ESTIMATING DEMAND FOR SELWYN'S CYCLEWAYS

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ABSTRACT

Selwyn District Council has a desired "outcome" for the future of “a Selwyn where people walk and cycle safely for transportation and enjoyment”. This will be achieved through a combination of inspired, ambitious walking and cycling education, engineering and enforcement projects. Selwyn doesn’t think in issues or problems - we call them challenges!

Selwyn proposed a package of seven cycleway / walkway projects connecting their main towns, including Lincoln, Rolleston and Darfield to each other and to greater Christchurch. The paths also extend the Little River Rail Trail project.

This paper describes the economic assessment approach taken in the funding approval processes for the New Zealand Transport Agency (NZTA). The economic assessment was based on the full procedures which, for walking and cycling projects, is a continuation of the simplified procedures (SP 11) demand estimation method. We used, however, several modifications to the SP 11 method to improve the accuracy of the predictions.

Estimating the demand for new facilities is an important part of the economic justification for walking and cycling projects. This paper, based on a ViaStrada project for Selwyn District Council, discusses how this was done for the Selwyn projects.

We note that this modified procedure is a variation on accepted New Zealand Transport Agency (NZTA) processes and has not yet received NZTA endorsement.

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1 INTRODUCTION

1.1 Walking and cycling in Selwyn

Selwyn District (situated south-west of Christchurch City), has 20 small rural towns with the majority of its population growth currently occurring in Prebbleton, Rolleston and Lincoln. In January 2009, Selwyn District Council (SDC) published a walking and cycling strategy. The desired "outcome" of this strategy is “a Selwyn where people walk and cycle safely for transportation and enjoyment”.

The walking and cycling strategy was accompanied by an action plan detailing specific projects and their anticipated funding sources, timeframes and expected costs. ViaStrada was commissioned to provide scheme designs and economic assessments for the following seven off-road walking and cycling infrastructure projects. This assessment was then presented to the New Zealand Transport Agency (NZTA) as a package for funding approval.

1. Lowes Road cycleway (3 km);
2. Edward Street section to Lincoln south Rail Trail (1.1 km);
3. Coalgate to Glentunnel (2.6 km);
4. Lincoln to Springston (3 km);
5. Lincoln to Rolleston (8.5 km);
6. Rolleston to Templeton (8 km); and
7. Leeston Road bridge.

These projects are shown in Figure 1 according to the numbering in the list above and are outlined more fully in the SDC Walking and Cycling Strategy Action Plan (2009), available on the council's website.

