

Post Implementation Review

Johnsonville Triangle Network Improvements

Wellington City Council and
Wellington Highways and Network Operations



November 2017

The purpose of NZ Transport Agency Post Implementation Reviews are to:

- assess how well a project (or package) has delivered its expected benefits
- explain any variation between actual results and expected benefits and costs
- identify any lessons learned that can be used to improve future projects

Executive summary

The Johnsonville Triangle network improvements form part of a wider effort to support future commercial and residential growth in the Johnsonville Town Centre which did not eventuate as envisaged. Specifically, this project sought to: improve traffic flows during peak periods (including bus travel times); provide for safer pedestrian and cyclist movements; and, support future land development. Improvements associated with the project were constructed between August 2014 and February 2016.

Figure 1 on page 3 highlights the project's location and key physical work inclusions.

Summary assessment of project outcomes

This post implementation review focused solely on project outcomes as they relate to journey time and journey time reliability as this accounted for all of the project's assessed economic benefits¹. Key findings are summarised below and discussed in more detail in Section 1 of this report.

- Project documentation appears to have significantly over-estimated the journey time savings the project would produce.
- Median journey times between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road, via the Johnsonville Road or Broderick Road route, increased in the post-construction period. An exception was for westbound motorists using the Broderick Road route during the PM peak period, which have had reduced travel times.
- Journey time reliability outcomes from the project were mixed for those travelling between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road.
- Median journey times and journey time reliability for motorists travelling on Moorefield Road between Haumia Street and the Moorefield Road and Johnsonville Road roundabout, which was not assessed in the project documentation, improved.
- There is an incomplete picture of traffic growth rates on local roads, but those at the Johnsonville interchange have remained unchanged since the completion of the project.
- It was not possible to assess the impact of the project on bus journey times

Lessons learned

A review of project documentation found that assumptions used to assess the project did not accurately reflect actual traffic conditions. Most significantly, journey time assumptions were not based on real world data. Based on this shortcoming in project analysis, it is considered likely that project documentation has significantly overestimated project benefit. Lessons learned are discussed in greater detail in Section 3 of this report.

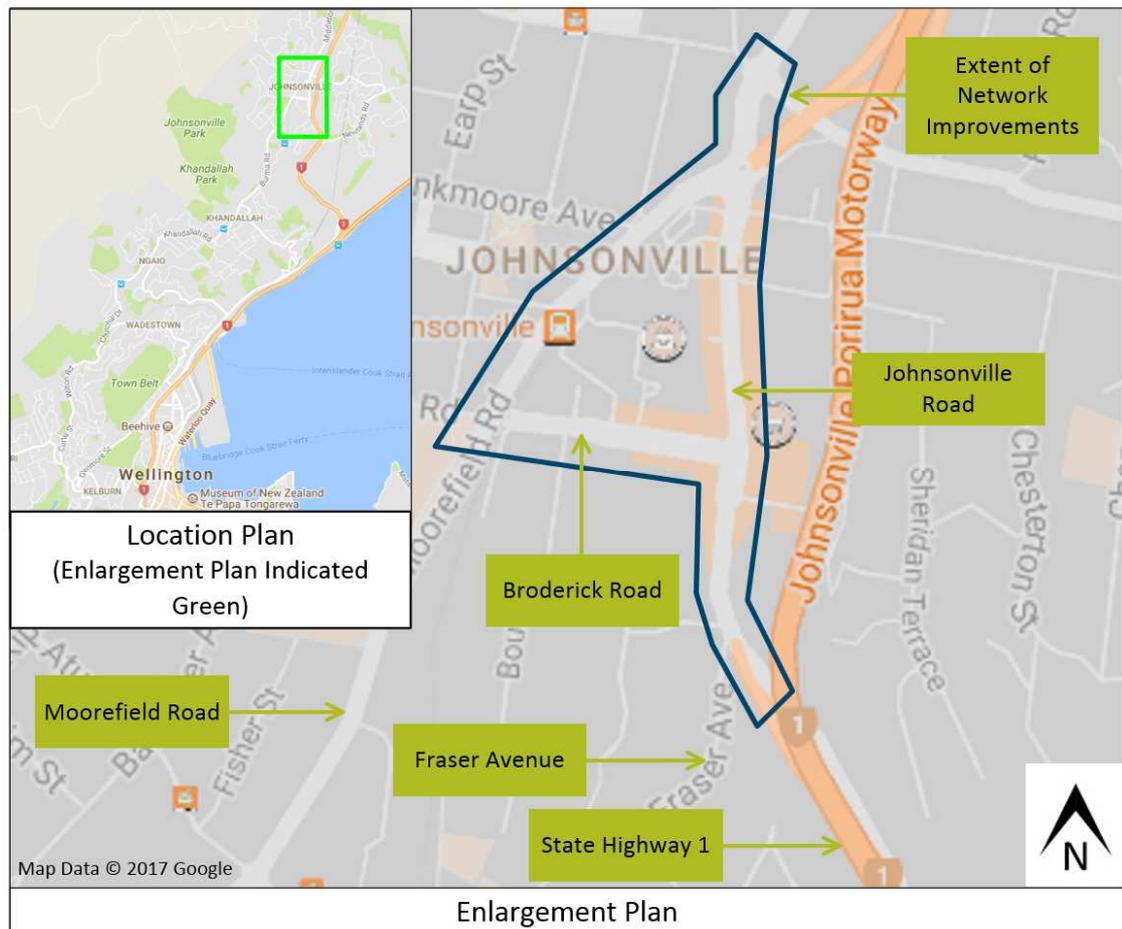
¹ Preliminary Investigation Report (GHD, 2014; page 24)

1. Project outcomes

Project description and objectives

This project involved the delivery of network improvements on Johnsonville Road, Moorefield Road and Broderick Road; collectively and locally referred to as the Johnsonville Triangle. Network improvements were focused on: improving traffic flows through the Johnsonville town centre; reducing peak hour queues on the State Highway 1 off-ramp; reducing bus travel times (and improvement to facilities); providing a safer environment for pedestrians and cyclists; and, enabling continued commercial and residential development in Johnsonville. A more detailed overview of the project's scope is included in Appendix A. An indicative overview of the project's general location is illustrated in Figure 1 below.

