EVALUATING THE AUCKLAND CYCLE MODEL

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ABSTRACT

Traditional transport planning uses transport modelling techniques to forecast future travel demands, and to evaluate users' mode and route choices. These transport modelling techniques are well established, widely accepted and relatively well understood, but have almost exclusively focussed on motorised modes of transport.

New Zealand is investing in cycle infrastructure at a previously unseen rate, and with this investment comes the need for credible cycle demand estimates, to ensure this investment is used in the most effective way. Techniques for cycle demand forecasting are however in their infancy both in New Zealand and internationally.

To meet this need, Flow Transportation Specialists developed the Auckland Cycle Model in 2015 to assess future cycling demands on Auckland's growing cycle network. The result was a cycle demand estimation tool that responds to projected changes in Auckland's land use and to improvements to cycle infrastructure, estimating the quantity of mode shift that might occur following given cycle projects. The model has been used to estimate future cycle demands for a range of cycle projects across Auckland.

But how accurate is the Auckland Cycle Model at predicting cycle demands, and to what extent can we rely on the model's outputs? This paper uses historic 'before' and 'after' cycle count data for a range of recently completed cycle projects, and compares these to retrospective 'forecasts' from the Auckland Cycle Model to assess the model's reliability.

INTRODUCTION

Historically there has been little interest or guidance on forecasting future cycle demands within New Zealand, but with increasing investment in cycle infrastructure across the country, the need for improved cycle demand forecasting tools has become apparent. This was highlighted in the NZ Transport Agency's National Cycle Network Design Guidance Stage 1 Report – Best Practice Review (2015), which reviewed the existing methods available and identified a gap in New Zealand practice.

Recognising this gap, Flow Transportation Specialists developed a cycle demand forecasting model, the "Auckland Cycle Model" in 2015. The model:

- Assigns a "Relative Attractiveness" attribute to all cycle infrastructure or routes that cyclists use, allowing cycle trips within the model to assign via routes by balancing trip distance, gradient and cyclist comfort/safety, rather than assigning cyclists to the most direct or fastest route
- Responds to land use changes by for example increasing cyclist trips where existing land uses intensity and generating new cycle trips where new land uses develop
- Responds to infrastructure changes; where a new cycle route is built, or an existing route is improved, the model identifies re-routed and new cycle trips that reflect more attractive routes and respond to mode shift and behaviour change as a result of the improved network.

The Auckland Cycle Model was calibrated against observed local data and international research, however, during its development phase, there was insufficient local data related to new cycle projects to substantially test the reliability of its predictions. With extensive data now being available that covers periods of time before and after investment in cycle infrastructure has been made, the model has been able to be assessed for its appropriateness, and improvements made, as appropriate. This paper reports on the evaluation process undertaken using data collected in 2016 to test the reliability of the Auckland Cycle Model and identifies the minor changes needed to improve the model in relation to the data collected.

CYCLE DATA USED

The development of the Auckland Cycle Model, and its evaluation as documented in this paper, have been carried out using a significant quantity of cycle count data, collected from a number of sources. Data used was generally:

- Manual count data collected on a single weekday, generally on a fine day in March 2013 but from a variety of sources and dates, and
- Automatic count data from the 54 cycle counters that Auckland Transport monitors across the region; this automatic data has provided average cyclist number over a period of months, or longer.

Where appropriate, count data has been seasonally adjusted to represent annual averages, and has been corrected for weather using the procedures in the NZ Transport Agency's Research Report 340 "Estimating Demand for New Cycling Facilities in New Zealand" (McDonald, et at., 2007)

The automatic cycle counters provide continuous data throughout the day, and the analysis of this data has found that weekday cyclist numbers across these count sites have typically fluctuated +/-65% from the annual average in 2016. Similarly, weekly counts have fluctuated typically +/-25% from the average. This illustrates the considerable fluctuation in cycle volumes, not only seasonally but also weekly and daily.

This fluctuation has also been evident in the manual count data obtained; multiple manual counts were often available for single locations, or for adjacent locations, with these counts fluctuating significantly.

This inherent variability in cyclist numbers has made the development of the Auckland Cycle Model particularly challenging, and the evaluation of the model that follows must therefore be considered in light of this variability.

THE AUCKLAND CYCLE MODEL

The Auckland Cycle Model was originally developed to include only central Auckland and the lower North Shore, but was subsequently extended to represent all major cycling routes within urban Auckland, with a greater level of detail within the city centre, Auckland's Metropolitan centres, and within the inner suburbs that have the target of increased cycle investment in recent years. Figure 1 below illustrates the extent of the model.