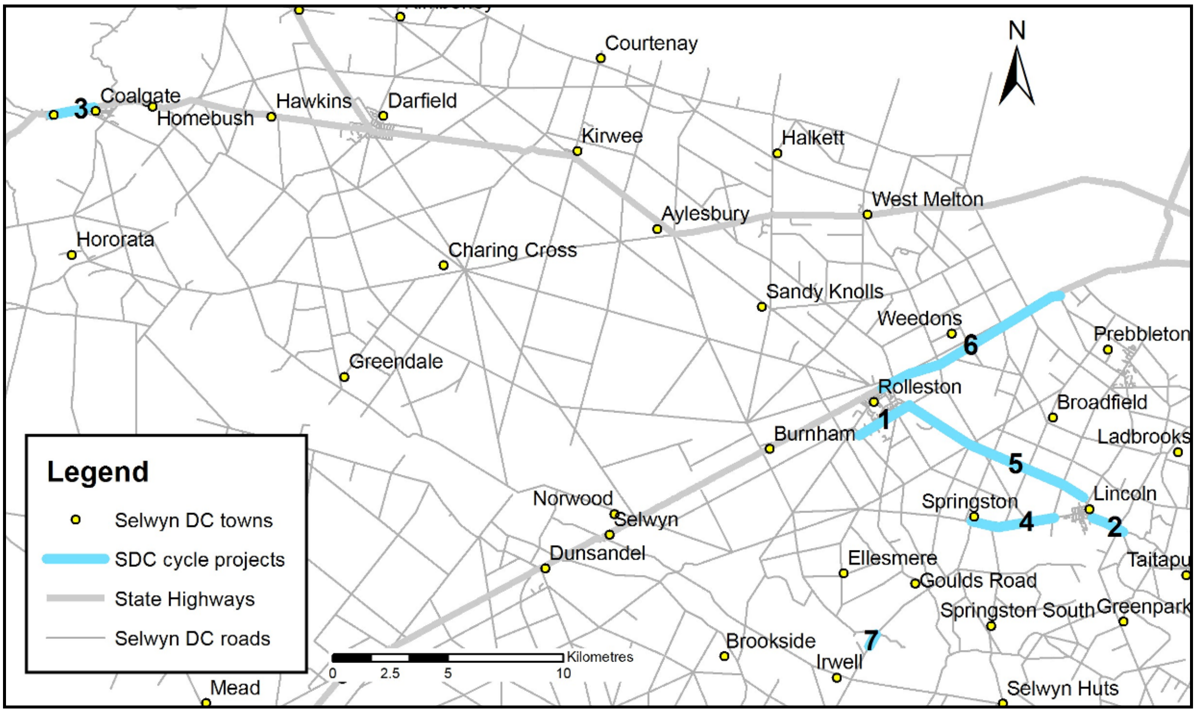

Figure 1: Selwyn DC cycle projects

1.2 Economic evaluation for walking and cycling projects

The element of a benefit / cost assessment for a walking and cycling project that involves the most uncertainty and is the hardest to define is arguably the prediction of future use. The anticipated numbers of users determines the level of expected benefits for a facility. It is particularly difficult to estimate future volumes for a completely new, off-road facility. Techniques generally rely on experiences at “similar” facilities, which can be limited in availability, or observed existing on-road cycle trip generation, which may not be relevant due to suppressed demand and the different preferences of on-road and off-road cyclists.

In January 2009 NZTA updated its simplified procedure 11 (SP 11) for the economic evaluation of walking and cycling projects (NZTA 2009). The updated procedure includes a new method for estimating the number of new cyclists. This method is based on census population data in buffer areas surrounding the cycle facility and comes from a model developed for the US “twin cities” of St Paul and Minneapolis, Minnesota (NCHRP, 2006).

The SP 11 method for predicting volumes of new cyclists generated by a new facility is detailed in SP 11 worksheet 7. The method is based on census data for population in buffer areas surrounding the facility and census cycle mode share (trips to work) data. Three buffer areas are used; 400 m, 800 m and 1600 m, as shown in Figure 2 for the Lowes Road cycle project. Under the SP 11 method, each of the buffers is assigned different weights (the assumption being that the further away from a facility someone lives, the less likely they are to use the facility). The buffers are measured "as the crow flies", although actual travel distance along a road or path network from the edge of the buffer to the proposed cycle facility would usually be longer.