Figure 1: Extent of network improvements plan



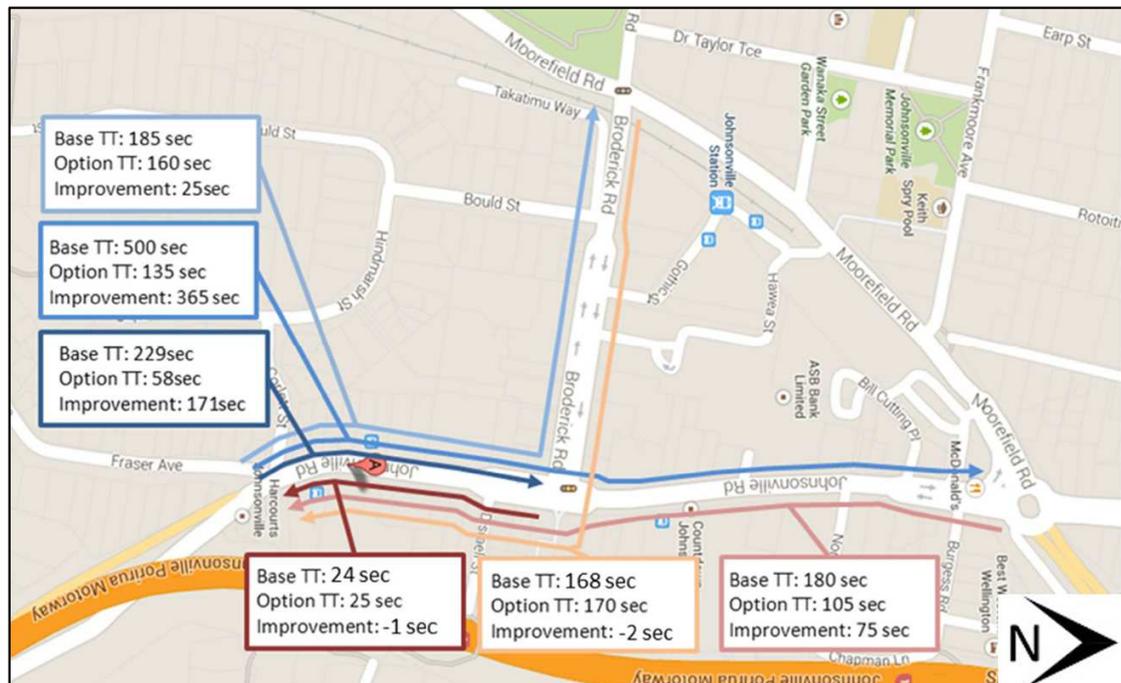
The project was jointly funded and managed by Wellington City Council and the Transport Agency due to works occurring on both local and state highway roads. During the construction phase Wellington City Council took responsibility for project management with the Transport Agency serving as Principal to the Contract.

Construction of the project occurred between August 2014 and February 2016 and set out to boost future commercial and residential growth; directly supporting the Johnsonville Town Centre and Urban Growth Plan. This post implementation review discusses project outcomes as they relate to changes in travel time, queuing, and traffic growth.

Expected journey time improvements have generally not been achieved

Project documentation suggested that based on 2013 data the proposed Johnsonville Triangle improvements would result in significant journey time savings²; as illustrated in Figure 2 below. Analysis of approximately the same routes using pre and post-construction journey time data found that while journey time reliability³ effectively remained static, median journey times increased by, on average, 17 seconds between 2013/14 and 2016/17. Analysis did, however, find journey times on Moorefield Road (which were not originally modelled) improved in the post-construction period. The paragraphs below summarise the analysis undertaken to review the project's impact on journey times and journey time reliability.

Figure 2: Changes in journey time expected as a result of Johnsonville Triangle network improvements (Source: GHD, 2014)⁴



Journey time analysis in this report has utilised data from August 2013 to August 2014 to represent the pre-construction period; and data from March 2016 to March 2017 to represent the post-construction period⁵. Analysis has focused on three time periods: that between 7am and 9am reflecting the AM peak period; 9am and 4pm reflecting the inter-peak period; and that between 4pm and 6pm reflecting the PM peak period. Together these periods account for the experience of approximately 85% of all road users, and include consideration of peak periods during which time network pressures in the area are at their

² Project documentation noted that while journey time reliability had not been quantified, it was expected that the easing of congestion would produce more consistent journey times (Preliminary Investigation Report: GHD, 2014).

³ Journey time reliability is defined in this report as the range between the 15th and 85th percentile journey time. In the case of the box and whisker graphs presented in this report, the wider the gap between the 15th and 85th percentile bars, the less reliable journey time is for motorists.

