ŌTAKI TO NORTH OF LEVIN PFRs

Report No. 10: SH57 / Queen Street East Intersection

Prepared for NZ Transport Agency

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QUALITY STATEMENT

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Executive Summary

This Project Feasibility Report (PFR) is one of a number of reports being undertaken to determine the package of improvements that should be implemented in the short to medium term to improve the safety and efficiency of the highway between Ōtaki and north of Levin as part of the Wellington Northern Corridor Road of National Significance (RoNS).

The purpose of this report is to determine the feasibility of options to improve the connection between State Highway 57 and Queen Street East, east of Levin.

The current intersection arrangement is a priority controlled cross roads intersection with significant turning volumes between the Queen Street East (Levin) leg and the SH57 north leg.

A roundabout option at the intersection was the only option considered. A cost estimate was undertaken together with an economic assessment to determine the Benefit-Cost Ratio.

A summary of the economic analysis is shown below.

Option Summary

Option Description	Capital Costs	NPV Benefits	Benefit Cost Ratio
Option 10-1 – Queen St East: 48 m diameter roundabout	$3.96M	-$1.79M	**Less than zero**

The BCR for this option was less than zero due to the high vehicle operating costs surpassing any crash savings. From an economic assessment perspective, the roundabout option is currently not feasible, but the remaining high crash rating is noted.

However, should consideration be given to the provision of passing lanes, inclusive of WRB along this length of SH57 to the north and south of Queen Street East, then a roundabout would provide a turning facility at the end(s) of the WRB in this location.

There is potential to use SH57 as a Heavy Vehicle Bypass of Levin which would direct heavy vehicles through the proposed roundabout. Should this eventuate the travel time, VOC and CO2 disbenefits would further disadvantage the proposed roundabout.

A sensitivity assessment has been undertaken to assess the likely crash numbers required to correspond to a BCR of 1.0. Given the calculated construction costs and the travel time and VOC and CO2 disbenefits to achieve a BCR of 1.0, the crashes at this site would require:

3 additional fatal crashes, invalidating the EEM's fatal/serious adjustment creating a BCR of 6.7; or
A mixture of 4 additional fatal or serious injury crashes with no more than 2 fatal crashes creating a BCR of 1.6; or
3 additional fatal or serious injury crashes with no more than 2 fatal and a minor injury crash creating a BCR of 1.05; or
24 additional minor injury crashes; or
50 additional non-injury crashes.

It is nevertheless recommended that the roundabout continue to be considered as part of the overall short, medium and long term strategy for Ōtaki to Levin, and be considered as part of the overall Ōtaki to North of Levin Safety Improvements package.

NZ Transport Agency

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1 Introduction and Background

Using the outcomes of the Ōtaki to North of Levin Scoping Report and addendum, the NZTA determined that the most appropriate strategy for the highway between Ōtaki and north of Levin is to upgrade the existing highways as the first stage of a long term strategy. This allows the NZTA to realise important safety benefits in the short to medium term whilst deferring the need to construct four lanes for the time being.

This Project Feasibility Report (PFR) is one of a number of reports being undertaken to determine the package of improvements that should be implemented to improve the safety and efficiency of the highway between Ōtaki and north of Levin as part of the Wellington Northern Corridor Road of National Significance (RoNS).

The objectives of the Wellington Northern Corridor RoNS, which runs from Wellington Airport to north of Levin, are:

- To enhance inter regional and national economic growth and productivity;
- To improve access to Wellington's CBD, key industrial and employment centres, port, airport and hospital;
- To provide relief from severe congestion on the state highway and local road networks;
- To improve the journey time reliability of travel on the section of SH1 between Levin and the Wellington Airport; and
- To improve the safety of travel on state highways

For the Ōtaki to north of Levin section; the objectives are:

- To provide best value solutions which will progressively meet (via a staged approach) the long term RoNS goals for this corridor of achieving a high quality four lane route;
- To provide better Levels of Service, particularly for journey time and safety, between north of Ōtaki and north of Levin;
- To remove or improve at-grade intersections between north of Ōtaki and north of Levin;
- To engage effectively with key stakeholders; and
- To lodge Notices of Requirement and resource consents as appropriate with the relevant consent authorities for the first individual project by the 2013/14 financial year.

The projects that are being developed to help meet these objectives are presented in Section 2.

The purpose of this report is to determine the feasibility of undertaking improvements to aid road safety and traffic flow at and near the intersection of State Highway 57 (SH57) and Queen Street East to the east of Levin.

The geographical extent of this project includes the intersections of SH57 / Queen Street East and SH57 / Meadowvale Drive, which are just over 500 m apart. The analysis of crashes includes those within 250 m of the intersections as is the usual case for rural highways, but also includes consideration of the alternative local route bearing in mind the rerouting arising if partial closure of the SH57 / Meadowvale Drive intersection should eventuate.

The outcome of this PFR will be considered alongside the outcomes of the other PFRs and used to determine the best package of works to progress as the first stage of the long term strategy.

2 Projects Currently Being Investigated

The projects that are currently being investigated to meet the short to medium term objectives of the Ōtaki to north of Levin RoNS project are presented in the figure below.

Figure 2-1: Projects Currently Being Investigated

In addition to the above PFRs, reports are also being undertaken on Route Improvements (i.e. edge treatments, passing lanes, seal width, walking and cycling, side friction etc.; Report No. 11) and on Four Lane Alignments (Report No. 12).

3 Description of Problem

3.1 Ōtaki to North of Levin

State Highway 1 and State Highway 57 through the study area have a number of deficiencies, resulting in a poor crash history and a number of locations where the free flow of vehicles is restricted by the tight physical characteristics of the highway.

State Highway 1 currently follows the historic route established in the late 19th and early 20th centuries. As a consequence it is constrained by a now substandard alignment, towns and settlements, narrow curved bridges and significant side friction caused by local roads, commercial frontages and property accesses for the entire stretch.

3.2 State Highway 57 / Queen Street East

The section of SH57 to the north and south of the intersection with Queen Street East has had eleven crashes in the latest five year period incorporating one fatality, one serious injury crash, 4 minor injury crashes and five non-injury crashes.

The intersection has significant volumes of conflicting traffic movements, specifically the right turn movement from SH57 into Queen Street East travelling towards Levin conflicting with northbound SH57 traffic.

The main safety and geometric deficiencies for the SH57 / Queen Street East intersection and the SH57 / Meadowvale Drive intersection are that they are priority controlled crossroads and T intersection layouts respectively in an open road speed limit (100 km/h) environment.

These deficiencies are considered to have contributed to the poor safety record at both intersections and cause traffic delays.

4 Site Description

The project area consists primarily of two key intersections. These are the SH57 / Queen Street East intersection east of Levin (RP 0/5.585) and the SH57 / Meadowvale Drive intersection (RP 0/5.07) located approximately 500 m to the south of Queen Street East.

The SH57 / Queen Street East intersection incorporates right turn bays on SH57 and left turn lanes which are separated from the SH57 through traffic by a flush painted island. There are central splitter islands provided on both the Queen Street East approaches to the intersection and the left turn movement from Queen Street East (Levin) has a separate left turn lane (segregated by a grassed traffic island) which turns into its own acceleration lane prior to merging with the northbound SH57 traffic.

The SH57 / Meadowvale Drive intersection has a right turn bay and there is short left turn lane for northbound SH57 traffic. Meadowvale Drive has a splitter island on the approach to SH57.

The western side of SH57 consists of residential housing (mainly separated with a buffer zone), while the eastern side is currently farmland. Meadowvale Drive is the only side road on SH57 between Queen Street East and Tararua Road. There is only one driveway off the same section which is to a residential property (which also has alternative access to the road network via Weld Street) and a field (which has no alternate access) approximately 100 m south of the start of the left turn bay for Queen Street East. The empty field is on a separate title which currently has a designated crossing place (CP32) to SH57.

The Horowhenua District Plan includes an operative 100 m widening designation along the eastern side of SH57. The large block of farmland bordered by SH57, Queen Street East, Tararua Road and Gladstone Road is an area of change for future residential development. However this is considered unlikely to occur in the short to medium term.

Figure 4-1 below shows the study location.

Figure 4-1: Study Area Location Map

5 Traffic Statistics

5.1 Daily flows and future traffic growth

The Annual Average Daily Traffic (AADT) flow for 2011 at the NZTA single loop count site on SH57 at Kimberley Road (ID: 057000002, RP 0/1.8) was 4,500 vehicles per day (vpd), 2011, with the proportion of Heavy Commercial Vehicles (HCVs) at 11% (506).

The AADT at the Arapaepae Road single loop site south of Tavistock Road (ID: 057000010, RP 0/9.6) was 7,800 vpd, 2011, with the proportion of HCVs at 9% (708).

The traffic growth rate at the count sites are calculated to be 2.0% and 2.3%, using data from 1992 to 2011. Volumes typically increased from 1992 to 2005; however since then volumes have remained generally stable. The traffic growth rate at the count sites using data from 2001 to 2011 are thus lower, calculated to be 0.7% and 1.0%. However, the calculated traffic growth rate for the past three years 2009 – 2011 is 1.9%.