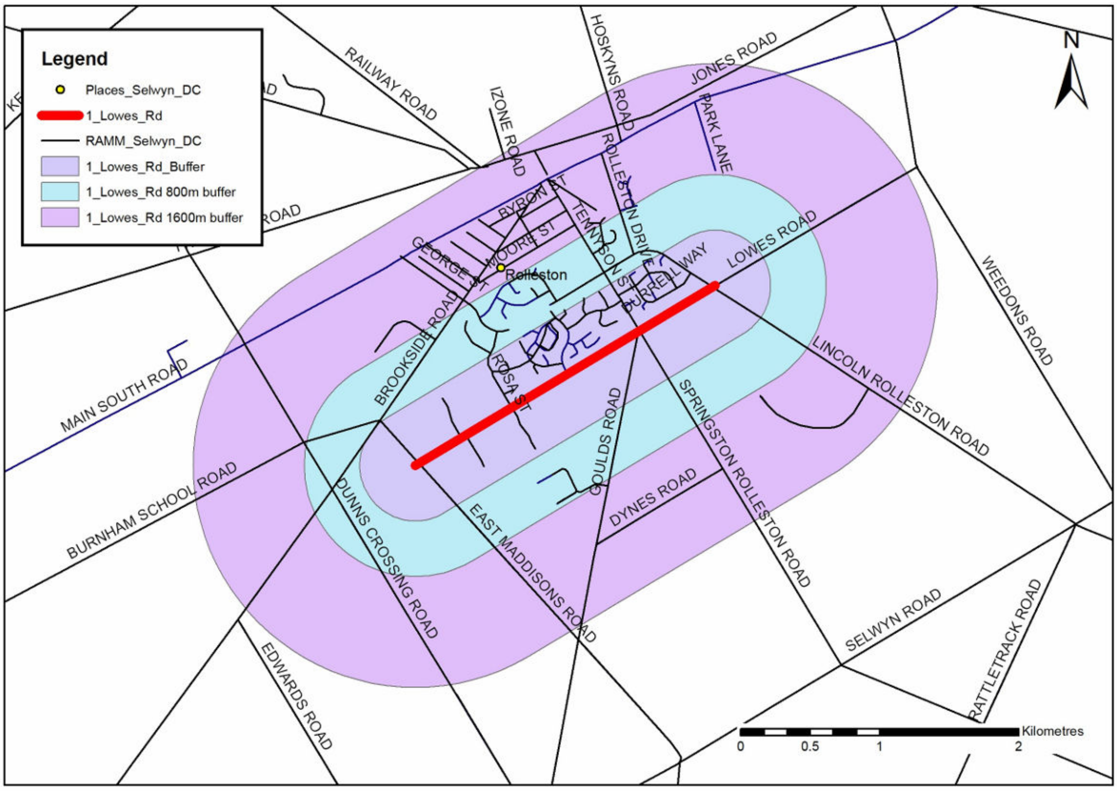

Figure 2: Buffer regions for Lowes Road cycle volume calculations

Use of a GIS (Geographic Information System) is the easiest way to calculate the population, area and hence population density for each of the three buffers. While this process is not explained in the SP 11 guidance it is important to weight the areas and populations of meshblocks included only partially in a buffer area according to the proportion of the meshblock area within the buffer.

Census data are available in spreadsheet form from the Statistics New Zealand website and can be linked to meshblock shapefiles (i.e. GIS format), which are also freely available (Statistics NZ, 2009).

The method has some limitations, primarily in that it was developed for a specific, urban American location. The developers of the original twin cities model specify that their model was developed for on-road facilities and were not confident that it could be applied to other locations. Thus it was considered that the model would not be directly applicable to the Selwyn projects, which are all off-road paths situated mainly in rural settings.

Instead of basing volume predictions purely on population data we suggest that other factors such as employment and education locations also affect the use of walking and cycling facilities, particularly for these projects many of which link small townships that “share” facilities. Several of the Selwyn paths, in particular Lowes Road and Coalgate to Glentunnel, are intended to attract school children due to their proximity to local schools (in the case of Lowes Road, a new primary school is planned near the path).

We suggest that, due to length of the routes in question and their rural nature, cyclists will be more willing to travel greater distances to reach facilities. Travelling a "crow flies" distance of 1.6 km (the largest buffer in the SP 11 model) to reach a facility is relatively insignificant relative to a facility length of 8 km. This is particularly true for recreational cyclists but also for commuters travelling between towns in Selwyn District. The Leeston Road bridge is a particular example of this as, although its buffers do not include any townships, cyclists (particularly recreational and sports training cyclists) may still use the route. Therefore, we consider that either the 1.6 km buffer is too small a catchment area or the relative weightings between the three buffers should be more even.

From a more practical perspective, another limitation of the method is its reliance on GIS (or, alternatively, lengthy hand calculations involving difficult data extraction processes) to determine the population densities from Census data. Also, the benefit / cost calculations require predicted pedestrian volumes but the SP 11 demand estimation method only predicts cyclist volumes.

2 SUGGESTED DEMAND PREDICTION APPROACH

2.1 Cyclists

We tested the accuracy of the current SP 11 method by applying it to the Birchs Road section of the Little River Rail Trail. We consider this to be the most similar section of the existing Rail Trail because it combines commuting and recreational users and is alongside an existing road. The SP 11 method predicted 73 cyclists per day for the Birchs Road section whereas actual count data demonstrate an average of 120 cyclists per day (AADT) (ViaStrada, 2008).