⁴ Routes coloured orange/red and blue respectively reflect expected journey time changes in the AM peak and PM peak period as assessed in the Preliminary Investigation Report (GHD, 2014). Both 'Base TT' and 'Option TT' relate to modelled journey times using 2013 traffic flow data.

⁵ Data pertaining to a full calendar year has been utilised to remove the effects of seasonal variation in traffic characteristics.

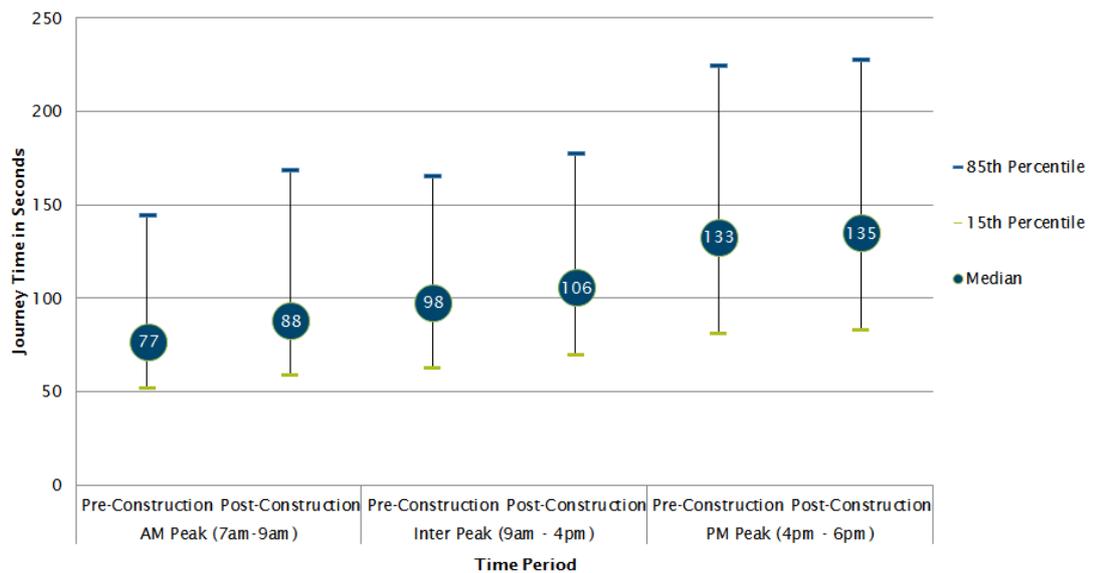
most significant. All journey time data used in analysis has been derived from the TomTom Traffic Stats database.

Motorists travelling between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road, using either the Johnsonville Road or Broderick Road route, generally experienced an increase in median journey time in the post-construction period. This finding is not wholly unexpected given the:

- Introduction of delay due to time lost between phases of the newly signalised 'Johnsonville Road, Corlett Street and Fraser Avenue' and 'Broderick Road and Gothic Street' intersections;
- Introduction of delay due to time lost to pedestrian phases associated with the newly signalised intersections; and,
- Reduced intersection efficiency and throughput due to the inclusion of advanced cycle stop boxes (waiting areas for cyclists) at intersections.

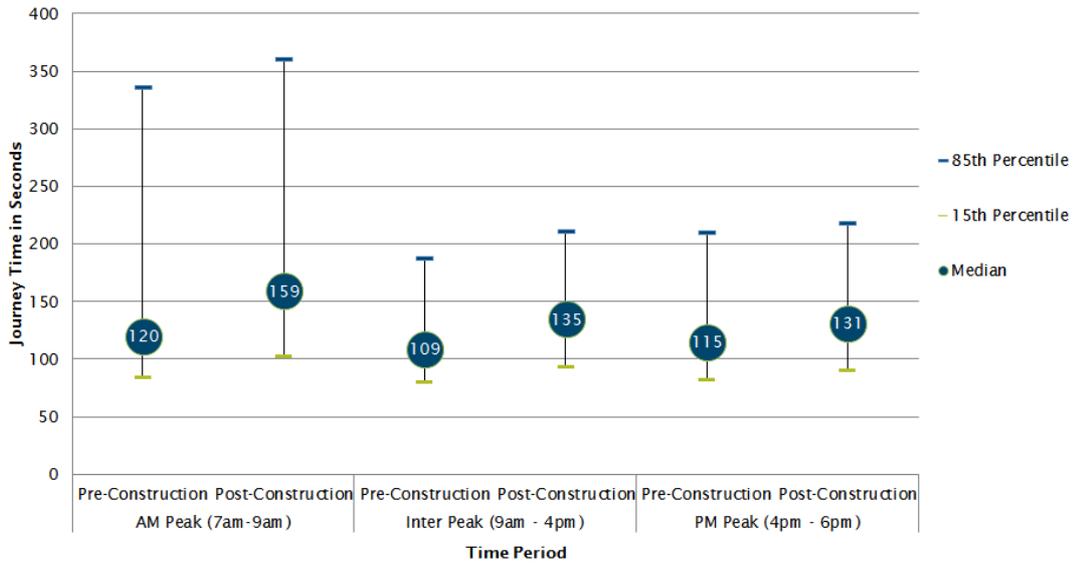
For the motorists using the Johnsonville Road route, as depicted in Figure 3 and Figure 4, it can be seen that median journey times increased by between two and 39 seconds. These same motorists also experienced a marginal reduction in journey time reliability in the post-construction period; which ranged from zero to 17 seconds.