The 2001 - 2011 growth rates are more consistent with those derived from the North of Ōtaki to North of Levin SATURN model for the 2011, 2016 and 2041 periods. This model made the realistic assumption that the large parcel of land bounded by SH57, Queen Street East, Tararua Road and Gladstone Road earmarked for future residential development will basically not proceed in the modelled time periods, there being sufficient supply of residential land closer to Levin to meet current foreseen demand.

The lower growth rates over the past ten years are considered to have been due in part to the global financial crisis and it is considered that long term growth rates are likely to be slightly higher when considering a 30 year analysis period. As a result the growth rate that has been adopted for this analysis is 1.3%.

The Ōtaki to north of Levin SATURN base network model outputs[1] show the intersection Level of Service (LoS) for the AM and PM Peak and inter-peak periods for both 2011 and 2041 being A/B.

As the NZTA permanent count stations are not in close proximity to the intersection

Based on the surveyed weekday morning, midday and evening peaks undertaken previously (refer Appendix B) the estimated AADTs (2011) for SH57 are:

SH57 Arapaepae Road north of Queen Street East: 8,460 vpd

SH57 Arapaepae Road south of Queen Street East: 5,360 vpd

Side road traffic daily volumes were estimated (from RAMM) as follows:

Queen Street East (Levin): 5,220 vpd

Queen Street East (Gladstone): 1,420 vpd

Meadowvale Drive (west of SH57): 850 vpd

This shows that Queen Street East west of SH57 carries similar traffic volumes to SH57 south of Queen Street East.

5.2 Existing intersection traffic flows

For the PM peak hour, approximately 48 per cent of the traffic is through traffic along SH57 while a comparatively high 33 per cent relates to the traffic travelling between Levin and Shannon via Queen Street East. The remaining 19 per cent relates to other turning traffic.

Further traffic information can be found in Appendix B. For the SIDRA output and traffic lane data refer to Appendix F.

6 Crash History

6.1 Crash Data

A review of NZTA's CAS database over the five year period from July 2007 to June 2012 revealed a total of 11 crashes along the 1 km section of SH57 from 250 m north of Queen Street East to 250 m south of Meadowvale Drive and including crashes on the side roads within 50 m of SH57.

There was one fatality which involved an intoxicated pedestrian wearing dark clothing who was hit at 1:30am and there was one serious injury crash which involved a northbound motorcyclist on SH57 who collided with a car which had turned out in front of him from the eastern Queen Street East approach. The remaining nine crashes were four minor injury and five non-injury crashes. One of these non-injury crashes occurred near SH57 / Meadowvale Drive.

The following tables provide a summary of the CAS output data, Intersections sites include crashes which occurred within 50 m.

[1] Refer Otaki to north of Levin Scoping Report

Table 6-1: Annual Distribution of Crashes At SH57 / Queen Street East

Year	Fatal	Serious	Minor	Non-Injury	Total	DSI
July - Dec 2007	-	-	-	1	**1**	-
2008	-	-	1	1	**2**	-
2009	-	1	-	-	**1**	1
2010	-	-	1	-	**1**	-
2011	-	-	-	-	**-**	-
Jan – June 2012	-	-	1	-	**1**	-
Total	**-**	**1**	**3**	**2**	**6**	**1**

* Death and Serious injury casualties.

The serious injury crash involved a car turning right out of Queen Street East (south east approach) failing to see a northbound motorcyclist on a winter evening (Friday at 6:50 pm) who hit the car and was seriously injured. The remaining five crashes were three minor injury and two non-injury crashes.

Table 6-2: Annual Distribution of Crashes: At or within 50 m of SH57 / Meadowvale Drive

Year	Fatal	Serious	Minor	Non-Injury	Total	DSI
July - Dec 2007	-	-	-	-	**-**	-
2008	-	-	-	-	**-**	-
2009	-	-	-	-	**-**	-
2010	-	-	-	-	**-**	-
2011	-	-	-	1	**1**	-
Jan – June 2012	-	-	-	-	**-**	-
Total	**-**	**-**	**-**	**1**	**1**	**-**

* Death and Serious injury casualties.

For the same five year period there was only one (non-injury) crash reported on SH57 Arapaepae Road within 50 m of Meadowvale Drive. The single non-injury crash involved a southbound car hitting a car making a U-turn in the same direction on a bright fine day.

Table 6-3: Annual Distribution of Crashes: SH57: 250 m north of Queen Street East to 250m south of Meadowvale Drive excluding the intersections above

Year	Fatal	Serious	Minor	Non-Injury	Total	DSI
July - Dec 2007	-	-	1	-	**1**	-
2008	-	-	-	-	**-**	-
2009	1	-	-	-	**1**	1
2010	-	-	-	-	**-**	-
2011	-	-	-	-	**-**	-
Jan – June 2012	-	-	-	2	**2**	-
Total	**1**	**-**	**1**	**2**	**4**	**1**

* Death and Serious injury casualties.

The fatal crash occurred on New Year's Day 2009 involving an intoxicated pedestrian wearing dark clothing who was walking along SH57 at 1:30 am north of Queen Street East and was hit by a northbound car. The remaining three crashes were one minor injury and two non-injury crashes.

The following two tables outline the crash types at the two intersections (SH57/Queen Street East and SH57/Meadowvale Drive) being considered.

Table 6-4: CAS Crash Type – SH57 / Queen Street East Intersection

Crash Type	Number of Reported Injury Crashes	Percentage of Reported Injury Crashes
Crossing / Turning	4	100%
Total	**4**	**100%**

Table 6-5: HRIG Injury Crash Types – SH57 / Queen Street East

Crash Type	Number of Reported Injury Crashes	Percentage of Reported Injury Crashes
Crossing no turning (H Type)	2	50%
Right turn against (L Type)	2	50%
Total	**4**	**100%**

The right turn against crashes of which there are two, both occur on SH57 and involve one crash from each direction on SH57 turning into the respective Queen Street East side road approach.

Table 6-6: HRRRG[2] Crash Type

Crash Type	Number of Reported Crashes	DSI	Percentage of Reported Crashes
Head on	-	-	0%
Run off Road	3	-	27%
Intersection Crashes	7	1	55%
Other	2	1	18%
Total	**11**	**2**	**100%**

The crashes classified as 'Other' above include one pedestrian being hit at night whilst walking along the road, the other crashes was a vehicle overtaking a right turning car.

[2] High Risk Rural Roads Guide (HRRRG), NZTA, September 2011

Table 6-7: Crash Causation Factors of Reported Injury and Non-Injury Crashes

Causation	Number of Reported Injury Crash Causation Factors	Number of Reported Non-Injury Crash Causation Factors
Alcohol	1	-
Too fast	-	-
Failed to give way/stop	4	3
Overtaking	1	-
Incorrect lane/position	1	-
Poor handling	1	2
Poor observation	3	-
Poor judgement	-	4
Fatigue	-	-
Pedestrian factors	1	-
Vehicle factors	-	1
Road factors	-	1
Weather	-	-
Other	1	2

Table 6-8: Environmental Factors (all crashes)

	Wet	Dry		Night	Day		Weekend (Fri 6:00PM to Monday 5:59AM)	Weekday
No.	1	10		2	9		4	7
%	9%	91%		18%	82%		36%	64%

Of the crashes occurring at and between the two respective intersections:

None were fatal, one was serious, three were minor injury and three were non-injury crashes. The serious crash occurred at Queen Street East, involving a car driver turning right out of Queen Street East (south east approach) intending to travel north and failing to see a northbound motorcyclist on a winter evening (Friday at 6:50 pm).

A motorist turning right out of Queen Street East (south east Gladstone approach) intending to travel north failed to give way to a southbound car, resulting in a minor injury. A similar non-injury crash occurred.

The other two minor injury crashes involved a car driver travelling east along Queen Street East hitting a northbound car during fine weather (around 4 pm on a weekday).

The main crash causation factor was failed to give way/stop, along with poor observation, poor judgement, and poor road handling in one case.

The one non-injury crash involving loss of control which occurred 100m north of Queen Street East happened whilst the road surface was under construction or maintenance as the road surface was identified as being uneven.

Further crash data can be found in Appendix C.

6.2 Crash Risk

This section of SH57 has been analysed using the High Risk Intersection Guide (HRIG), to calculate crash risk at this intersections of SH57 / Queen Street East, SH57 / Meadowvale Drive has not been assessed as there have been no injury crashes within the last 5 years. Addition, as the project area is

only 1 km in length, it has been determined too short to analyse using the High-Risk Rural Roads Guide (HRRRG).