We attempted to improve the SP 11 process by introducing a different weighting function and calibrating it according to the Birchs Road data. The first assumption we employed to do this was that a facility’s actual catchment area is proportional to its length – the longer a facility is the more likely people will travel further to reach it, whether these trips are diversions of existing trips or completely new trips generated by provision of the facility. However, we do not know the exact relationship. Thus, in lieu of a better understanding of the actual catchment areas of facilities or a larger sample of control sites with which to determine the relationship, we retained the 1.6 km catchment area.

We also assumed that the difference between the 400 m and 800 m buffers should be negligible for cyclists relative to a trip of several kilometres (a distance of 400 m would be travelled by the majority of cyclists in less than two minutes) and therefore decided to use only two buffers – the 800 m and 1600 m ones.

Thirdly, we assume that there should be some form of "decay function" applied to the two buffers, where the likelihood of using the facility diminishes as distance from the facility increases, but not to the extent currently used in SP 11. We have assumed that cyclists who have to travel twice the distance to reach a facility will be half as likely to do so.

Finally, we assumed that resident population is not the only factor that generates use of a cycle / walking facility. We assumed that major trip attractors, such as school and employment locations also contribute to the likelihood of users choosing a facility. Employment data were not readily available but we were able to add the school roll for schools located in each buffer to the resident population for the estimates of new commuters. While some students at a particular school may also live within the buffer area we have assumed that the calibration process will avoid any double counting effects. We consider that including school data gives a more complete understanding of the situation; similar methods have been employed for studies for ARTA and VicRoads (Melbourne) where school and employment numbers were added to the population numbers.

Figure 3 shows the schools in Selwyn District near the proposed paths and their school rolls. For Lincoln University, we used the number of full time equivalent students (2,577) rather than the total roll (around 4,500 students) as we consider full time equivalents to be more representative of daily cycle demand rates.