Figure 3: Northbound journey time and reliability between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Johnsonville Road



Source: TomTom, Traffic Stats

Figure 4: Southbound journey time and reliability between Moorefield Road and Johnsonville Road (adjacent to Fraser Road intersection) via Johnsonville Road

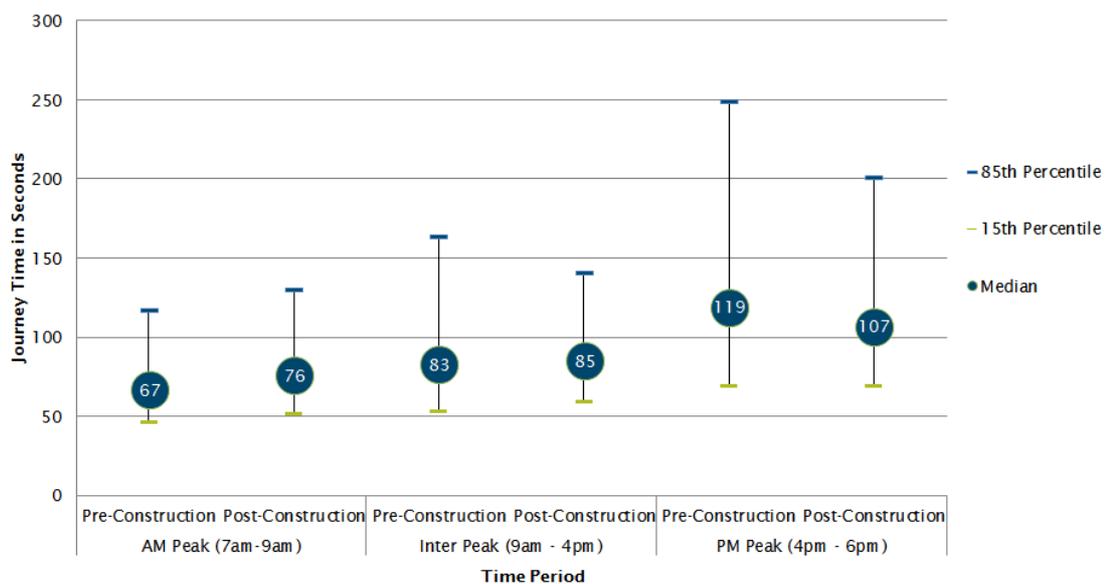


Source: TomTom, Traffic Stats

Journey time data for motorists using the Broderick Road route to travel between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road is illustrated in Figure 5 and Figure 6. While those motorists travelling in the westbound direction during the PM peak period experienced a 12 second reduction in median journey time; motorists travelling at all other time periods experienced a median journey time increase of between two and 56 seconds.

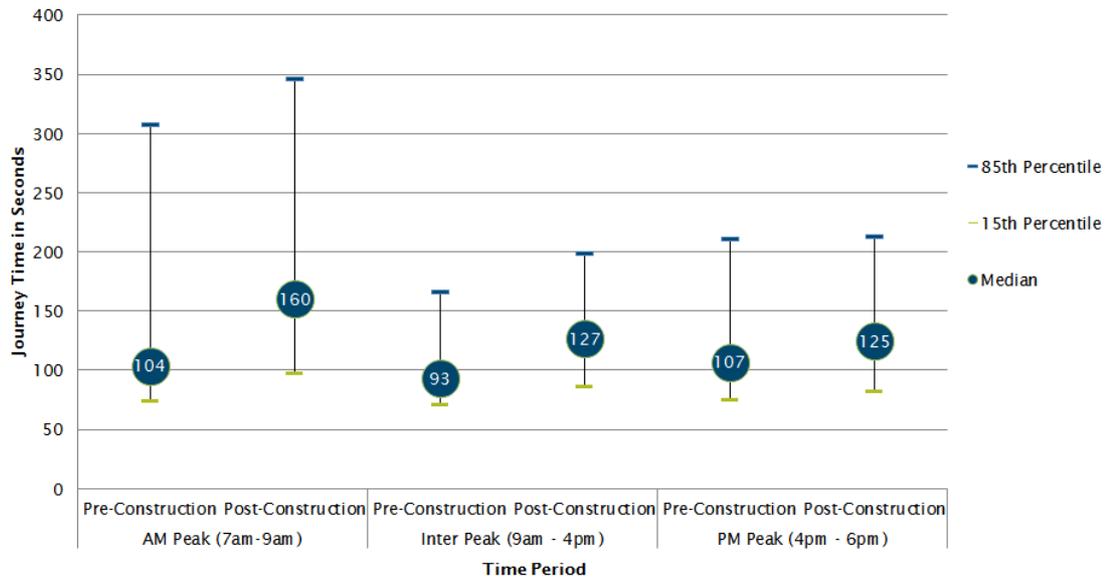
In the post-construction period journey time reliability improvements of between five and 48 seconds were available for those motorists travelling in the PM peak period, and in the westbound direction during the inter-peak period. Outside of these movements, motorists experienced a reduction in journey time reliability of between seven and 17 seconds.