HRIG identifies that crash risk can be defined in two specific ways:

> Collective Risk, also known as Crash Density, is measured as the number of fatal and serious (F&S) crashes per intersection in a crash period
>
> Personal risk or crash rate is measured in terms of the number of F&S crashes per 100 million vehicles using an intersection

6.2.1 Crash Risk: SH1/57 Intersection

In terms of collective crash risk for the intersection of SH57/Queen Street East, there are two methods of calculation

> Reported F&S Crashes: Over the 5 year assessment period: there have been one F&S crashes
>
> Estimated F&S Crashes: The second method involves the estimation of F&S crashes that have occurred at an intersection using all injury crashes that have occurred during the crash period. This method take into account the crash movement type, intersection form and control, and collision speed on crash severity outcomes. The estimated collective crash risk is calculated at 1.28 F&S crashes for a 5 year period. This is presented in the table below:

Table 6-9: Estimation of F&S Collective Risk Using Severity Index SH57 / Queen Street East Intersection

Crash Type	Number of Reported Injury Crashes	Adjusted F&S crashes / All injury crashes[3]	Estimated Number of F&S Injury Crashes
Crossing	2	0.34	0.68
Right Turning	2	0.30	0.60
Total	**9**		**1.28**

To be classified as high-risk, an intersection must have a medium high or high collective risk level or a medium high or high personal risk level. As tabled above, the Queen Street East stop controlled cross roads intersection is classified as medium high for both risk levels and is thus considered to be high-risk.

This is consistent with it having a Level of Safety Service (LoSS) rating of IV.

There was one F&S crash at the Queen Street East intersection and with an estimated 1.28 F&S crashes in five years it has a medium high (1.2-1.6) collective risk level. In terms of personal risk it is also classed as medium high, while in terms of the Level of Safety Service (which is based on injury crashes) it is LoSS IV (refer HRIG Figure A5-7 for rural priority controlled crossroad intersections).

With no severe or injury crashes, by necessity the Meadowvale Drive intersection has not been assessed. Therefore the Meadowvale Drive intersection if assessed would be LoSS I with a low risk level.

7 Alternatives and Options considered

One option, which changes the SH57 / Queen Street East intersection form, has been considered in detail.

The Do Minimum has been assumed to be the continued maintenance and operation of the existing stop controlled intersections and current layout.

Option 10-1 Roundabout – This option involves replacing the current rural cross road junction with a four leg roundabout.

[3] HRIG, Table 8.10

7.1 Discarded Options

The option of closing the SH57 / Meadowvale Drive intersection has not been assessed although it is a possibility. Likewise the option of upgrading this intersection to a roundabout has not been included since the volume of turning movements is low and a roundabout would unduly delay the overwhelming majority of SH57 through traffic.

Grade separation of the SH57 / Queen Street East intersection has been excluded as the cost of grade separation has been estimated based on similar projects to be around $15 to $20 million dollars and so would be prohibitive given the low traffic volumes.

The current intersection is well laid out and other than the pedestrian and cyclist facilities discussed in section 7.3 below, it is considered that no further minor safety improvements are necessary at this time.

7.2 Option 10-1: Roundabout

This option involves construction of a roundabout with a 48 metre diameter central island and two through lanes for SH57 traffic. Included in this option is the compatibility with a potential northbound passing lane immediately north of Queen Street East and a southbound passing lane immediately south of Queen Street East. A roundabout would help facilitate the introduction of passing lanes along this part of SH57 and would also facilitate U-turns should a wire rope median barrier be installed as is desirable for new passing lanes on highways.

Refer to Appendix D for the outline plan drawing.

With respect to the SH57 / Meadowvale Drive intersection, this option restricts the right turn movements and converts it to a left in left out (LILO) intersection.

With respect to motorists turning right out of Meadowvale Drive who could then no longer do so with Meadowvale converted to a LILO intersection, the proposed roundabout at Queen Street East would enable these motorists to travel southbound on SH57 (after completing a U-turn at the proposed roundabout). Similarly for those motorists who would previously turn right into Meadowvale Drive, this manoeuvre would be undertaken at the proposed roundabout at Queen Street East with access to Meadowvale Drive via the local road network.

7.3 Other Aspects

Consideration could be given to the provision of pedestrian and cyclist facilities to better define the route across SH57 from one side of Queen Street East to the other. It is understood that there is current demand for this as pedestrians and cyclists access the walking tracks in the foothills of the Tararua Ranges. There is a current demand for pedestrian and cyclist facilities to provide safer access across SH57 to cater for pedestrian cyclist movement along Queen Street East to the walking tracks available in the foothills of the Tararua Ranges on the eastern side of SH57.

Given the high traffic flow between Queen Street East (Levin) and SH57 north of the intersection, consideration could be given to the inclusion of a separate left turn slip lane at the proposed roundabout at the SAR stage.

8 Design Statement

This project is at a feasibility stage, and therefore several assumptions have been made in the design.

8.1 Roundabout design

The design assumptions include the following:

The minimum size central island diameter is 48 metres (in line with Austroads Guide to Road Design Part 4B: Roundabouts)

Four metre wide entry lanes

Kerb and channel, lighting, positive drainage

Given the existing terrain, there are no topography restrictions hindering sight visibility

There are no special requirements provided in the design at this concept stage to specifically cater for pedestrians or cyclists. This would be addressed at the SAR stage.

The approach speed has been estimated to be 100 km/h along SH57.

8.2 Costing

The design assumptions include the following:

The cost estimate (refer to Appendix E) has been based on the judgement of an engineer who has knowledge of the site.

The cost estimate has been based on the assumption that the project can be built using proven technology.

No adverse ground conditions are encountered (e.g. contaminated material).

Regrading the carriageway would not be required but new surfacing would be laid across the entire width and length of the project.

No median or roadside barriers are required.

Some drainage provision has been included (subsoil drains, sumps, culverts, headwalls) within the cost estimation but this is estimated based purely on the judgement of a drainage engineer.

A structural asphalt pavement, with stone mastic asphalt surfacing will be required for constructing the roundabout circulating carriageway and approaches.

The costs exclude the separate cost of potentially introducing passing lanes.

9 Traffic Modelling

9.1 Assessment procedure

SIDRA version 5.1.12 was used to assess the performance of the existing intersections and proposed modifications.

The critical gap and follow up headways were set at the default values given in the EEM for stop controlled intersections on higher speed roads. The values for the northbound merge, included to enable a better comparison with the option, were set at the SIDRA default values based on the Austroads guide, namely 3.0 second critical gap and 2.0 second follow-up.

The left turn radii were entered and for the roundabout the entry angles and radii were also entered based on the concept 52 m diameter central island roundabout. A check was made of the difference in outputs for a 48 m diameter central island roundabout which indicated negligible differences.

The peak flow factors for the AM and PM peak hours were based on those observed for the turning surveys and 15 minute peak flow period. For the inter-peak hour, taken as 11 am – 12 pm consistent with the previous studies, a 15 minute peak flow period was also assumed with the peak flow factor set as 90 per cent for all movements.

The light and heavy vehicle flows were entered rounded to the nearest 5 vph, with the model setting changed to include the effect of all heavy vehicles. Lane widths were left at the default 3.3 m except for the roundabout approach lanes which were set at 4.0 m.

Refer to Appendix F for the SIDRA output data.

9.2 2011 Performance

The summary of the SIDRA results for each intersection and time period for both the do minimum and the option are given in the table below.

Table 9-1: SH57 / Queen Street East and SH 57 / Meadowvale Drive current performance (2011)

Period	Option	Vehicles	Level of	Veh-hrs	Geom.	Fuel	Worst delay
		vph (%HV)	Service*	per hour	sec/veh	litres/hr	(volume/capacity)
Queen Street East			**Overall LoS**				
2011 AM	Existing	852 (8.3%)	A to C	2.12	7.0	88.9	
	Roundabout	897** (8.6%)	B	2.95	11.2	116.4	
2011 IP	Existing	683 (8.1%)	A & B	1.40	6.1	74.1	
	Roundabout	694 (8.0%)	B	2.16	10.8	95.6	
2011 PM	Existing	967 (7.1%)	A to C	2.29	6.3	103.6	28 sec/veh (0.28)
	Roundabout	1007 (6.8%)	B	3.18	10.8	133.6	20 sec/veh (0.15)
Meadowvale Drive			**Right Turn out LoS**				
2011 AM	Existing	475 (8.6%)	C	0.44	3.0	47.7	
	LILO	432 (8.2%)	n/a	0.21	1.6	43.1	
2011 IP	Existing	383 (10.1%)	B	0.19	1.7	41.2	
	LILO	372 (10.4%)	n/a	0.12	1.1	40.0	
2011 PM	Existing	571 (6.7%)	C	0.42	2.2	54.2	18 sec/veh (0.07)
	LILO	526 (7.3%)	n/a	0.20	1.3	49.4	

*The level of service (LoS) excludes the minor approach movements that typically operate at a lower LoS for the existing Queen Street East intersection. The LoS for the roundabout is that for the whole intersection.

**Roundabout traffic movements are higher to account for the transfer of right turn (U-turn) movements from Meadowvale Drive.

The above results indicate that the worst period is the PM peak but that the intersections currently operate with reasonably low delays (which include the geometric delay component of needing to slow down to stop or turn before accelerating back to the desired 50 or 100 km/h exit cruise speed).

In all cases the roundabout does not perform as well overall as the existing intersection, due to the need for almost half the traffic that currently does not need to stop, having to slow down from 100 km/h to negotiate the roundabout.

The apparent slight saving in overall delay from converting the Meadowvale Drive T intersection to Left in Left out (LILO) does not compensate for the increased delay at the roundabout. In any event the additional travel time for the traffic turning right at the Meadowvale Drive intersection has not been included and might be expected to be comparable to the slight apparent saving in delay at Meadowvale Drive.