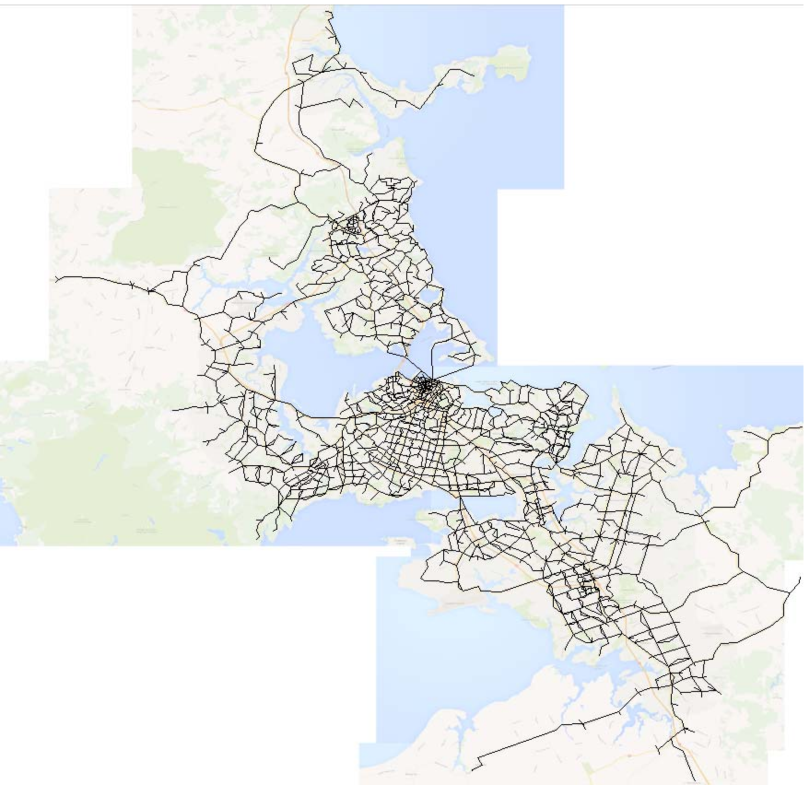


Figure 1: Extent of the Auckland Cycle Model

The model represents two-hour morning (7 to 9 am) and evening (4 to 6 pm) peak periods. Insufficient cycle count data was available for the additional development of an interpeak model. A base model representing March 2013 cycle network and demands and both 2016 and 2026 forecasts have been developed. This paper focuses on outputs from the 2013 and 2016 models.

The model interface uses traditional SATURN traffic modelling software, however the majority of the model mechanism is through a series of spreadsheet based matrices and algorithms. Common to all the models are the algorithms used to determine cyclists' route choices – these are essentially based on a weighting of type of cycle facility and its perceived attractiveness/safety (its "Relative Attractiveness"), trip distance and gradient. The mechanisms for determining demands consider a similar weighting when determining travel mode, in addition to the likelihood of a trip transferring to a cycle trip from another mode based on trends in typical cycle journey lengths. In addition, the following provides a brief summary of the steps taken to determine demands for the March 2013 and average day 2016 models.

March 2013 Base Model

- Uses bicycle trips to work from the 2013 New Zealand census,

- Factors the above trips to account for other cycling trip types, based on Auckland regional results from the Household Travel Survey,
- Applies a matrix estimation[1] process to better fit the resulting peak period cycle trip matrices to observed data, using approximately 400 cycle count data points,
- The resulting March 2013 base model has then been validated against a further 400 data points, with plots of this validation illustrated in Figure 2 (in terms of observed versus modelled data points).

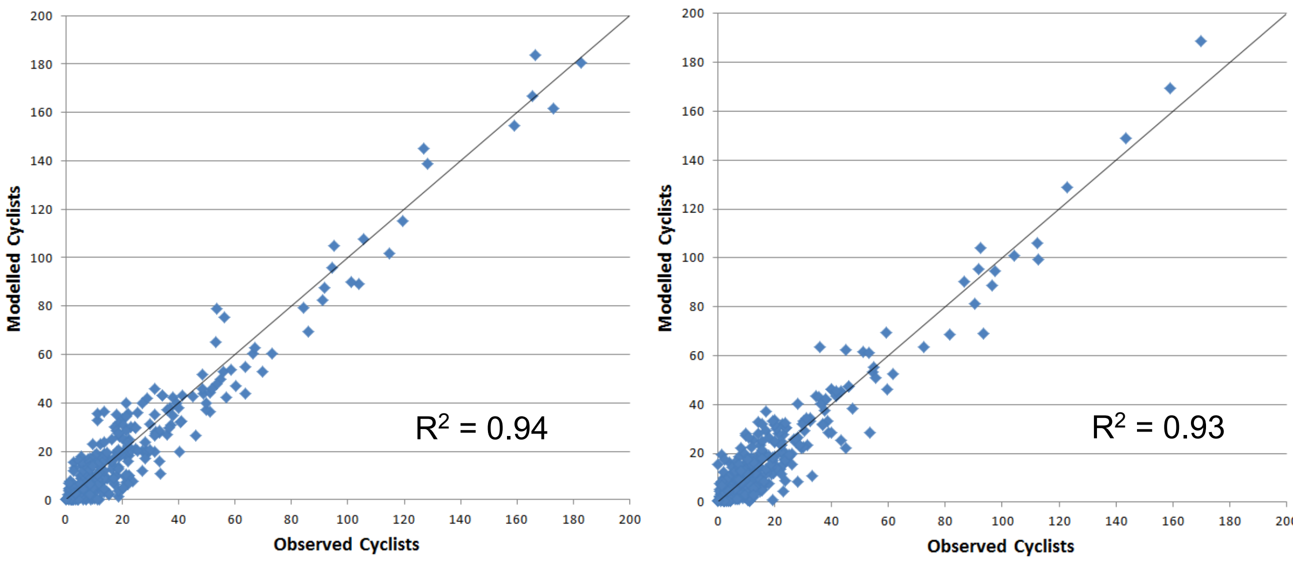


Figure 2: Plot of March 2013 Observed versus Modelled Cyclists, Morning (left) and Evening (right) Peak Periods

It is noted at this stage that a traditional traffic model would be validated against criteria from the NZ Transport Agency's Transport Model Development Guidelines. The criteria within this document were developed for application to traditional traffic models and have not generally been found to be appropriate to the cycle model. The criteria relating to GEH statistics[2] for example were found to be a poor measure of cycle model validity, as GEH criteria are too easy to meet when dealing with low value data points. This suggests that a new set of criteria may need to be developed to validate cycle demand models in future.

The R^2 and Root Mean Square Error (RMSE) statistics have however been useful, and the base model obtained R^2 values of 0.94 and 0.93 in the morning and evening peak periods, respectively, and RMSE values obtained were 35% and 39% respectively. Both measures fall marginally short of the criteria[3] of 0.95 (or higher) and 20% to 30% (or lower), respectively. Closer validation has not been possible however, as while the base model represents an average weekday in March 2013, the data used in the estimation and validation processes are subject to significant variability, as discussed previously.