Figure 5: Westbound journey time and reliability between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Broderick Road



Source: TomTom, Traffic Stats

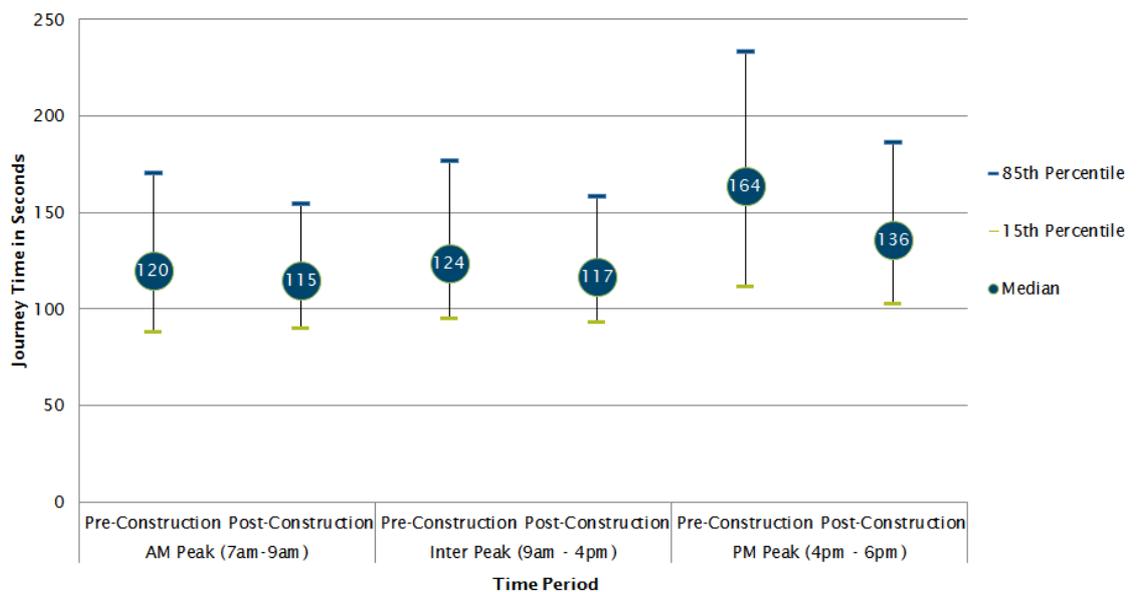
Figure 6: Eastbound journey time and reliability between Moorefield Road and Johnsonville Road (adjacent to Fraser Road intersection) via Broderick Road



Source: TomTom, Traffic Stats

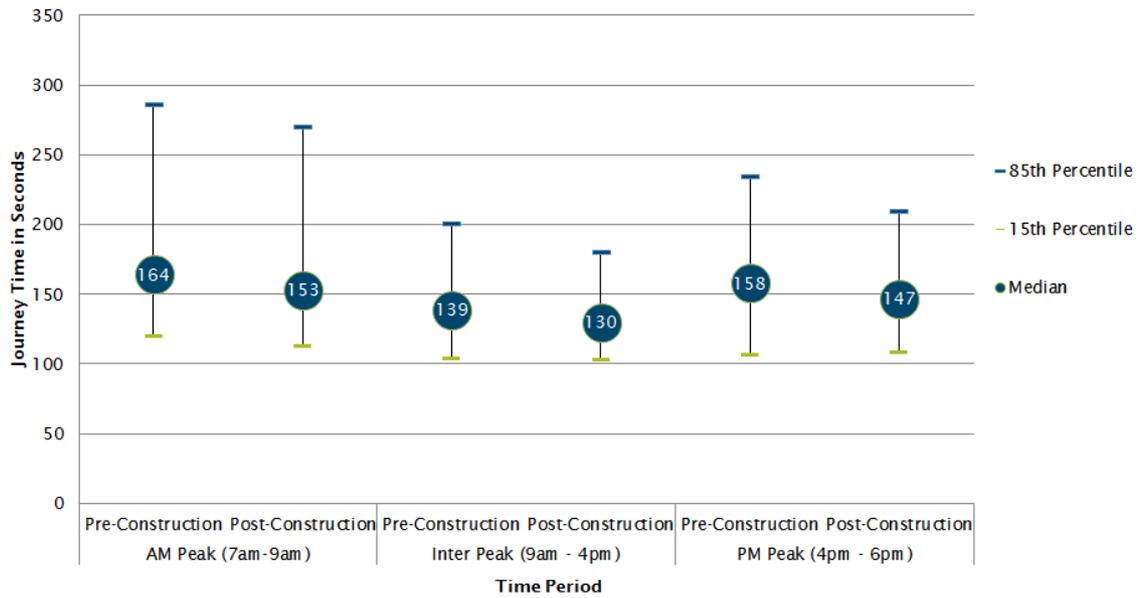
With the exception of the Moorefield Road intersections with Broderick Road and Johnsonville Road, project documentation did not appear to consider the journey time effects on Moorefield Road. Figure 7 and Figure 8 show that motorists experienced a decrease in median journey times of between five and 28 seconds on Moorefield Road when travelling between Haumia Street and the Johnsonville Road and Moorefield Road roundabout. The figures also show that motorists benefited from an improvement in journey time reliability in the post-construction period.

Figure 7: Northbound journey time and reliability on Moorefield Road between Haumia Street and the Moorefield Road and Johnsonville Road roundabout



Source: TomTom, Traffic Stats

Figure 8: Southbound journey time and reliability on Moorefield Road between the Moorefield Road and Johnsonville Road roundabout and Haumia Street



Source: TomTom, Traffic Stats

Limitations exist in our ability to accurately compare journey time expectations (as detailed in project documentation and replicated in Figure 2) and actual journey times achieved (based on TomTom data). This limitation arises due to project documentation modelling both pre and post-construction journey times using a base year of 2013; while construction was not actually completed until September 2015. Additionally, it is not possible to be completely certain that the extents of the routes assessed in this post implementation review match those used in the project documentation, despite our best efforts to do so.

