the accelerated program, albeit to a lesser extent than the base case, as noted above;**

xiv. As a 'midpoint' scenario, an alternative accelerated program was tested (slower implementation than proposed acceleration, but more rapid implementation than the base case) which provided a result closer to the base case benefits stream – and again, total benefits are greater than total costs;

xv. Sensitivity tests have been applied adding the WEBs and CGE results to the CBA. Noting concerns and lack of precedents in using such an approach (particularly in relation to CGE) the results have been as an indicative proxy with which to assess a single net present value (NPV) and benefit cost ratio (BCR) result that can be used to inform decision making with regards the acceleration of the RoNS program.

xvi. The application of WEBs (regional and/or national level) changes the quantum of benefits across all scenarios (including the base case);

xvii. However it does not change the overall outcome – in that, while the benefit cost ratio is greater than 1, the accelerated program costs outweigh the additional costs of doing so, as demonstrated in Table 8.1 below;

xviii. A summary of results is provided in Table 8.1 below.

**Table 8.1: Program Results for Conventional and Accelerated Scenarios**

| Criteria | Base Program | Accelerated Program | *Alternative Program* |
|---|---|---|---|
| **Total Undiscounted Capital Costs ($m)** | 9,770 | 9,787 | *9,779* |
| **Total Project Costs (PV, $m)** | 4,268 | 5,948 | *4,901* |
| **Total Project Benefits (PV, $m)** | 8,248 | 9,025 | *8,667* |
| Conventional CBA Economic Evaluation Measures: | | | |
| **Net Benefits (NPV $m)** | 3,980 | 3,076 | *3,766* |
| **Benefit-Cost Ratio** | **1.9** | **1.5** | ***1.8*** |
| Economic Evaluation Measures with WEBs (agglomeration + employment): | | | |
| **Net Benefits (NPV $m)** | 6,832 | 6,777 | *7,258* |
| **Benefit-Cost Ratio** | **2.6** | **2.1** | ***2.5*** |
| Economic Evaluation Measures with WEBs (agglomeration only): | | | |
| **Net Benefits (NPV $m)** | 5,177 | 4,527 | *5,170* |
| **Benefit-Cost Ratio** | 2.2 | 1.8 | *2.1* |
| Economic Evaluation Measures with GE (high estimate): | | | |
| **Net Benefits (NPV $m)** | 11,982 | 12,231 | *12,390* |
| **Benefit-Cost Ratio** | **3.8** | **3.1** | ***3.5*** |
| Economic Evaluation Measures with GE (low estimate): | | | |
| **Net Benefits (NPV $m)** | 3,702 | 2,838 | *3,511* |
| **Benefit-Cost Ratio** | 1.9 | 1.5 | *1.7* |

xix. Sensitivity testing shows that certain parameters such as capital cost increases impact considerably on the economic assessment outcomes, indicating that costings need to be at a high order of accuracy to ensure the assessments can remain as robust as practical through the individual project feasibility and approvals phases;

xx. NZTA now must consider the issues associated with accelerating the RoNS which, while retaining a benefit to cost ratio outcome greater than one, may not be the optimal investment and funding outcome when considered in its broadest context against other roading projects and/or other government portfolio areas,. While this is somewhat outside the scope of this report it is noted here as it is a key issue to be considered in taking the outputs from this assessment forward.