9.3 2041 Performance

The adopted traffic growth rate was 1.2% per annum as discussed in Section 5.1 due to the lower growth rates over the past ten years considered to have been due in part to the global financial crisis. It is considered that long term growth rates are likely to be slightly higher when considering a 30 year analysis period. This was applied to all movements although it would also be reasonable to assume that a lower rate applies to the side road movements. With a 30 year design horizon, 36% was applied to all the traffic flows.

In terms of the expected future performance, the roundabout still results in more overall delay than the existing intersection; even though the side road movements delay for the existing layout almost reach one minute for the weekday peak.

The exception is for the 2041 Friday PM peak for which 54% growth was applied to the current SH57 through movements and 36% to all other movements. The additional through traffic along SH57 results in increased delay to the side road traffic for the existing intersection layout, with the Queen Street East (Levin) through and right turn delays potentially increasing to about 82 seconds per vehicle but with the degree of saturation (volume/capacity ratio) still below the usual practical level of 0.80 and with only about 100 vehicles per hour affected. For the less than 60 vehicles per hour (one vehicle per minute) on the Queen Street East (Gladstone) approach wishing to turn right or proceed straight ahead, the delay is less than a minute. However the small amount of long term travel time benefit (-12%) for the roundabout during the Friday PM peak is likely to be offset by the additional vehicle operating costs (+30%).

Table 9-2: SH57 / Queen Street East and SH 57 / Meadowvale Drive future performance (2041)

Period	Option	Vehicles	Level of	Veh-hrs	Geom.	Fuel	Worst delay
		vph (%HV)	Service	per hour	sec/veh	litres/hr	(volume/capacity)
Queen Street East			**Main LoS**				
2041 AM	Existing	1158 (8.3%)	A to C	3.62	7.0	122.2	40 sec/veh (0.49)
	Roundabout	1220 (8.6%)	B	4.10	11.2	160.0	21 sec/veh (0.18)
2041 IP	Existing	929 (8.1%)	A to C	2.12	6.1	101.2	27 sec/veh (0.22)
	Roundabout	944 (8.0%)	B	2.98	10.8	131.1	20 sec/veh (0.15)
2041 PM	Existing	1316 (7.1%)	A to C	2.29	6.3	103.6	59 sec/veh (0.65)
	Roundabout	1369 (6.8%)	B	4.43	10.8	183.6	21 sec/veh (0.21)
2041 Fri PM	Existing	1395 (7.1%)	A to C	5.36	5.9	152.1	82 sec/veh (0.79)
	Roundabout	1448 (6.8%)	B	4.70	10.8	196.5	21 sec/veh (0.21)
Meadowvale Drive			**Right turn out LoS**				
2041 PM	Existing	776 (6.7%)	C	0.64	2.2	73.8	24 sec/veh (0.16)
	LILO	716 (7.3%)	n/a	0.27	1.3	67.2	

Based on the above, it is clear that upgrading the present intersection to a roundabout is not warranted on the basis of traffic delay either now or within the 30 year timeframe.

9.4 Crash performance

The HRIG identifies the Queen Street East Intersection with SH57 as a high risk intersection with medium high personal and collective risk. Based on the crash history, this intersection has approximately $450,000 per year crash costs.

As intersection delays increase the typical pattern is for drivers to take greater risk which will progressively increase conflict, with crashes increasing.

10 Cost Estimates

The expected and 95th percentile estimates for the roundabout option are detailed in Table 10-1 below.

Table 10-1 : Cost Estimate

Option Description	Expected Estimate	95th Percentile Estimate
Option 10-1 – Queen St East: 48 m dia roundabout	$3.97M	$5.08M

The cost estimate for the roundabout option has been calculated using a concept layout and with no survey data, and is based on the design statement assumptions as listed above. The cost estimate is provided in Appendix E.

Property costs have been included in the option cost estimation based upon information provided by NZTA to MWH in 2011[4]. These figures are calculated considering land use and zoning and applying a broad land value rate to the areas required for the improvements.

11 Economic Assessment and Risk Assessment

11.1 Basis of Economic Analysis

Economic analysis was carried out in accordance with NZTA's Economic Evaluation Manual (EEM) using a modified version of the full procedures.

The intersection modelling software, SIDRA, was used to model the existing cross roads intersection using 2011 traffic counts to model for 2011 and 2041 time periods. SIDRA models were also constructed for the proposed roundabout at Queen Street East and the LILO at Meadowvale Drive.

The following assumptions have been made in the calculation of the Benefit Cost Ratio. They are:

1. The base year is 2011 (given date of traffic counts) and time zero is 2013.
2. Time zero (2013) AADT are calculated as:
    a. SH57 Arapaepae Road north of Queen Street East – 8460 vpd,
    b. SH57 Arapaepae Road south of Queen Street East – 5360 vpd,
    c. Queen Street East (Levin) – 5220 vpd,
    d. Queen Street East (Gladstone) – 1420 vpd.
3. A composite annual traffic growth is estimated as 1.3% (refer to Section 5.1) using the EEM standard regional (Manawatu-Wanganui) rural strategic traffic growth figure rate (used, as 3 count locations have different growth rates over the period 1992-2011)
4. The crash analysis has been undertaken for the five year period July 2007 – June 2012 and considers the following:
    a. The current accident costs were calculated using Method C of the EEM as there are less than five injury crashes or two fatal and serious injury crashes occurring at the intersection.
        i. General model (7) high speed cross and T-intersections was used for this analysis using the cross road priority values for b_0, b_1, and b_2.
            1. This model was used to simplify the assessment at this early stage of the project.
            2. Typically this model would not be used as there is greater than 25% difference in major and minor approach flows and caution should be noted around the results as they are outside the bounds of confidence.
            3. The average of the major approaches and minor approaches were used in the model for traffic volumes when major and minor flows were required.

[4] Email provided from Mitchell Cocking (NZTA) to Marten Oppenhuis (MWH) on 12 August 2011

ii. This was weighted using the four injury crashes that occurred 'at' the proposed roundabout site over the five year crash history.

iii. Injury crash costs were taken from Table A6.22 as Intersection Priority (X) 100km/h near rural.

b. The future accident costs were calculated using Method B of the EEM as the roundabout represents a fundamental change to the intersection type.

i. Conflict model (8) high speed roundabout was used to assess the crash numbers.

ii. Injury crash costs were taken from Table A6.22 as Intersection Roundabout 100 km/h near rural.

c. No calculations of the accident cost benefits of closing Meadowvale Drive were calculated because no injury crashes have occurred at this intersection in the analysis period.

d. Traffic growth of 1.3% and a posted speed limit of 100 km/h.

11.2 Travel Time Analysis

The travel time is derived by utilising 2-lane rural road travel time analysis with free speed, and then the link travel time is combined with the volume and cost per km for the route to derive the travel time cost (TTC). As the option directly relates to a different form of intersection control, SIDRA has also been used to calculate intersection delays for the existing and proposed intersection arrangement. This figure is then combined with the travel time for the remainder of the route and TTCs calculated for the option.

The expected travel time cost benefits are shown in Table 11-1 below.

Table 11-1: Travel Time Cost Benefits

Option	Travel Time Cost Benefits (NPV)
Option 1 – Roundabout	-$735,000

As there is currently little delay for the higher volume turning movements at this intersection, the benefits of easily turning right with a roundabout at this location are outweighed by the resulting increase in delays for the State Highway through traffic, which previously travelled through the intersection unimpeded. This also has resulted in increased vehicle operating costs and CO2, see Table 11-2 below.

11.3 Vehicle Operating Cost

Using the travel time data, vehicle operating costs (VOC) are calculated using the rural strategic standard traffic composition for all periods (as per Table A2.3). An allowance has also been made for an improvement in roughness as part of the new pavement construction (assumed existing situation has a roughness of 3.2 IRI and the new construction would be 2.5 IRI). Carbon dioxide emission cost benefit savings are also calculated using the VOC data.

The expected VOC and CO2 cost benefits are shown in Table 11-2 below.

Table 11-2: VOC and CO2 Cost Benefits

Option	VOC Benefits (NPV)	CO2 Cost Benefits (NPV)
Option 1 – Roundabout	-$3,550,000	-$114,000

11.4 Crash Benefits

The do-minimum scenario used a 5 year weighted crash prediction model from the EEM for high speed crossroads and T-intersections. For the option, the crash rate was derived using the EEM crash rate models at roundabouts.

The expected accident cost benefits are shown in Table 11-3 below.

Table 11-3: Crash Benefits

Option	Accident Cost Benefits (NPV)
Option 1 – Roundabout	$2,600,000

Caution should be used as this assessment is outside the bounds of confidence. A more detailed crash analysis would be needed if this project is progressed further.

11.5 Maintenance Costs

Current and future maintenance costs were not considered in the economic evaluation due to their minor influence.

11.6 Benefit Cost Ratio Results

Table 11-4: Economic Analysis Summary

Option Description	Total Cost (NPV)	Total Benefits (NPV)	BCR
Option 10-1 – Queen St East: 48 m dia roundabout	$3.81M	-$1.79M	**Less than zero**

Option 10-1 has a BCR less than zero as a result of the crash benefits being less than the significant VOC disbenefits. Therefore the option is not currently feasible, although it is noted that the crash risk rating as per HRIG remains high.