Notwithstanding these limitations the general order of magnitude and nature of expected and actual average journey time savings have been displayed in

Table 1. The data presented in

Table 1 suggests poor alignment between expected and actual average journey time savings, with the exception of those travelling Westbound between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Broderick Road during the PM peak period.

Table 1: Comparison of expected and actual average journey time savings

Assessment Period	Route	Average Journey Time Saving (Seconds) ⁶	
		Expected (based on project documentation)	Actual (based on TomTom data)
AM Peak	Southbound between Moorefield Road and Johnsonville Road (adjacent to Fraser Road intersection) via Johnsonville Road	75	-22
PM Peak	Northbound between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Johnsonville Road	365	1
AM Peak	Eastbound between Moorefield Road and Johnsonville Road (adjacent to Fraser Road intersection) via Broderick Road	-2	-42
PM Peak	Westbound between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Broderick Road	25	21
Total Accumulated Journey Time Saving (Seconds)		463	-42

The average journey time savings detailed in

⁶ Please note that journey time savings displayed in this table are based on average journey times to ensure fair comparison with figures presented in project documentation. Care should be exercised when comparing data contained in this table with median data generally used elsewhere in this report.

Table 1 reflect the difference between post-construction and pre-construction journey times. In the case of the expected journey time savings (as detailed in project documentation), pre-construction journey times were not based on traffic speed or journey time surveys. As illustrated in Appendix B, the difference between expected and actual journey time benefits is largely attributable to the inaccuracy of pre-construction journey time data used in project documentation.

Traffic queue surveys do not suggest a reduction in queueing

Traffic queue surveys undertaken by Wellington City Council in the week before and four weeks after the Fraser Avenue, Corlett Street and Johnsonville Road traffic signals were turned on. The survey results were highly variable and in themselves, do not provide a clear indication that traffic queuing has improved markedly at the intersection. The survey data has been provided in Appendix C. The additional lane provided on the approach to the traffic signals will have ensured additional queuing capacity, reducing the length of any queueing.

Traffic growth on local roads has been generally muted

Average daily traffic volume data is held for a number of roads in the vicinity of the Johnsonville Triangle; and are based on week long tube counts (in some cases at different times of the year). Week-long traffic counts are, however, subject to significant variability due to factors such as weather, traffic crashes, and local events affecting localised traffic patterns. Despite the risk in drawing conclusions from such traffic count data, the following observations were made for weekday traffic:

- Johnsonville Road (50m north of Broderick Road) traffic flows have decreased by approximately 5% between 2010 and 2017.
- Moorefield Road (30m south of Wanaka Street) traffic flows appear to have increased. This inference is based on traffic flows in August 2017 being greater than flows in December 2012, given that traffic flows in December are typically greater than at other times in the year.
- Broderick Road has insufficient data to determine whether traffic flows are likely to have increased or decreased.

Traffic count infrastructure on the state highway network allows significantly more accurate assumptions to be made regarding changes in traffic flow. Based on State Highway traffic count data, as illustrated in Figure 9, traffic growth patterns for the on and off ramps at the Johnsonville interchange have remained largely unchanged. Interestingly, northbound off-ramp traffic flows, which were a notable benefactor from the completion of this project (due to the two-laning of the off-ramp), have continued to decrease at an average rate of 2.6% per year. This likely reflects the outcomes associated with the combination of the Grenada Interchange, north of Johnsonville, and the opening of the Westchester Drive Extension in April 2013. It is expected that traffic accessing the fast growing residential suburbs immediately north of Johnsonville (Churton Park and Glenside) would likely prefer to utilise the Grenada interchange in an effort to avoid Johnsonville's CBD.

Other traffic movements at the Johnsonville interchange have continued to increase at an annual average rate of around 1.6%. Traffic modelling undertaken for this project applied a uniform 1% annual traffic growth rate.

Figure 9: Traffic volumes at the State Highway 1 Johnsonville Interchange



Data Source: NZ Transport Agency, State Highway AADT Data Booklet 2012–2016

Insufficient data exists to consider effects of bus journey times

Bus journey time data relating to the pre-construction period is not held by Greater Wellington Regional Council. It was therefore not possible to assess the impact of the project on bus journey times.

2. Project cost and timeframe

Construction of the project commenced in August 2014 and was substantially complete by September 2015, three months earlier than originally envisaged. Road surfacing works were completed however in February 2016 to tie in with Council's resurfacing programme.

In 2013 documentation submitted as part of the project funding application suggested an estimated 95th percentile physical works cost⁷ of \$10.9 million. The project was delivered for \$9.64 million, nearly \$1.3 million (13%) below funding budget.

3. Lessons learned

Lessons with relevance for other future projects were identified as follows:

Actual journey time data should be used to calibrate traffic model outputs. Project documentation stated that no formal speed surveys or journey time surveys were undertaken as part of project investigations. Had such data been collected and used to calibrate the traffic model, it is likely that the accuracy of modelling outputs would have aligned more closely with that actually achieved. In turn, this would have allowed more accurate information to influence project decisions.

Historical traffic growth trends should be considered when undertaking traffic modelling exercises. In this project a uniform annual growth rate of 1% was applied to future traffic predictions, in the case of the Johnsonville northbound off-ramp, traffic flows have been declining at an average rate of 2.6% per annum. While unlikely to have affected the project in this instance, traffic growth projections can influence design elements (particularly those relating to capacity) and delivery timing decisions.