2016 Forecast Model

- The forecast 2016 model has been developed by factoring the March 2013 base model cyclist volumes to represent an annual average 2013 weekday, then
- Applying 2013 to 2016 growth to the above demands, based on the forecast population and employment projections for each model zone, followed by

[1] A degree of caution was applied to the matrix estimation process by limiting the extent of estimation. The resulting matrices were then sensibility checked on a zone by zone basis, and in terms of the resulting trip length distribution

[2] The GEH statistic is a form of Chi-squared statistic, commonly used to compare observed and modelled count data.

[3] For an "Urban Area" classification traffic model

- Applying new trips to the network where cycle infrastructure is improved. This has been done by:
  - Taking car and public transport trips from the Auckland Regional Transport (ART) model, removing or factoring trips unlikely to be undertaken by bicycle (such as employer's business trips),
  - Applying demand elasticities such that, where a trip between A and B has been improved by new infrastructure, a small portion of relevant car and public transport trips between A and B shift mode to cycling. These elasticities were developed by Flow, such that the Auckland Cycle Model predicted responses to cycle infrastructure investment that matched international experience.
  - Applying a trip length distribution based on 2013 Census data for cycle trips within the Auckland region; this has allowed shorter trips to be more likely to switch to cycling than longer distance trips. This assumes that the journey to work trip length distribution from Census data reasonably represents the majority of cycle trip lengths during the commuter peak periods.

EVALUATION

The model has been evaluated by comparing 2016 cycle count data with model predictions for the same period. Between March 2013 (the period represented by the base model) and July 2016, a significant number of cycle infrastructure improvements have been opened around Auckland, including:

- Grafton Gully and Beach Road cycleways,
- Westhaven Promenade,
- Nelson Street cycleway and Te Ara I Whiti (Lightpath),
- Carlton Gore Road protected/buffered cycle lanes,
- Improvements to the existing Northwestern cycleway,
- Upper Harbour Drive buffered cycle lanes,
- Mt Roskill Safe Routes,
- Dominion Road parallel cycle route, and most recently in July 2016
- Quay Street cycleway.

Accordingly, the 2016 model includes the above infrastructure. The model represents the annual average weekday morning and evening peak periods, and incorporates changes to cycle demands associated with land use changes between 2013 and 2016, as well as changes to travel behaviours that have been driven by the above infrastructure improvements.

The cycle demand forecasts from the model have been compared to data from 21 automatic count data sites. These 21 sites correspond to areas that have seen significant cycle infrastructure investment since 2013 – generally those close to or within the city centre, on the Northwest cycleway, and on the Upper Harbour Bridge. The sites are generally directional, and have allowed comparisons to be made with 41 data points.

Count data has been obtained for the period from August to November 2016 (inclusive), as this corresponds with a relatively stable period in the development of Auckland's cycle network, with no major cycle infrastructure projects being completed over this period. This data was then annualised using automatic cycle count data for the past four years[4].

Figure 2 below shows plots of the observed and modelled data points, for both the morning and evening peak periods. The two data sets can be seen to be a relatively good fit, with R^2 values of

[4] Average cycle volumes over the August to November period have consistently been 3% lower than the annual average, across the central Auckland counters that have been operational since 2013

0.86 and 0.81 in the morning and evening peak periods, respectively. RMSE values obtained were 38% and 42%, respectively. Two outliers (circled) relate to the Northwest cycleway at Kingsland and are discussed subsequently.

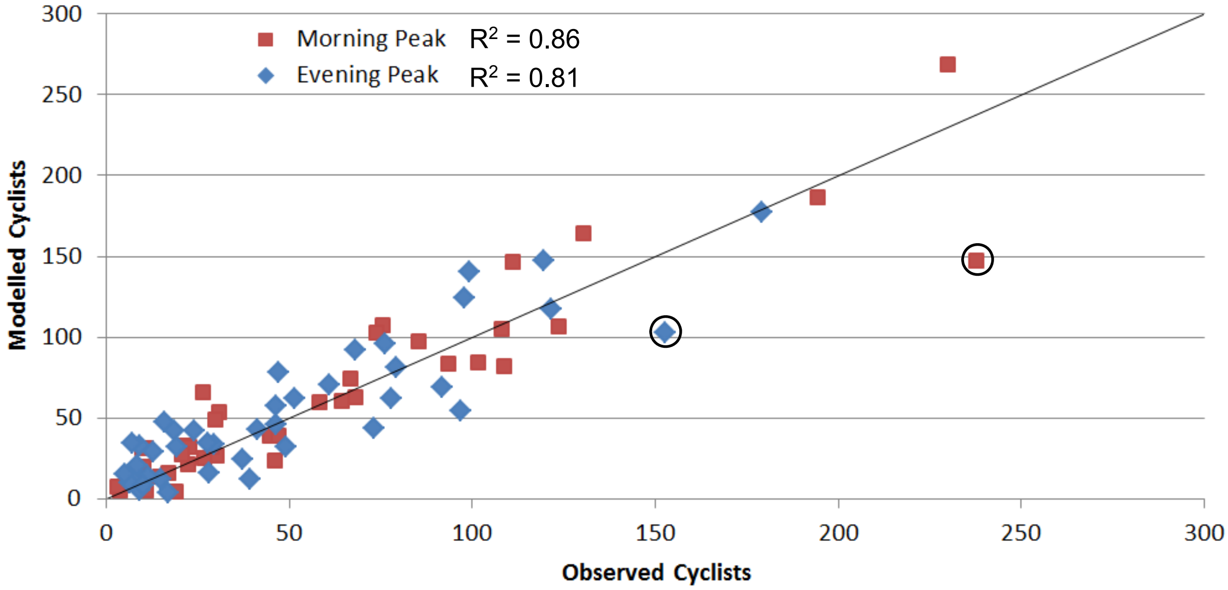


Figure 3: Plot of 2016 Observed versus Modelled Cyclists (directional)

Table 1 below presents the observed and modelled cycle demands on each of 21 cycle routes assessed. Routes have been categorised into new routes that did not exist in 2013, routes improved between 2013 and 2016, and routes unimproved over this period.