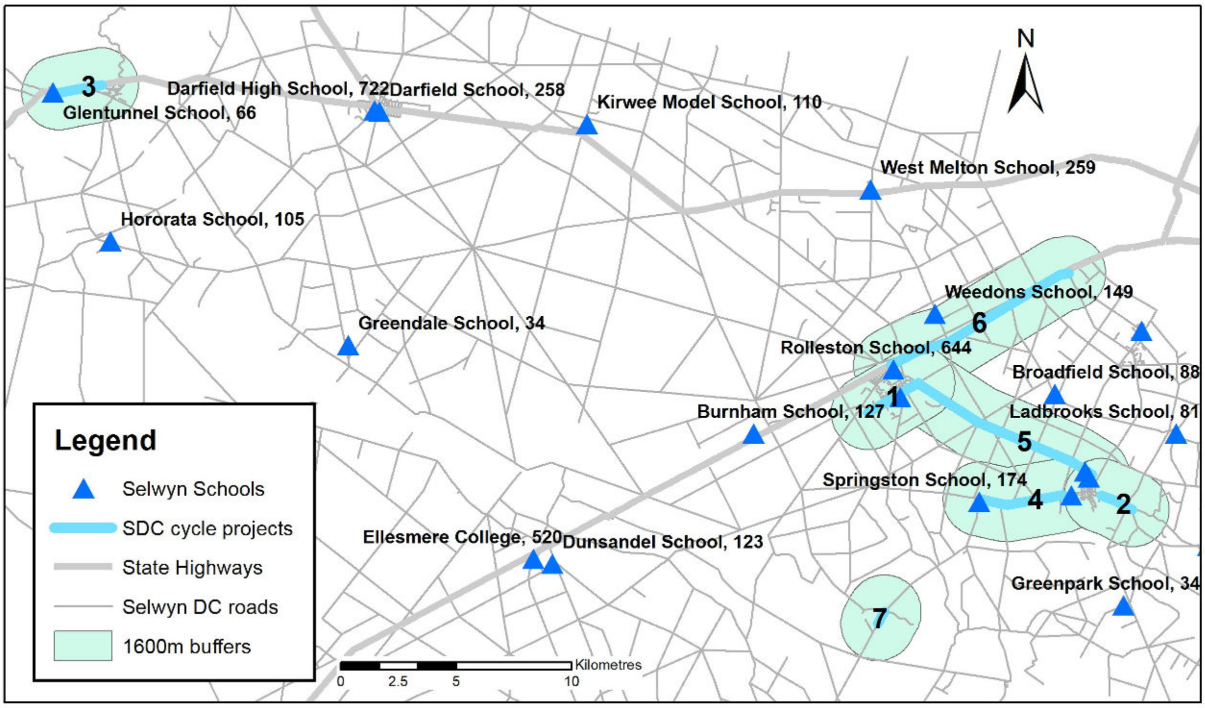

Figure 3: Schools near proposed Selwyn paths

We developed a model based on the above assumptions and data sources and calibrated it by modifying the buffer weightings so that, when applied to the Birchs Road site, the model predicted the same values as the observed AADT.

Our calibrations of the weightings according to the Birchs Road counts suggest that the likelihood of new cyclist "multipliers" should be 0.26 for the 800 m buffer and 0.13 for the 1600 m buffer. (The multipliers currently used in SP 11 are 0.33, 0.17 and 0.07 for the 400 m, 800 m and 1600 m buffers respectively.[1])

[1] Since the development of this new approach, the SP 11 methodology and multipliers have been modified slightly.

There are still some site-specific limitations of the modified SP 11 method that come from the fact that it is a generalised approach. For example, the Coalgate to Glentunnel and Lincoln to Springston proposed paths have had particularly high levels of community support and may therefore be likely to have above average levels of use. However, the purpose of SP 11 is to standardise the approach for demand estimation. While in some circumstances it may be beneficial to tailor estimates to site specific data the general method developed should be capable of producing a reliable estimate in lieu of additional information.

A benefit / cost assessment is limited not only by the accuracy of the benefit assessment but also by the cost estimates. At feasibility stage only scheme (rather than detailed) designs are available which limits the accuracy of cost estimates. Therefore, it is not critical that demand estimation models be highly accurate either.

In terms of cyclist growth rate, we applied the off-road facility growth rate formula from LTNZ Research Report 340 (Macdonald, Macbeth, Ribeiro and Mallett, 2007).

2.2 Pedestrians

As mentioned previously, although it requires pedestrian volume predictions, SP 11 does not provide a method of obtaining these. Very limited data on pedestrian volumes experienced at existing Selwyn District shared facilities were available for use in predicting the pedestrian volumes that will be experienced by the proposed facilities.

Thus, to predict the pedestrian volumes, we used census trip-to-work data in conjunction with the cyclist estimate. We obtained the numbers of people who walked and cycled to work on the 2006 census day for the 1.6 km buffer areas surrounding the proposed projects. This gave a rough indication of the relative levels of walking and cycling in the vicinities of the facilities, for the trip to work. We then multiplied the ratio of pedestrians to cyclists by the predicted cyclist volume to obtain estimates of pedestrian volumes.

SP 11 also requires pedestrian traffic growth rates; we are unaware of any research on this for new facilities. Therefore we estimated pedestrian growth rates based on the proportion of trips to work made by walking as recorded in several previous censuses.

3 APPLICATION TO SELWYN PROJECTS

3.1 Inputs

As the seven Selwyn projects were presented as a package the total estimated construction cost was well over the $1 M threshold to which the SP 11 method can be applied. In fact, some of the individual project costs were over this threshold. Therefore, full procedures were required.

The two other main monetised contributors to benefit values according to SP 11 and the full procedures are travel time savings and accident savings. As a conservative approach, we assumed that travel time savings would be negligible and thus did not explore this area further.

In terms of accident savings, we expect that the paths will produce accident savings because cyclists will use the paths rather than the road and therefore be exposed to a much lower risk of accidents. Pedestrians too will experience less potential for conflict when using the paths in locations where footpaths are not currently provided. We applied the "safety benefit for cycle lanes, cycleways or increased road shoulder widths in the absence of a specific accident analysis" method because it would be difficult to determine the proportions of cyclists who previously used alternative on-road routes and cyclists who previously did not cycle (i.e. suppressed demand). The low crash rates of the adjacent roads also decrease the statistical accuracy of any specific analysis.