However, should consideration be given to the provision of passing lanes inclusive of WRB, along this length of SH57 to the north and south of Queen Street East, then a roundabout would provide a turning facility at the end(s) of the WRB in this location.

There is a proposal to use SH57 as a Heavy Vehicle Bypass of Levin which would direct heavy vehicles through the proposed roundabout. Should this eventuate the travel time, VOC and CO2 disbenefits would further disadvantage the proposed roundabout.

A sensitivity assessment has been undertaken to assess the likely crash numbers required to correspond to a BCR of 1.0. Given the calculated construction costs and the travel time and VOC and CO2 disbenefits to achieve a BCR of 1.0, the crashes at this site would require:

- 3 additional fatal crashes, invalidating the EEM's fatal/serious adjustment creating a BCR of 6.7; or
- A mixture of 4 additional fatal or serious injury crashes with no more than 2 fatal crashes creating a BCR of 1.6; or
- 3 additional fatal or serious injury crashes with no more than 2 fatal and a minor injury crash creating a BCR of 1.05; or
- 24 additional minor injury crashes; or
- 50 additional non-injury crashes.

Given the high traffic flow between Queen Street East (Levin) and SH57 north of the intersection, consideration would need to be given to the inclusion of a separate left turn slip lane at the proposed roundabout at the SAR stage.

11.7 Risk Assessment

The risks to the project have been assessed using the General Approach as determined in the NZTA Risk Management Process Manual (AC/Man/1).

The major potential risks associated with the SH57 / Queen Street East roundabout project are considered to be:

- Project unable to get funded due to constrained funding environment and current BCR less than zero, despite a high crash risk rating.

Sensitivity to severity of crashes as delays increase.

Inaccurate cost estimate due to level of available data at this feasibility state, including utility information and assumptions in regards to topography and land value / use.

Traffic delays during construction.

Environmental effects during construction.

Unforeseen geotechnical challenges.

Drainage outfalls.

Impacts on existing services.

Land acquisition difficulties.

Difficulties in obtaining resource consents and/or alteration to designation.

Opposition from local iwi.

Additional landowner accommodation works required.

Noise / vibration.

12 Assessment Profile

The Government Policy Statement on Land Transport Funding (GPS) requires the NZTA to consider a number of matters when evaluating projects. To assist in understanding how projects perform against these matters and hence what investment decisions to make, the NZTA utilises an assessment profile process.

The assessment profile is a three-part rating for an activity, rated as high, medium or low e.g. HMM, and representing the assessment for Strategic Fit, Effectiveness and Efficiency respectively.

It is considered that the assessment profile[5] for the section of SH57 incorporating the intersection with Queen Street East is **HH**_. The following paragraphs outline how this profile has been created.

12.1 Strategic Fit

The strategic fit factor is a measure of how an identified problem, issue or opportunity that is addressed by a proposed activity or combination of activities, aligns with the NZTA's strategic investment direction.

As this project is part of a Road of National Significance and is classified as a High Risk Rural Road, the Strategic Fit is **High**.

12.2 Effectiveness

The effectiveness factor considers the contribution that the proposed solution makes to achieving the potential identified in the strategic fit assessment and to the purpose of the Land Transport Management Act (LTMA).

A wide range of assessment factors are available for use in this effectiveness rating and these draw from the five LTMA areas of:

Economic Development

Safety and Personal Security

Access and Mobility

Public Health

Environmental Sustainability

[5] NZTA Planning and Investment Knowledge Base, www.pikb.co.nz/assessment-framework

A number of other key criteria need to be considered including integration, consideration of options and responsiveness.

As this project is part of the Roads of National Significance programme, it is recommended that the effectiveness factor for RoNS projects of **High** is adopted.

This is considered appropriate as the project will contribute positively to safety and is consistent with NZTA's strategies and plans.

12.3 Efficiency

The economic efficiency assessment considers how well the proposed solution maximises the value of what is produced from the resources used. This is primarily undertaken by the Benefit Cost Ratio.

As this project has a BCR less than zero the efficiency rating is **blank**.

13 Social and Environmental Assessment

The Scoping Report phase of the Ōtaki to north of Levin RoNS identified a number of social and environmental factors which will need to be assessed during the scheme assessment phase. The limited physical extent of the intersection upgrade is not affected by any known social or environmental constraints. The adjoining landowners will however be affected and their concerns will need to be addressed.

High level consultation has been carried out under the scoping phase of the Ōtaki to north of Levin RoNS and on-going consultation will continue with stakeholders throughout the planning and design process. The area as a whole is identified as being of cultural importance to the iwi of Rangitane o te Whanganui a Tara, Ngati Raukawa ki te Tonga and Ngati Toa Rangitira.

A Consultation Plan for the entire Ōtaki to north of Levin project has been prepared and consultation will be undertaken in accordance with the plan. The purpose of the plan is to:

Provide a documented process for intended engagement with the community, including the project context, the parties involved, and desired outcomes;

Maximise effective and efficient engagement of community within generally tight time constraints;

Provide the specifics of consultation to be undertaken, including timeframes;

Help the project team to proactively manage risks to the project/project future from inappropriate or inadequate community engagement; and

Help the project team to constructively manage community expectations.

14 Geotechnical Requirements

A preliminary geotechnical appraisal report was prepared by MWH in 2011. This report outlined that the majority of the stretch of the highway is underlain by beach deposits (Ōtaki Sandstone). To investigate the subsurface conditions along the alignment which includes the Queen Street intersection, MWH recommended field investigations consisting of hand-auger bores, boreholes and test pits.

The preliminary geotechnical appraisal report for the Ōtaki to Levin RoNS noted the following aspects in regards to the subject study areas:

It has moderate settlement potential;

It has a seismic potential due to the proximity of the active Northern Ohariu Fault;

It has low susceptibility to liquefaction; and

It is not located within a tsunami influence zone.

15 Land Requirements

Land requirement has been included in the concept development and cost estimation.

Option 10-1 requires approximately 2,100 m^2 of land

The land calculations are based on that required for the construction of the roundabout using only an aerial plan.

16 Resource Management Issues

The project must meet all statutory requirements. There are a number of documents (both statutory and non-statutory) that must be considered when planning for the state highway improvements. In particular, the requirements of the Resource Management Act, the operative Horowhenua District Plan and the Horizons Regional Plan (proposed One Plan) will be assessed to ensure that the proposed project meets the plan provisions and follows the statutory process.

16.1 Horowhenua District Council

16.1.1 Designations

SH57 is designated under the operative Horowhenua District Plan for "state highway purposes" (D3). The existing designation at the intersection with Queen Street East is limited in physical extent on the eastern side of the proposed intersection upgrade and will need to be altered to accommodate the road improvements. Accordingly, it is recommended that the designation boundaries be altered to accommodate these works under s181 RMA. NZTA will be required to give notice to the Council of its requirement to alter the designation (NOR). An outline plan will also be required to indicate the scale of the proposed works within the designation.

The road works on the western side will be undertaken within the road reserve and on land owned by the Horowhenua District Council. On the eastern side it is expected that land will be required to accommodate the proposed work.

16.1.2 Proposed Gladstone Greenbelt Structure Plan

The proposed Horowhenua District Plan includes the proposed Gladstone Greenbelt Residential Area Structure Plan which is a non-statutory plan. The operative District Plan is under review and is currently open to submissions.

The structure plan area covers a large block of farmland bordered by SH57, Queen Street East, Tararua Road and Gladstone Road. It is located within the south eastern quadrant of the proposed intersection upgrade. The structure plan recognises that SH57 is a potential Levin bypass route and a 100m corridor has been identified alongside the existing road to provide sufficient width to cater for future upgrades.

16.2 Regional Plans

The final designs and construction plans will determine what regional consents are required. But given that there are no water courses in the immediate vicinity of the proposed works, it is unlikely that any consents will be required. Drainage discharge from surface via stormwater positive system (could be soakpits)

16.3 Other Provisions

Given that the proposed works would involve earthworks, there is the potential to unearth Maori artefacts. Current information does not identify any known sites but an archaeological authority may be required should a site be discovered.

17 Maintenance Issues

The current proposals would not result in any significant changes to the maintenance regime.

18 Conclusions and Recommendations

This report explores the option for improving the intersection at SH57 / Queen Street East. The current intersection arrangement is a priority controlled cross roads intersection with significant turning volumes between the Queen Street East (Levin) leg and the SH57 north leg.

A roundabout option at the intersection was the only option considered. A cost estimate was undertaken together with an economic assessment to determine the Benefit Cost Ratio.

A summary of the economic analysis is shown below.

Table 18-1: Option Summary

Option Description	Capital Costs	NPV Benefits	Benefit Cost Ratio
Option 10-1 – Queen St East: 48 m diameter roundabout	$3.96M	-$1.79M	**Less than zero**

The BCR for this option was less than zero due to the high vehicle operating costs surpassing any crash savings. From an economic assessment perspective, the roundabout option is currently not feasible but the remaining high risk crash rating is noted.