Cycle Route	Weekday Morning Peak Period (7-9 am)			Weekday Evening Peak Period (4-6 pm)		
	2013 Count	2016 Count	2016 Model	2013 Count	2016 Count	2016 Model
Grafton Gully	-	124	118	-	95	138
Lightpath	-	126	98	-	110	83
Total: New routes	**-**	**249**	**216**	**-**	**205**	**221**
Beach Road	68	116	94	63	97	85
Carlton Gore Road[5]	69	106	153	73	99	133
Nelson Street	16	134	137	5	108	116
Quay Street	112	188	224	98	168	175
Total: Improved routes	**265**	**545**	**608**	**240**	**471**	**509**
Curran Street	36	61	38	27	37	30
Grafton Bridge	133	153	153	142	129	155
Grafton Road	15	21	55	17	18	64
Great North Road	n/a	64	60	n/a	9	5

[5] Manual surveys were undertaken on Carlton Gore Road in 2016, as cyclists were known to cycle on the road and be missed by the automated cycle counters in the cycle lane

Cycle Route	Weekday Morning Peak Period (7-9 am)			Weekday Evening Peak Period (4-6 pm)		
	2013 Count	2016 Count	2016 Model	2013 Count	2016 Count	2016 Model
Hopetoun Street	34	34	32	49	46	22
Karangahape Road	116	135	130	153	129	173
NW cycleway (Kingsland)	130	269	181	91	190	129
NW cycleway (Te Atatu)	82	132	176	93	126	161
Quay Street (Vector)	233	224	235	170	166	194
Symonds Street	151	83	106	153	96	80
Tamaki Drive	275	275	307	190	220	221
Te Wero Bridge	39	114	114	20	127	95
Upper Harbour Bridge	15	17	31	14	20	28
Upper Queen Street	54	37	71	31	31	46
Victoria Street West	53	32	40	76	17	44
Total: Unimproved routes	**1,365**	**1,653**	**1,729**	**1,227**	**1,361**	**1,445**

Table 1: 2016 Observed and Modelled Cyclists (two-way)

The above comparison generally shows a good level of agreement, with consistent trends evident in both observed and modelled 2016 data such as:

- Consistent growth in cyclist numbers across the network overall. Among the 15 routes that have not been improved between 2013 and 2016, cyclist numbers have grown relatively modestly (16% growth); this has been matched by the model (22% growth)
- Consistently higher growth in cyclist numbers on routes that have been improved between 2013 and 2016, such as Nelson Street and Quay Street. Cyclist numbers across these four routes have grown by 101% between the two periods, and this growth has been matched by the model, albeit growth in the model is slightly too high (121%)

In terms of individual routes, the following is noted:

- On Symonds Street, the construction of the Grafton Gully cycleway has seen a reduction in cyclists on the former route in favour of the new route. The model has appropriately represented this shift.
- The model has predicted very reasonable estimates of 2016 cyclists on the Grafton Gully cycleway and Lightpath – this is a significant result, given that these are both new routes without prior count data in the 2013 base model
- The model slightly underestimates cyclists on Lightpath however. This piece of infrastructure was coded within the 2016 model (prior to its construction) with the highest level of Relative Attractiveness, reflecting its separation from motorised traffic, generous width and relatively flat grades. The route has been constructed to an exceptionally high standard with iconic colouring and lighting, it has views of the city and harbour, has received a number of design awards, and has become an attraction in its own right. In retrospect, a new, higher Relative Attractive rating may be justified for this route, although the count data may still reflect its early “honeymoon” period.
- There is generally a very good level of agreement between the observed and modelled data across three of the four improved routes. The model has however slightly overestimated

cyclists on Carlton Gore Road. The cycle lanes on this road are relatively isolated, in that they do not yet connect to any other cycle infrastructure, and accessing Carlton Gore Road requires users to cycle on relatively unappealing arterial roads. This isolation is almost certainly suppressing cycling demands on this route, and it is possible that the model does not adequately reflect this lower uptake.

- Across the cycle routes that have not been improved, there is some variability in the level of agreement between the observed and modelled data, although most data falls within +/-30 cyclists or less
- With regard to the Northwest cycleway at Kingsland, a very large growth in observed peak period cyclist numbers between 2013 and 2016 (108% growth) has not been matched by the model (40% growth). It is noted that daily cyclist volumes on this cycleway have grown by 62% over the same period[6]. This indicates that use of this cycleway has become more 'peaky', with substantial growth in commuter peak cyclists that has not been matched off peak or in the contra-peak directions. Growth in commuter peak use of the Northwest cycleway (Kingsland) has similarly outpaced growth on routes that have been more directly improved, such as Beach Road and Quay Street. The cycle model has been unable to replicate this unusual pattern of extreme tidal growth, although it is noted that the model has reasonably represented cycle demands on city centre routes that connect to the Northwest cycleway (Upper Queen Street, Nelson Street, Lightpath, Symonds Street and Grafton Gully).
- By comparison to the above, growth in use of the Northwest cycleway at Te Atatu (a further 10 km west of the Kingsland count site) has been matched by the model (although in this case the model predicts higher numbers of cyclists than observed).

Two further measures of evaluating the Auckland Cycle Model have been used, by comparing model forecasts to automatic count data across cordons and screenlines, as follows.