The full procedures apply the same demand estimation method as SP 11 but introduce additional considerations, namely national strategic factors, equity impacts and other non-monetised effects.

In terms of national strategic factors we commented on the relevance of the Selwyn projects with respect to the five objectives of the New Zealand Transport Strategy (MoT, 2008). Specifically, we noted the projects' relevance to the four objectives of: ensuring environmental sustainability; assisting safety and personal security; improving access and mobility; and protecting and promoting public health.

In terms of equity impacts we noted that walking and cycling are relatively inexpensive modes of transport and are therefore equitable for those of all income brackets. The facilities are also expected to improve equity for those with mobility limitations (for example wheel chair users, older, less agile pedestrians / cyclists and young, inexperienced cyclists). The facilities will be provided in places where there were previously no off-road options for cycling and on-road options were severely limited by narrow carriageways, high motor vehicle speeds and, in some cases, high traffic volumes. Many of the facilities are to be installed in locations that did not previously have footpaths.

We also noted several non-monetised benefits specifically related to the proposed Selwyn paths. We did not attempt to quantify these benefits but recognise their worth and contribution to the project. Therefore we list them in this paper as examples for future applications:

- The benefits of having a cycle network and linkages between key locations rather than isolated facilities – users are more likely to walk or cycle if their trip is catered for;
- The social aspects of walking and cycling;
- The aesthetic aspects of the mainly rural locations in which the proposed paths are located (this could also have implications for the number of recreation or touring cyclists who use the paths);
- The community satisfaction that will come as a result from achieving the projects that had a high level of community support, especially the Lincoln to Springston and Coalgate to Glentunnel routes;
- Increased economic activity generated by the network for small rural townships, as has been evident with the Otago Central Rail Trail;
- Synergies with the national cycleway project, giving more options to users of the cycleway who wish to explore the country further; and
- Synergies with the Little River Rail Trail; the Edward Street path will further the completion of the Rail Trail and thus improves its connectivity and the other paths will give more options to users of the Rail Trail who wish to cycle in other areas of the district.

We assumed that the disbenefits during the implementation and construction of the proposed Selwyn paths will be negligible. Specifically we assumed that:

- As the paths are all off-road there will be little disturbance to road users during their construction.
- Midblock path construction will not require any lane closure.
- Where kerb construction / modification at intersections and median island installations are required it may be necessary to close one lane of traffic for a short amount of time but such works can be performed during off-peak times and adequate traffic management can ensure that the roads can continue to operate for traffic in both directions with minimal delays to road users.

- Construction of the paths is expected to be undertaken during day time and therefore any noise associated with construction should not overly affect local residents; the rural nature of the majority of the path locations means that the construction will take place at a reasonable distance from most dwellings.
- Construction of paths over driveways will not take long and therefore should not cause much disturbance to local residents.

3.2 Results

The total new daily cyclist volumes, according to both the original and modified SP 11 worksheet 7 processes, for the seven projects are presented in Table 1.

Table 1: Census population densities and cycle volume predictions

	Original SP 11 cycle AADT prediction	Modified SP 11 cycle AADT prediction
1. Lowes Rd	107	126
2. Edward St	49	78
3. Coalgate to Glentunnel	8	9
4. Lincoln to Springston	46	90
5. Lincoln to Rolleston	83	148
6. Rolleston to Templeton	116	156
7. Leeston Rd Bridge	1	2

The modified SP 11 method we have developed gave higher volume estimates than the original method in all cases. Overall, the modified method prediction was 49% higher than that of the original. Our model was calibrated according to data from a Selwyn path. This suggests that the original model, which is based on observations of cycling patterns from a very small sample area in the USA, underestimates the amount of cycling that will occur on Selwyn facilities. Although other districts in New Zealand will have different rates to Selwyn it is likely that the current SP 11 model would underestimate cycle demand throughout New Zealand.

The pedestrian volumes predicted for the Selwyn paths, according to comparisons of journey to work census data and the previously estimated cycle volumes, are shown in Table 2.