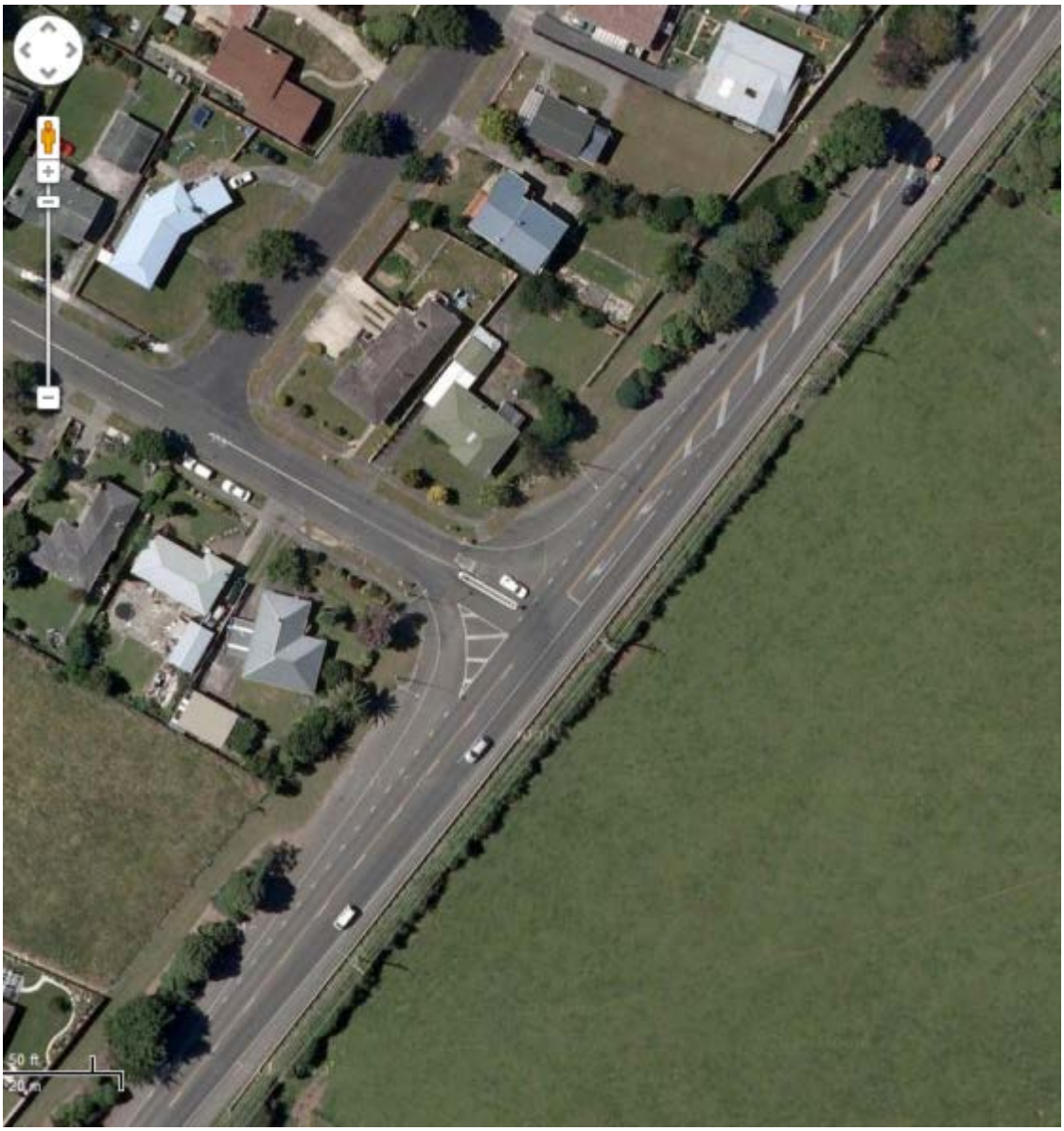
However, should consideration be given to the provision of passing lanes inclusive of WRB, along this length of SH57 to the north and south of Queen Street East, then a roundabout would provide a turning facility at the end(s) of the WRB in this location.

There is potential to use SH57 as a Heavy Vehicle Bypass of Levin which would direct heavy vehicles through the proposed roundabout. Should this eventuate the travel time, VOC and CO2 disbenefits would further disadvantage the proposed roundabout.

It is nevertheless recommended that the roundabout continue to be considered as part of the overall short, medium and long term strategy for Ōtaki to Levin, and be considered as part of the overall Ōtaki to north of Levin improvement package.

Appendix A Photographs

SH57 / Queen Street East intersection



SH57 / Meadowvale Drive intersection

View along Meadowvale Drive towards SH57

View from Meadowvale Drive south-west along SH57

View from Meadowvale Drive north-east along SH57

View of the existing accessway approximately 100 m south of the left turn bay into Queen St East

View north-east along SH57 by the end of the acceleration lane from Queen St East

View along Queen St East toward SH57

View from Queen St East (Levin approach)

View south-west along SH57

View north-east along SH57

View along Queen Street East towards Levin

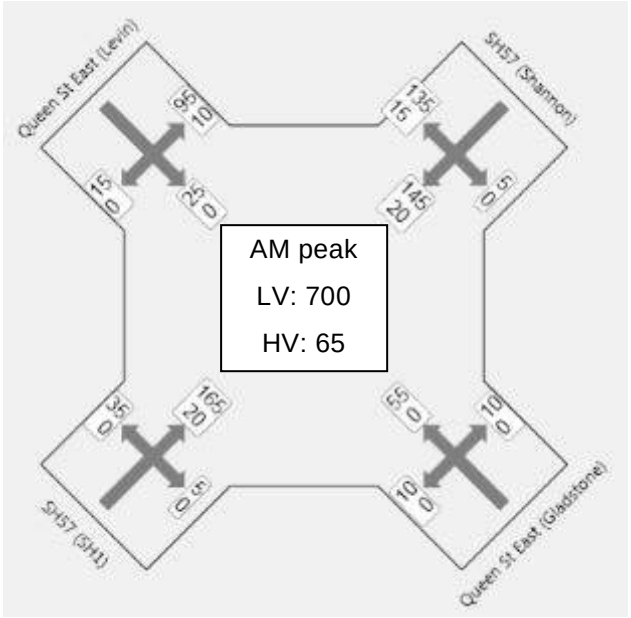
Appendix B Traffic Data

SH57 / Queen Street East surveyed traffic flows Wed 11 May 2011

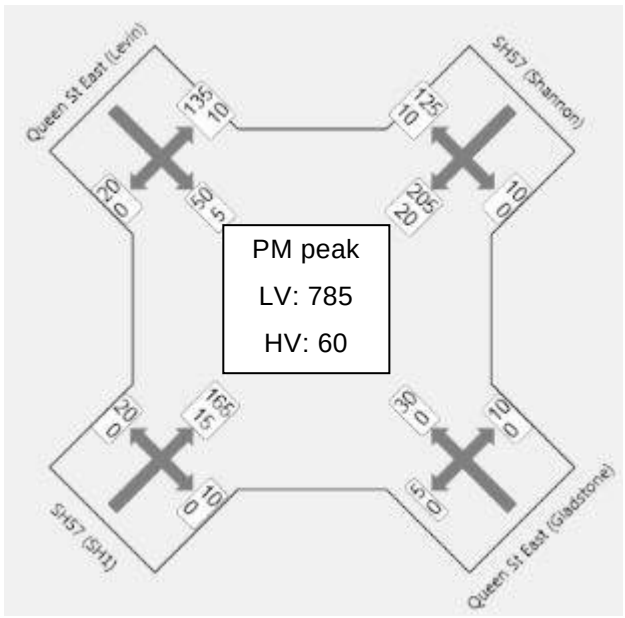
Queen St East / SH 57 Wed11/05/11 Weather Fine AM rain on and off from about 1pm ish