- A CBD cordon. This measure effectively ring fences the city centre, and compares the model to count data across all routes that cross the cordon, helping to illustrate whether the model is reasonably predicting total cycle trips into and out of the city centre
- A north-south 'University' Screenline that includes Symonds Street and the Grafton Gully cycleway. These two parallel routes perform similar network roles in providing the main cycle access to the university area from the south. To some degree, increased cyclists on one route would be matched by reductions on the other, and when viewed together they provide an indication of whether the model is reasonably predicting north-south trips to and from the university area.

The CBD cordon and the university screenline are illustrated in Figure 4.

[6] 401 average daily cyclists in 2013; 649 in 2016

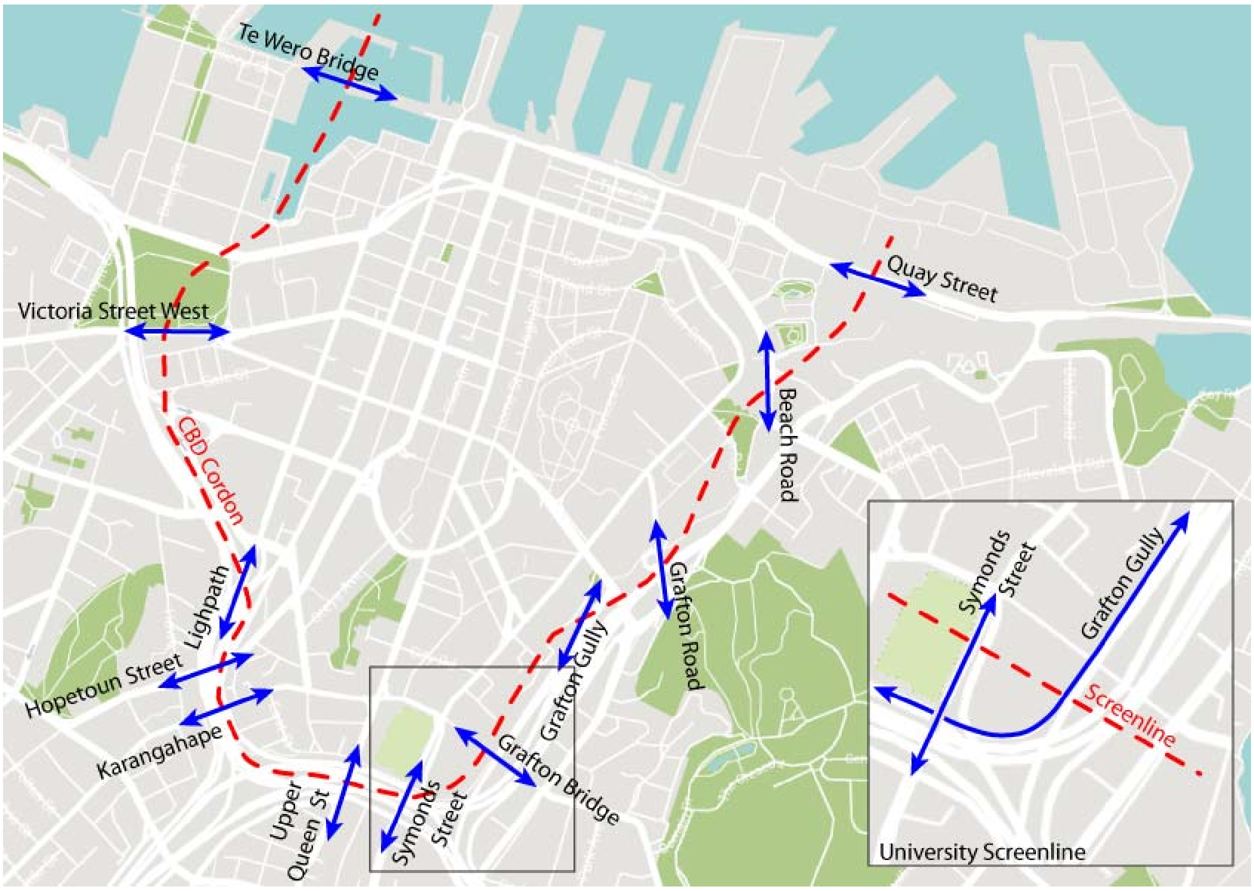


Figure 4: Map of CBD Cordon and University Screenline

The CBD cordon is acknowledged as being an incomplete cordon, in that it excludes Viaduct Harbour Avenue, Fanshawe Street, Wellington Street and Alten Road. No count data was available for these routes, and none of these routes have dedicated cycle infrastructure. With the exception of Viaduct Harbour Avenue these routes are unlikely to carry significant numbers of cyclists compared to adjacent routes, such as Quay Street.

The results of the CBD cordon and university screenline comparisons are shown graphically in Figure 5 and Figure 6, respectively, illustrating both 2013 and 2016 observed and modelled data.