The provision of infrastructure to support land development requires greater attention to timing. The delivery timing of this project was largely based on the expectation that construction of the Johnsonville Mall was imminent; due to the pending lapse date of the Mall's resource consent. Construction of the mall did not eventuate. While drivers for land development will include consideration of regulatory factors, other aspects (for example, economic factors) will also influence development timing.

⁷ The 95th percentile physical works cost estimate includes provision for known/unknown construction risks. This figure is used as the basis for calculating the project's benefit cost ratio, and the consideration of funding applications. See Cost Estimation Manual (SMO14) for more detail.

4. Wellington City Council response to findings

The following response was received from Wellington City Council:

“While Wellington City Council accepts the findings of the Post Implementation Review the project is still be seen as successful from the City’s perspective. The project is the first stage of transport improvements for the Triangle with further work required on Moorfield Road once the Mall is redeveloped. While the predicted economic and residential growth has not yet occurred, it is only a matter of time before these predictions are realised. The roading improvements put the network in a better position to respond to this growth.

While there is a heavy reliance on journey time savings and journey time reliability to achieve the benefits that underpin the project’s economics, there are other benefits that the project has delivered that are of an undeniable benefit in managing a complex urban roading network for all modes and which have not been evaluated. This is not surprising given the attributes that are valued in the economic assessment of roading projects. Other benefits this project has delivered are dedicated facilities for cycling that go beyond the cycle stop boxes mentioned in the report and future proofing of public transport routing in and around the Johnsonville Town Centre which was not possible before the work was carried out. This benefit for public transport will be realised when new routes are implemented in the middle of next year as part of the Wellington Bus Review carried out by the GWRC. In addition pedestrian phases were added to the traffic signals to recognise the desire of pedestrians for greater safety, convenience and accessibility in the town centre.

Equally, as identified in the report, adding traffic signals on Johnsonville Road at Fraser Ave on a route that predominantly carries traffic on the main road will always show negative benefits in terms of travel time efficiency. What is lost in this type of analysis is the benefit attributed to the safety and convenience of local traffic interacting with through traffic. In this project this was further complicated by having to accommodate a private access into the signal configuration. Even though the addition of this set of traffic signals initially generates a negative impact on the main flow, the signals themselves enable better coordination along the route to enable more efficient management of increasing volumes of traffic without further disbenefits. This is also reflected in the queuing on the off-ramp. Again it is pleasing to see this has not been negated by the installation of traffic signals and can be managed into the future.

All these additional amenities come at the cost of travel time efficiency but are necessary to provide a better level of service for all modes and to meet the expectations of the competing needs of the community. Perhaps in future these highly relevant factors which have clear road user and wider community benefits could be better analysed up front to recognise their value rather than the narrower approach taken to justify the pure economics of the project”.

5. Wellington Highway and Network Operations response to findings

The following response was received from Wellington Highway and Network Operations:

“Project staff that were directly involved in the planning and delivery of the Johnsonville Triangle Network Improvements project no longer work at the Transport Agency. It is therefore difficult to provide a detailed response to the report’s findings. We do however wish to comment that:

- Although this project was an NZTA led project, in conjunction with WCC, the majority of the works involved improvements to WCC infrastructure. Much of the project was designed to improve access and road safety in the area, particularly for vulnerable road users (pedestrians and cyclists);

- We accept that based on the limited data collected (and a vehicle breakdown further restricting the amount of data available) it is difficult to determine whether a significant change in queuing has occurred. We note that short-term variability in queuing would be expected in the post-construction period; and
- The review perhaps doesn't fully highlight some of the important improvements achieved as a result of the project – i.e. pedestrian and cycling improvements in the area plus the overall safety/access enhancements of implementing new signalised intersections”.

Appendix A – Detailed project scope

The breakdown below provides a more detailed overview of the project's scope than the project summary included in Section 1 of this report:

- provision of an additional lane on the State Highway 1 Johnsonville northbound off-ramp and new traffic lights at the intersection of Johnsonville Road and Fraser Avenue;
- upgrading the intersection of Johnsonville and Broderick roads;
- new traffic lights and signalised pedestrian crossing at the intersection of Broderick Road and Gothic Street;
- replacing the existing Broderick Road/Moorefield Road bridge over the railway lines with a new bridge that will be longer and one lane wider to future proof for potential double-tracking into Johnsonville Railway Station;
- improving the signalised pedestrian crossings on Johnsonville Road, and a new signalised pedestrian crossing to replace the zebra crossing on Broderick Road
- a new path for cyclists and pedestrians to by-pass the two northern roundabouts (at the intersection of Johnsonville and Moorefield roads and further north at the intersection of Ironside, Helston and Middleton roads);
- cycle stop boxes (waiting areas for cyclists) at intersections;
- better bus flow around the Johnsonville triangle (Johnsonville, Moorefield and Broderick roads), new bus stops on Johnsonville Road and upgraded bus shelters; and,
- real-time bus travel information.

Many of the network improvements are too nuanced to outline in detail, and as such reference is made to the project website (<http://nzta.govt.nz/projects/unlocking-the-johnsonville-triangle/> and <https://wellington.govt.nz/your-council/projects/johnsonville-projects/johnsonville-triangle-road-improvements>) which includes detailed scheme plans of the project.