	SH 57 North			SH 57 North			SH 57 North			Queen St east			Queen St east			Queen St east			SH 57 South			SH 57 South			SH 57 South			Queen St west			Queen St west			Queen St west						
start	Left into Queen St			Straight into SH 57 Sth			Right into Queen St			Left into SH 57			Straight into Queen St			Right into SH 57			Left into Queen St			Straight into SH 57 Nth			Right into Queen St			Left into SH 57			Straight into Queen St			Right into SH 57						
Time	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses	Cars	Trucks	Buses				
7:00				15	2		12	1		1			6			3			1			26	2					22	2		3			4			93	7	100	7.0%
7:15	1			21	2		13	2					16	1		1			4			36	9		1			26	1		2			2			123	15	138	10.9%
7:30				24	8		16	1		2			7			1			6			40	8					29	2	1	5			3			133	20	153	13.1%
7:45				43	5		29	2	1	2			12			4			11			44	8					26	2		2			2			175	18	193	9.3%
8:00	2			26	3		31		1	3			16			2			6			44	3		2			24	2		5			8			169	9	178	5.1%
8:15	1			38	4	1	42	2	1	2			17		1	3	1		9	1		43	3					28	3		5	1		2			190	18	208	8.7%
8:30	1			39	5	1	32	5	1	4			9			2			7			37	4		2		1	16	3		13			2			164	20	184	10.9%
8:45	1			37	1		37			2			16			0			12			34	6		2			22	4		9			8						
11:00	1			23	4		30	1					4			2			4			38	1		1			16	6		4			4			127	12	139	8.6%
11:15				30	5		31	1		2			4	1		1			3			33	1		1			27	3	1	4			2			138	12	150	8.0%
11:30	1			28	5		27	2					12			1			3			42	5		1			31	2		12			1	2		159	16	175	9.1%
11:45	4			24	9		26	1	1	2			7			2			5			31	4		1			17			12			7			138	15	153	9.8%
12:00	2			20	5		14	4		1			8						10	1		29	5			1		33	1		6			2			125	17	142	12.0%
12:15	2			15	3		23						12			1			4			23	2					23	1		3			4			110	6	116	5.2%
12:30				26	1		23	1					6	1					2			29	3	1	2			34		2	4			4			130	9	139	6.5%
12:45	1			25	2		25			1			10						8			26	1		1			27	1		6			4	1		134	5	139	3.6%
13:00	1			26	3		24						4			1			5			33	6		2			29	3		10			6			141	12	153	7.8%
13:15	2			39	7		21	1					13			1			8			26	6		0			37	1		12			2			161	15	176	8.5%
13:30	2			23	7		29	4		1			8	1		1			8			37	3		2			23	2		1	1		3			138	18	156	11.5%
13:45	2			41	3		41	1					10			2			7			30	3		0			20	5		7			4			164	12	176	6.8%
16:00				48	4		25	4	1				6			1			4			27	3		2			37	1		7	2		4			161	15	176	8.5%
16:15	4	1		60	5		21	1		1			3			2	1		4			44	3		3			31	1		12			2			187	12	199	6.0%
16:30	2			53	8		44	3	1	2			8			1			6			46	2		2			38	3		4			2			208	17	225	7.6%
16:45	2			50	5		26		1	2			9	2		2			5			39	4		3			25	2		17			7			187	14	201	7.0%
17:00	2			44	2		31	4		2			8			2			3			35	2	2	2			44		1	18	2		8			199	13	212	6.1%
17:15	2			51	3	1	28		1				10			2			3			38	3		2			24	2		21	1		6			187	11	198	5.6%
17:30	4			45	3	1	26	5	1	1			4				1		5			31						21	1		12			9			158	12	170	7.1%
17:45	1			34	6		23	1					8						2			25	1	1	2			26	1		12			7						

	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	%HV
7-9 am	6	0	6	243	32	275	212	17	229	16	0	16	99	2	101	16	1	17	56	1	57	304	43	347	7	1	8	193	20	213	44	1	45	31	0	31	1227	118	1345	8.8%
7:45-8:45	4	0	4	146	19	165	134	13	147	11	0	11	54	1	55	11	1	12	33	1	34	168	18	186	4	1	5	94	10	104	25	1	26	14	0	14	698	65	763	8.5%
8:00-9:00	5	0	5	140	15	155	142	10	152	11	0	11	58	1	59	7	1	8	34	1	35	158	16	174	6	1	7	90	12	102	32	1	33	20	0	20	703	58	761	7.6%
11-12	6	0	6	105	23	128	114	6	120	4	0	4	27	1	28	6	0	6	15	0	15	144	11	155	4	0	4	91	12	103	32	0	32	14	2	16	562	55	617	8.9%
12-1 pm	5	0	5	86	11	97	85	5	90	2	0	2	36	1	37	1	0	1	24	1	25	107	12	119	3	1	4	117	5	122	19	0	19	14	1	15	499	37	536	6.9%
1-2 pm	7	0	7	129	20	149	115	6	121	1	0	1	35	1	36	5	0	5	28	0	28	126	18	144	4	0	4	109	11	120	30	1	31	15	0	15	604	57	661	8.6%
4-6 pm	17	1	18	385	38	423	224	23	247	8	0	8	56	2	58	10	2	12	32	0	32	285	21	306	16	0	16	246	12	258	103	5	108	45	0	45	1427	104	1531	6.8%
4:15-5:15	10	1	11	207	20	227	122	10	132	7	0	7	28	2	30	7	1	8	18	0	18	164	13	177	10	0	10	138	7	145	51	2	53	19	0	19	781	56	837	6.7%
4:30-5:30	8	0	8	198	19	217	129	10	139	6	0	6	35	2	37	7	0	7	17	0	17	158	13	171	9	0	9	131	8	139	60	3	63	23	0	23	781	55	836	6.6%
4:30-4:45	312	2.0	1.375	254	11.4	0.930	364	2.0	0.688	78	2.0	0.875	38	11.4	0.938	50	2.0	2.000	216	2.0	0.750	174	11.4	0.922	197	2.0	1.250	155	2.0	0.884	151	11.4	3.313	225	2.0	2.375	0.833	1.023	0.915	1.154
appr PFF	284	2.0	4248	264	11.4	4212	317	2.0	8459	45	2.0	689.2	42	11.4	728.8	80	2.0	1418	186	2.0	2810	148	11.4	2551	246	2.0	5361	246	2.0	2481	163	11.4	2736	193	2.0	5218	8459	1418	5361	5218



AM peak hour LV & HV flows as input into SIDRA



PM peak hour LV & HV flows as input into SIDRA

SH57 / Meadowvale Drive surveyed traffic flows Thursday 11 May 2011

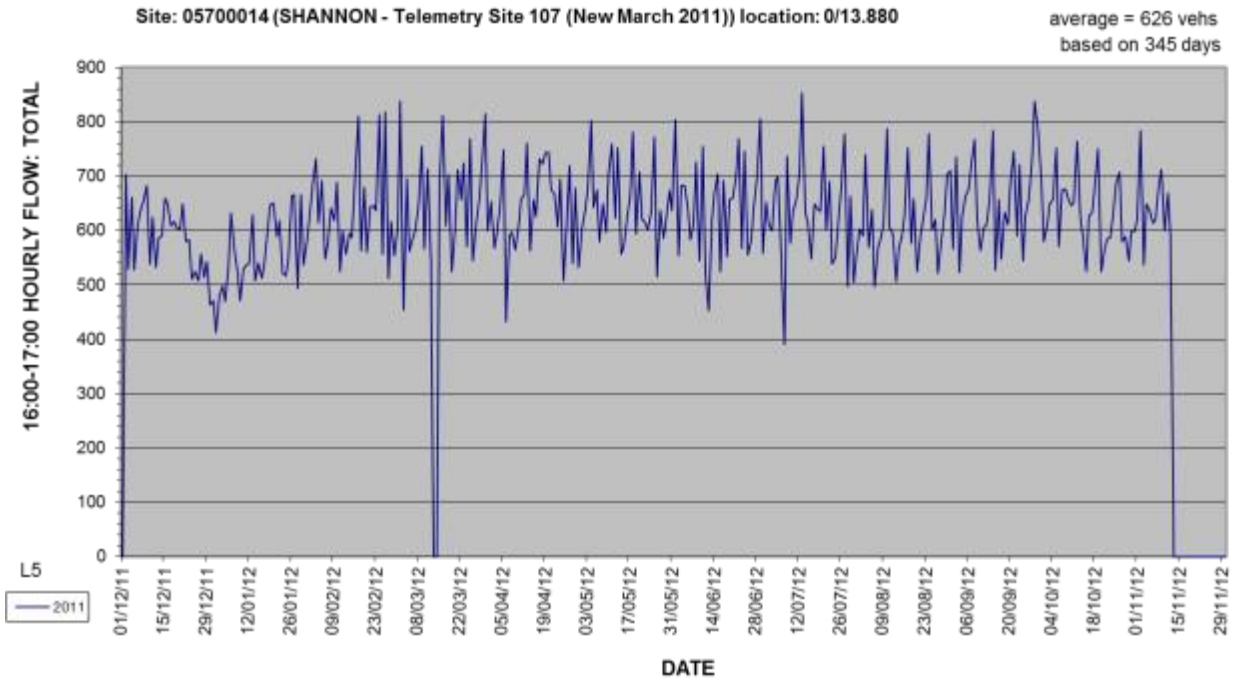
Meadowvale Dr/ SH 57 **Thurs 12/05/11** **Weather rain on and off for most of the day**

start	Left into Meadowvale Dr			Right into Meadowvale Dr			Left into SH 57			Right into SH 57		
Time	**Cars**	**Trucks**	**Buses**	**Cars**	**Trucks**	**Buses**	**Cars**	**Trucks**	**Buses**	**Cars**	**Trucks**	**Buses**
7:00	2						6			3		
7:15	2			2	1		4			3		
7:30	9			2			2			3		
7:45	7				3		4	1		4		
8:00	5			3			4			3		1
8:15	6	1		6			10	1		3		
8:30	9			10			6			3		
8:45	10			4			3	1		1		
11:00	2			1			2					
11:15	5			1	1		2	1				
11:30	1						3			1		
11:45	5	2		4			7	2		4		
12:00	2			3	1		3			1		
12:15	1			3			8			3		
12:30	3			4			4	1		8		
12:45	3			3			1			2		
13:00	3			1			5			5		
13:15	3			1			5			3		
13:30	3			1								
13:45	4			3	1		3	1		2		
16:00	10			4	1		4			5		
16:15	5			3			4			4		
16:30	10			1			5			6		
16:45	10			4			4			2		
17:00	3			8			9			6		
17:15	5			10			4			2		
17:30	4			2			3			4		
17:45	7			4			2			7		