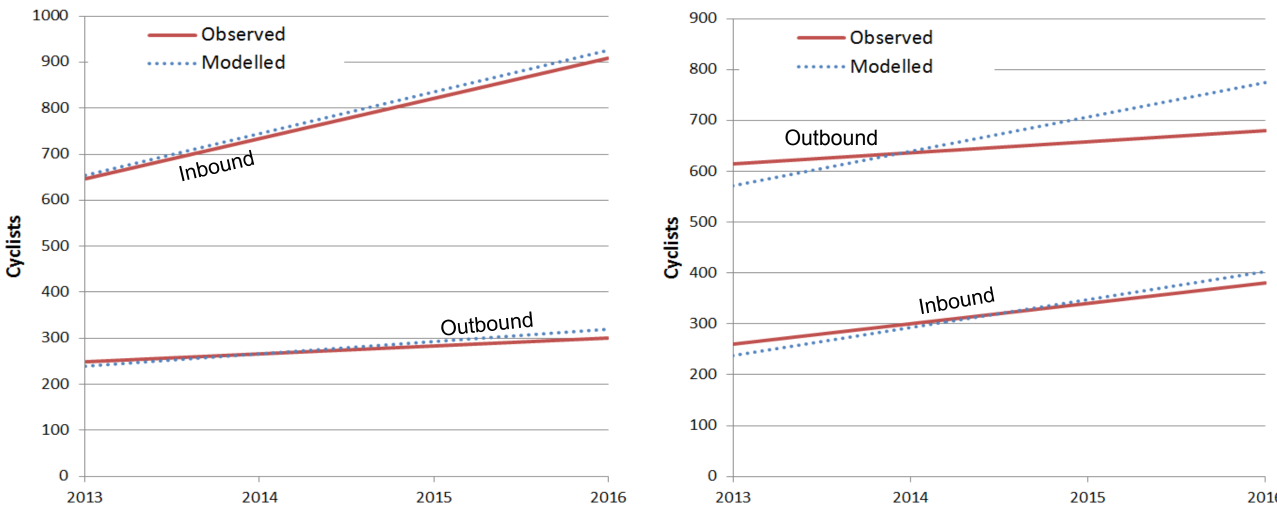
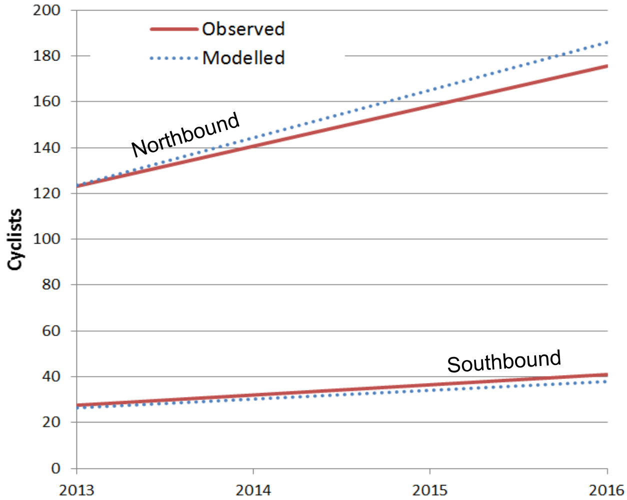


Figure 5: City Centre Cordon – Plot of Observed versus Modelled Cyclists, Morning (left) and Evening (right) Peak Periods



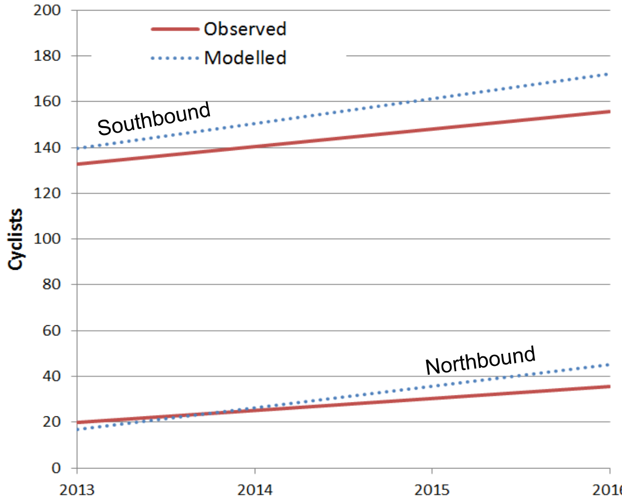


Figure 6: University Screenline – Plot of Observed versus Modelled Cyclists, Morning (left) and Evening (right) Peak Periods

Between 2013 and 2016 there has been significant growth in cyclist numbers both across the CBD cordon (up to 46% growth) and the north-south university screenline (up to 79% growth). The model matches this growth well across both periods and both count methods. Growth in cyclist numbers within the model does however tend to exceed the observed growth slightly, with this most apparent in the evening peak period.

POTENTIAL SOURCES OF ERROR

Bain (2011) reports on responses to a poll that sought responses on the "reasonableness" of traffic forecasts among transport professionals. For a transport model with a five year forecast, "reasonable" margins of error were reported as between 15% and 25% (for an existing and a new route, respectively). The Auckland Cycle Model does not reach this level of certainty for some routes, although approximately half of the observed and modelled data points fall within this range. To some degree, this outcome is both expected and acceptable, given that the Bain criteria relate to traditional vehicular traffic models and that:

- There is inherently greater variability in cyclist numbers between one day and the next, then there is among general traffic[7]. This variability makes cycle demand forecasting for an annual average day challenging
- Cyclist numbers are generally much smaller than traffic volumes – it requires only a small variation in the number of cyclists for a model to have a 25% error on a cycle route carrying 100 cyclists a day, relative to a traffic route carrying 10,000 vehicles per day
- There is significantly more risk involved when forecasting general traffic – should predicted and actual vehicle traffic on an arterial road differ by 25% the implications may be problematic, while the implications of a 25% error on a cycleway may be merely academic.

The March 2013 base model was constructed using cycle count data, and the forecast year models have been built by firstly factoring the base model to reflect an annual average day and then factored to match land use changes assumed for each future year. The 2013 counts were typically undertaken on a single (different) day at each location and the surveys were carried out on fine weekdays in March 2013. The model predictions therefore need to be considered in light of the variability seen in hourly, daily and weekly cycle data among the automated count locations, and the often contradictory manual count data obtained for the same or adjacent locations.

[7] Variations in general traffic volumes on metropolitan routes typically vary by +/-5% from week to week, relative to the annual average, from the NZ Transport Agency's Research Report 209 (Douglas and McKenzie, 2001)

The forecast 2016 cyclist demands have been developed by factoring the annual average 2013 demands, with factors developed based on forecast land use. This has been shown in Table 1, Figure 5 and Figure 6 to somewhat overestimate the 2013 to 2016 growth in cyclists, particularly in relation to the evening peak period. It may be that the predicted land use growth has not occurred to the same degree as expected, or that the land use growth has not resulted in a proportional response in cyclist numbers. The former is a type of optimism bias that is common in transport modelling, and was shown in a Highways England study of major transport projects to be a factor in 50% of cases where forecasts had exceeded actual traffic flows by more than 15% (Highways England, 2015).