Table 2: Pedestrian volume predictions

Project	Census		Pedestrian predictions
	Cyclists	Pedestrians	
1. Lowes Rd	45	72	202
2. Edward St	63	108	134
3. Coalgate to Glentunnel	0*	12	18*
4. Lincoln to Springston	69	141	184
5. Lincoln to Rolleston	111	168	224
6. Rolleston to Templeton	69	90	203
7. Leeston Rd Bridge	3	12	8

*Note: for the Coalgate to Glentunnel project the census data proportion of cyclists to pedestrians could not be used as zero cyclists were present. Thus the average ratio of pedestrians to cyclists as observed from the other sites was used in conjunction with the modified SP 11 cyclist estimate to determine the pedestrian estimate.

There is little information available with which to compare the pedestrian estimates and assess their validity. It would be useful for NZTA to conduct further research into pedestrian volume generation, including monitoring of existing facilities.

The total benefits for the Selwyn projects (including accident savings) were calculated, according to the method detailed in this paper, as approximately $97 M.

It is beyond the scope of this paper to include discussion on the scheme designs developed for the proposed facilities or the assumptions made in producing cost estimates. The scheme designs were developed based on design philosophies regarding path widths, clearances to carriageways, crossing provisions, intervisibility requirements and other important path characteristics. Capital costs, annual maintenance and periodic costs associated with the paths were estimated based on these scheme plans and existing cost information. From this, we estimated the total cost of the package to be about $9 M and the overall benefit / cost ratio for the package was 10.8.

The Selwyn cycle projects, however, were not approved for funding in the National Land Transport Programme and further consideration is being given as to how these facilities might be funded in future.

4 CONCLUSIONS

The modified demand estimation approach presented here has been based on the existing SP 11 approach but adjusted according to existing data from the Little River Rail Trail (a similar, off-road Selwyn District shared path) and assumptions regarding how off-road shared paths in rural environments differ to on-road cycle facilities in urban environments. We believe that this method is justified and results in sound demand estimates within the abilities of the data available. It is considered a useful improvement on the original SP 11 method. We are exploring the acceptability of this method with NZTA through this project.

We recommend use of the general SP 11 accident savings methods (in the absence of a specific accident analysis) for off-road, shared facilities, due to the high statistical variability associated with sites of low crash rates and the likelihood of suppressed demand for cycling.

This paper also indicates several areas of non-monetised benefits expected to result from shared pedestrian and cycle facilities. If these benefits were somehow quantified they would further increase the total package benefit / cost ratio. However, to be conservative, we did not attempt to monetise these benefits for the Selwyn package proposal.

The specific Selwyn package on which the method was based achieved a benefit / cost ratio of 10.8. The individual projects in the package each have different individual benefit / cost ratios but the projects were presented as a package to achieve the full network synergies that come from implementing the projects together. This benefit / cost ratio is significantly above typical thresholds for funding approval (often around 2.0) and the package was therefore considered worthy of funding.

5 REFERENCES

Austroads (1999). *Guide to Traffic Engineering Practice Part 14: Bicycles. Austroads*. Sydney, Australia.

McDonald, A. Macbeth, A., Ribeiro, K. and Mallett, D. (2007). *"Estimating Demand for New cycling Facilities in New Zealand."* LTNZ Research Report 340, LTNZ, Wellington, New Zealand.

National Cooperative Highway Research Program (NCHRP) (2006). "*Guidelines for Analysis of Investments in Bicycle Facilities*." NCHRP Report 552. Transportation Research Board, Washington DC, USA.

Ministry of Transport (MoT) (2008). "*New Zealand Transport Strategy 2008*." Available: www.transport.govt.nz/ourwork/KeyStrategies/new-zealand-transport-strategy/

New Zealand Transport Agency (NZTA) (2009). "*Economic Evaluation Manual Volume 2.*" NZTA, Wellington, New Zealand.

Statistics New Zealand (2009). Website page: "*2006 Census Data*". Available: www.statistics.govt.nz/Census/2006CensusHomePage.aspx

ViaStrada (2008). "*Rail Trail Cycle Counting*." Project report for Christchurch City Council and Selwyn District Council.
Available: http://viastrada.co.nz/project/2009/rail-trail-traffic-counting