Appendix B – Variance in pre-construction and post-construction journey times

Assessment Period	Route	Pre-Construction Journey Time (Average in Seconds)		Post-Construction Journey Time (Average in Seconds)	
		2013 do-nothing <u>expectation</u> (as per project documentation)	2013 do-nothing <u>actual</u> (as per TomTom data)	2013 built option <u>expectation</u> (as per project documentation)	2016 built option <u>actual</u> (as per TomTom data)
AM Peak	Southbound between Moorefield Road and Johnsonville Road (adjacent to Fraser Road intersection) via Johnsonville Road	180	210	105	232
PM Peak	Northbound between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Johnsonville Road	500	161	135	160
AM Peak	Eastbound between Moorefield Road and Johnsonville Road (adjacent to Fraser Road intersection) via Broderick Road	168	183	170	225
PM Peak	Westbound between Johnsonville Road (adjacent to Fraser Road intersection) and Moorefield Road via Broderick Road	185	161	160	140

Appendix C – Traffic queue survey data (collected by Wellington City Council)

Intersection Johnsonville / Fraser / Corlett (i=970)
Johnsonville Northbound Off Ramp Queueing
Week Before Signals Turned On

Leo / TK

	Queue beyond:	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	19:00				
	'Motorway Begins' sign																																						
Monday	'Newlands 1' gantry																																						
3.8.15	Newlands On-Ramp																																						
	'Motorway Begins' sign																																						
Tuesday	'Newlands 1' gantry																																						
4.8.15	Newlands On-Ramp																																						
	'Motorway Begins' sign																																						
Wednesday	'Newlands 1' gantry																																						
5.8.15	Newlands On-Ramp																																						
	'Motorway Begins' sign																																						
Thursday	'Newlands 1' gantry																																						
6.8.15	Newlands On-Ramp																																						
	'Motorway Begins' sign																																						
Friday	'Newlands 1' gantry																																						
7.8.15	Newlands On-Ramp																																						

■ No queue. Traffic free-flowing
■ Slow moving queue
■ Stationary queue
■ Data not collected
 * Breakdown blocking Off Ramp

Notes:

- 1 'Motorway Begins' sign is approximately 125m from Off Ramp limit line
- 2 'Newlands 1' gantry is approximately 340m from Off Ramp limit line
- 3 Newlands On-Ramp merge is approximately 720m from Off Ramp limit line
- 4 Above chart records snapshots only at the stated time.

Intersection Johnsonville / Fraser / Corlett (i=970)
Johnsonville Northbound Off Ramp Queueing
1st Week After Signals Turned On

Dan / TK

	Queue beyond:	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	19:00			
	'Motorway Begins' sign																																					
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Wednesday	'Newlands 1' gantry																																					
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Thursday	'Newlands 1' gantry																																					
17.9.15	Newlands On-Ramp																																					
	'Motorway Begins' sign																																					
Friday	'Newlands 1' gantry																																					
18.9.15	Newlands On-Ramp																																					

■ No queue. Traffic free-flowing
■ Slow moving queue
■ Stationary queue
■ Data not collected

Notes:

- 1 'Motorway Begins' sign is approximately 125m from Off Ramp limit line
- 2 'Newlands 1' gantry is approximately 340m from Off Ramp limit line
- 3 Newlands On-Ramp merge is approximately 720m from Off Ramp limit line
- 4 Above chart records snapshots only at the stated time.

Intersection Johnsonville / Fraser / Corlett (i=970)
Johnsonville Northbound Off Ramp Queueing
2nd Week After Signals Turned On

TK

Queue beyond:		7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:30	10:00	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	19:00				
	Tip of "Gore Zone"																																					
Monday	'Newlands 1' gantry																																					
21.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Tuesday	'Newlands 1' gantry																																					
22.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Wednesday	'Newlands 1' gantry																																					
23.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Thursday	'Newlands 1' gantry																																					
24.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Friday	'Newlands 1' gantry																																					
25.9.15	Newlands On-Ramp																																					

Legend:
 No queue. Traffic free-flowing
 Slow moving queue
 Stationary queue
 Data not collected

Notes:
 1 Tip of "Gore Zone" is approximately 200m from Off Ramp limit line
 2 'Newlands 1' gantry is approximately 340m from Off Ramp limit line
 3 Newlands On-Ramp merge is approximately 720m from Off Ramp limit line
 4 Above chart records snapshots only at the stated time.

Intersection Johnsonville / Fraser / Corlett (i=970)
Johnsonville Northbound Off Ramp Queueing
3rd Week After Signals Turned On

TK

Queue beyond:		7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:30	10:00	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	19:00				
	Tip of "Gore Zone"																																					
Monday	'Newlands 1' gantry																																					
28.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Tuesday	'Newlands 1' gantry																																					
29.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Wednesday	'Newlands 1' gantry																																					
30.9.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Thursday	'Newlands 1' gantry																																					
1.10.15	Newlands On-Ramp																																					
	Tip of "Gore Zone"																																					
Friday	'Newlands 1' gantry																																					
2.10.15	Newlands On-Ramp																																					

Legend:
 No queue. Traffic free-flowing
 Slow moving queue
 Stationary queue
 Data not collected
 * denotes estimated only

Notes:
 1 Tip of "Gore Zone" is approximately 200m from Off Ramp limit line
 2 'Newlands 1' gantry is approximately 340m from Off Ramp limit line
 3 Newlands On-Ramp merge is approximately 720m from Off Ramp limit line
 4 Above chart records snapshots only at the stated time.