Count data also indicates that cyclist numbers have increased more dramatically in the morning peak period than the evening peak period, among the count sites available. This may be due to increased trips by users who commute during the morning peak period, but who return home outside of the peak, such as for example university students who may finish lectures before 4 pm.

MODEL ADJUSTMENTS

In response to some of the minor discrepancies between the observed and modelled data presented previously, the model has been refined to provide a better fit. Refinements have included:

- Adjusting the elasticities used to generate new cyclists where infrastructure is improved; this has been optimised iteratively, and a value of 0.65 for Relative Attractiveness elasticity was found to be optimal (previously 0.75). This has had the effect of slightly reducing the forecast number of cyclists on improved routes
- The growth in evening peak period cycle trips between 2013 and 2016 has been dampened down by 10% to better reflect observed growth over this period
- The higher observed counts on Lightpath have been better replicated by applying a new Relative Attractiveness category for routes of this nature; this has effectively resulted in more new cycle trips being generated on this route through the demand process, and also the assignment of more existing trips onto Lightpath.

After making the above refinements, the following comparisons can be made between the observed and modelled 2016 cycle volumes:

- The morning peak period model achieves an R^2 0.87 and a RMSE of 37% (previously 0.86 and 38%, respectively)
- The evening peak period model achieves an R^2 0.81 and a RMSE of 38% (previously 0.81 and 42%, respectively)
- Forecast demands on Lightpath are 121 cyclists in the morning peak period and 103 in the evening peak period (previously 98 and 83, respectively, and closer to the observed 126 and 110 cyclists, respectively)
- The model predicts 16% growth in cyclist numbers among the 15 routes that have not been improved between 2013 and 2016 (previously 22%); this matches the 16% growth observed
- The model predicts 113% growth in cyclist numbers among the four routes that have been improved between 2013 and 2016 (previously 121%); this better matches the 101% growth observed.

Updated plots of observed and modelled growth across the CBD cordon and university screenline are shown in Figure 7 and Figure 8. The previous model version is plotted in dashed blue, while the update is plotted in solid blue. The modelled growth now more closely follows the observed growth.

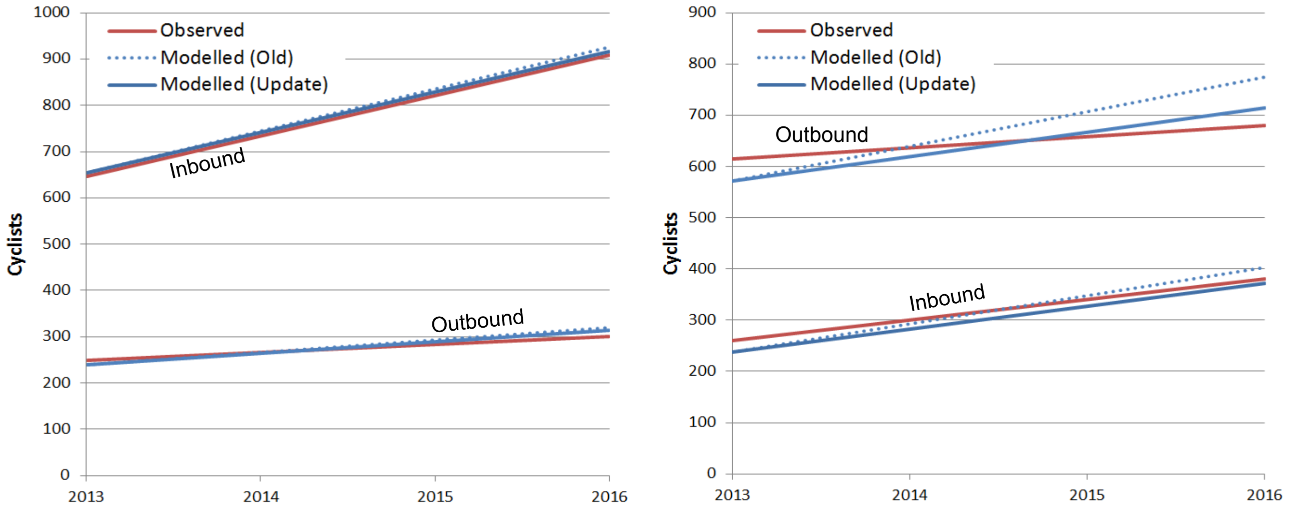


Figure 7: City Centre Cordon – Plot of Observed versus Modelled Cyclists, Morning (left) and Evening (right) Peak Periods

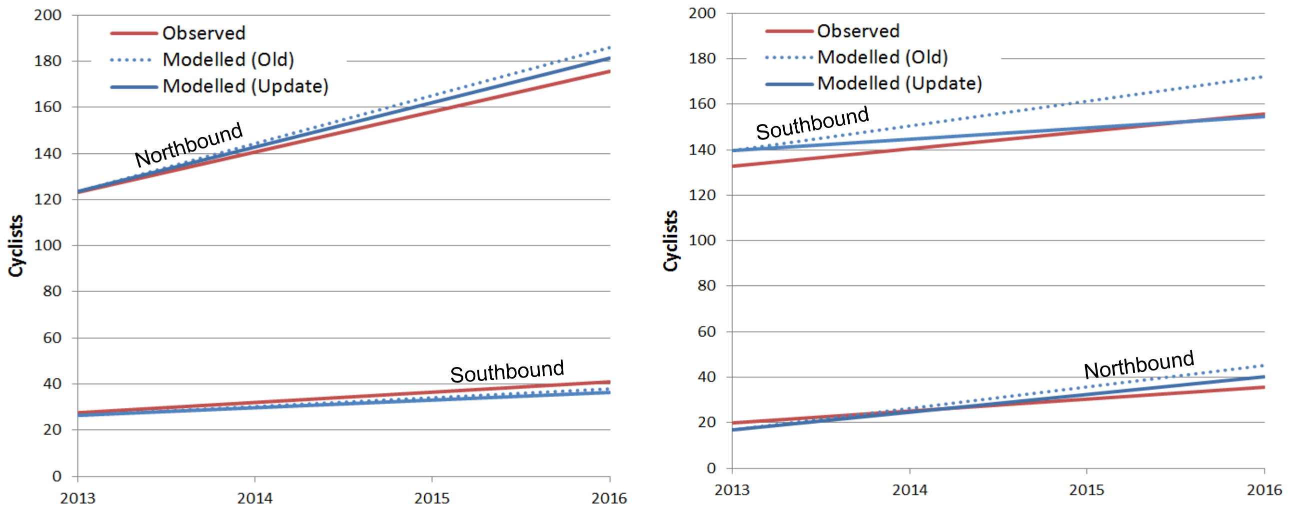


Figure 8: University Screenline – Plot of Observed versus Modelled Cyclists, Morning (left) and Evening (right) Peak Periods

COMPARISON WITH ALTERNATIVE DEMAND PREDICTION METHODS

Forecast cyclist estimates from the refined Auckland Cycle Model have been compared to those obtained using alternative methods, namely:

- The methods documented in the NZ Transport Agency's Research Report 340, "Estimating Demand for New Cycling Facilities in New Zealand" (McDonald, et at., 2007), and
- Simplified Procedure 11, from the NZ Transport Agency's Economic Evaluation Manual (EEM).

The first of the above documents identifies two methods for estimating cycling demand, depending on the type of facility. For on road routes, the method applies a step function to existing cyclist counts on a route, followed by a subsequent linear annual growth based on census mode share data. For off road routes, the method makes use of existing cyclist and private car volumes on the adjacent parallel route, in addition to a linear annual growth.

The method in the second document above relies on resident populations within the catchment of a cycle route, and applies existing mode share proportions to this data.

Both methods have been used to estimate cycling demands on the two new and four improved routes from Table 1 previously, with these estimates compared with those from the (refined) Auckland Cycle Model. The results are summarised in Table 2.

Route	Observed Cyclists (2016)	2016 Auckland Cycle Model		Research Report 340		EEM Simplified Procedures 11	
		Cyclists	Error	Cyclists	Error	Cyclists	Error
Beach Road	343	263	-23%	392	+14%	1,158	+237%
Carlton Gore Road	317	410	+29%	423	+33%	1,067	+237%
Grafton Gully	344	373	+8%	465	+35%	1,660	+383%
Nelson Street	340	373	+10%	64	-81%	1,535	+352%
Lightpath	375	351	-6%	248	-34%	1,594	+325%
Quay Street	715	761	-6%	628	-12%	956	+34%
Average Error			**±14%**		**±35%**		**±261%**

Table 2: Comparison of 2016 Cycle Demand Predictions – Three Methods (two-way, average annual daily cyclists)

The Auckland Cycle Model has resulted in the most accurate cycle demands estimates among the three methods, on five out of six routes, with errors ranging from -23% to +29%. The Research Report 340 methods have resulted in relatively realistic estimates of cyclist numbers, albeit less accurately than the Auckland Cycle Model and errors ranging from -81% to +35%. On Nelson Street in particular, Research Report 340 has resulted in a very low estimate, due to the very low cyclist volumes on this route prior to construction of the Nelson Street Cycleway.

The EEM Simplified Procedures 11 method has significantly overestimated cyclist numbers on all six routes, with errors ranging from +34% to +383% – a result of this method's reliance on population catchments to develop cycle demands. This outcome suggests that the EEM SP11 method requires review, and that it may not be suitable in its current form for use in areas with high population catchments, such as central Auckland.

CONCLUSIONS

Data collected from automatic cycle counters in 2016 has been compared to forecast 2016 cyclist numbers produced by the Auckland Cycle Model. This comparison has generally shown a good level of agreement, with:

- Modest observed growth in cyclist numbers on unimproved routes matched by the model
- Observed significant growth in cyclist numbers on improved routes such as Nelson Street and Quay Street also matched by the model
- Observed reductions of cyclists on Symonds Street due to the opening of the parallel route of Grafton Gully cycleway also matched by the model
- Relatively consistent comparisons between observed and modelled cyclist numbers across a CBD cordon and across a university screenline.

In general however, the model was found to slightly overestimate evening peak period cyclist numbers in 2016. Similarly, the model was slightly overestimating cyclist numbers on improved routes, and to conversely be slightly underestimating cyclist numbers on the Lightpath route.

In response to the above, the forecast model was recalibrated against observed 2016 data, resulting in a model that now very reasonably represents observed 2016 network conditions. Outputs from this refined model were compared to equivalent predictions made by two alternative cycle demand prediction methods, with:

- The Auckland Cycle Model found to result in an average error of 14% when compared to observed cycle data across six new or improved city centre routes,
- The method within the NZ Transport Agency's Research Report 340 resulting in an average error of 35% when compared to the same observed data, and
- The Simplified Procedure 11 method from the NZ Transport Agency's EEM found to result in an average error of 261%.

In conclusion, it is found that the Auckland Cycle Model has the most accurate forecasts of cycle demands among the three available methods. Going forward, it is recommended that:

- The Auckland Cycle Model be the preferred method of assessing forecast cycle demands within Auckland.
- New model validation criteria be developed for cycle models, with these criteria added to the NZ Transport Agency's Transport Model Development Guidelines.

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