													side road approach			side road exit leg		
	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All	LV	HV	All
7-9 am	50	1	51	27	4	31	39	3	42	23	1	24	62	4	66	77	5	82
7:45-8:45	27	1	28	19	3	22	24	2	26	13	1	14	37	3	40	46	4	50
8-9 am	30	1	31	23	0	23	23	2	25	10	1	11	33	3	36	53	1	54
11-12	13	2	15	6	1	7	14	3	17	5	0	5	19	3	22	19	3	22
12-1 pm	9	0	9	13	1	14	16	1	17	14	0	14	30	1	31	22	1	23
1-2 pm	13	0	13	6	1	7	13	1	14	10	0	10	23	1	24	19	1	20
4-6 pm	54	0	54	36	1	37	35	0	35	36	0	36	71	0	71	90	1	91
4:15-5:15	28	0	28	16	0	16	22	0	22	18	0	18	40	0	40	44	0	44
4:30-5:30	28	0	28	23	0	23	22	0	22	16	0	16	38	0	38	51	0	51

The SH57 through flows were not surveyed

Annual variation in the 4-5 pm two-way hourly flow south of Shannon



Note that this graph is from December 2011 to November 2012 (only continuous from 2 Dec 2011).

It seems a reasonable degree of annual uniformity aside from the main summer vacation period.

Appendix C Crash Data

Coded crash listing (1 July 2007 to 30 June 2012)

ROAD	DIST	FRO	INT	SIDE	IDNO	DATE	DYWK	TIME	MVMT	VEHS	CSCD	OBJS	CURV	SURF	LITE	WTHR	JNTY	TRAF	MARK	SPDL	FAT	NSER	NMIN	PEDA	CYC
FEATHERSTON ST			I	MEADOWVALE DRIVE	2756180	25/10/07	Thu	15	DC	CS1	101A 112A 335A	PS	R	D	DO	F	T	S	C	50	0	0	0		
FEATHERSTON ST	50	W		TAINUI ST	2953700	22/07/09	Wed	1752	MC	CN1C	372B 862		R	D	DN	F		N	R	50	0	0	0		
MEADOWVALE DRIVE			I	FEATHERSTON ST	201011205	14/02/10	Sun	342	DC	CS2	103A 112A 357A	HP	E	W	DO	F	T	N	N	50	0	0	1		
MEADOWVALE DRIVE			I	FEATHERSTON ST	2852663	04/06/08	Wed	920	DB	CE1	131A	S	R	D	O	F	T	G	C	50	0	0	0		
MEADOWVALE DRIVE	15	W		TAINUI ST	201055178	12/10/10	Tue	1330	BE	CW1CT	125A 377A 443C 839	M	R	D	B	F		N	N	50	0	0	0		
QUEEN ST EAST			I	FEATHERSTON ST	201012954	09/10/10	Sat	1225	KB	CE1C	302B 335B		R	D	O	F	X	G	C	50	0	0	1		
57/0/5.086	500	S		QUEEN ST EAST	201150741	09/03/11	Wed	946	MC	CS1C	303B 407B		R	D	B	F		N	C	100	0	0	0		
57/0/5.581			I	QUEEN ST EAST	2850657	20/02/08	Wed	1703	HA	CW2C	301A 382A		R	D	B	F	X	S	C	100	0	0	0		
57/0/5.581			I	QUEEN ST EAST	2811484	05/03/08	Wed	1000	LB	CS1C	303B		R	W	O	L	X	S	R	100	0	0	1		
57/0/5.581			I	QUEEN ST EAST	2756831	02/12/07	Sun	1225	CB	CN1C	137A 303B	IS	R	D	B	F	X	G	R	100	0	0	0		
57/0/5.581			I	QUEEN ST EAST	2912622	21/08/09	Fri	1850	LB	MN1C	303B 375B		R	D	DO	F	X	S	R	100	0	1	0		
57/0/5.586			I	QUEEN ST EAST	201211311	27/02/12	Mon	1605	HA	CE2C	301A 375A		R	D	B	F	X	S	C	100	0	0	1		
57/0/5.586			I	QUEEN ST EAST	201012530	27/07/10	Tue	1541	HA	CE2C	301A 375A		R	D	O	F	X	S	C	100	0	0	1		
57/0/5.686	100	N		QUEEN ST EAST	201251155	07/04/12	Sat	1250	CB	CN1	130A 402A 688A 812 817	V	R	D	B	F		N	C	80	0	0	0		
57/0/5.781	200	N		QUEEN ST EAST	2713323	21/10/07	Sun	1545	CC	MS1C	137A 160A 181A 144B 927		R	D	B	F	D	N	C	100	0	0	1		
57/0/5.786	200	N		QUEEN ST EAST	2910001	01/01/09	Thu	130	PA	CN1E	105B 702B 724B		R	D	DN	F		N	C	100	1	0	0	33	
57/0/5.786	200	N		QUEEN ST EAST	201250295	15/02/12	Wed	1220	GE	CS14	160A 387A 402A 927		R	D	B	F	D	N	C	80	0	0	0		

Dark blue = 50-250 m north of Queen St E; blue = within 50m of or at Queen Street East; Orange = between Queen Street East and Meadowvale Drive; Yellow = Meadowvale Drive/Featherston Street/Queen Street East route

English language listing (1 July 2007 to 30 June 2012)

ROAD	DIST	FRO	SIDE	IDNO	DATE	DYWK	TIME	MVMT	MVMT	SURF	LITE	WTHR	JNTY	TRAF	FAT	SER	NMIN
57/0/5.086	500	S	QUEEN ST EAST	201150741	9/03/2011	Wed	946	ca	CAR2 failed to give way when turning to non-turning traffic, driver over-reacted	Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
57/0/5.581		I	QUEEN ST EAST	2850657	20/02/2008	Wed	1703	CAR1 WBD on QUEEN ST EAST hit CAR2 crossing at right angle from right	CAR1 failed to give way at stop sign, misjudged speed etc of vehicle coming from another dirn with right of way	Dry	Bright Sun	Fine	X Type Junction	Stop Sign	0	0	0
57/0/5.581		I	QUEEN ST EAST	2811484	5/03/2008	Wed	1000	CAR2 turning right hit by oncoming CAR1 SBD on SH 57	CAR2 failed to give way when turning to non-turning traffic	Wet	Overcast	Light Rain	X Type Junction	Stop Sign	0	0	1
57/0/5.581		I	QUEEN ST EAST	2756831	2/12/2007	Sun	1225	CAR1 NBD on SH 57 lost control; went off road to left, CAR1 hit Traffic Island, Traffic Sign	CAR1 lost control avoiding another vehicle CAR2 failed to give way when turning to non-turning traffic	Dry	Bright Sun	Fine	X Type Junction	Give Way Sign	0	0	0
57/0/5.581		I	QUEEN ST EAST	2912622	21/08/2009	Fri	1850	CAR2 turning right hit by oncoming MOTOR CYCLE1 NBD on SH 57	CAR2 failed to give way when turning to non-turning traffic, didnt see/look when required to give way to traffic from another direction	Dry	Dark	Fine	X Type Junction	Stop Sign	0	1	0
57/0/5.586		I	QUEEN ST EAST	201211311	27/02/2012	Mon	1605	CAR1 EBD on QUEEN ST EAST hit CAR2 crossing at right angle from right	CAR1 failed to give way at stop sign, didnt see/look when required to give way to traffic from another direction	Dry	Bright Sun	Fine	X Type Junction	Stop Sign	0	0	1
57/0/5.586		I	QUEEN ST EAST	201012530	27/07/2010	Tue	1541	CAR1 EBD on QUEEN ST EAST hit CAR2 crossing at right angle from right	CAR1 failed to give way at stop sign, didnt see/look when required to give way to traffic from another direction	Dry	Overcast	Fine	X Type Junction	Stop Sign	0	0	1
57/0/5.686	100	N	QUEEN ST EAST	201251155	7/04/2012	Sat	1250	CAR1 NBD on SH 57 lost control; went off road to left, CAR1 hit Ditch	CAR1 lost control, new driver showed inexperience, towed vehicle or trailer too heavy or incompatible ENV: road surface (uneven), road surface under construction or maintenance	Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
57/0/5.781	200	N	QUEEN ST EAST	2713323	21/10/2007	Sun	1545	MOTOR CYCLE1 SBD on SH 57 lost control; went off road to right	MOTOR CYCLE1 lost control avoiding another vehicle, overtaking vehicle signaling right turn, following too closely CAR2 didn't signal in time when turning right ENV: entering or leaving other commercial	Dry	Bright Sun	Fine	Driveway	Nil	0	0	1
57/0/5.786	200	N	QUEEN ST EAST	2910001	1/01/2009	Thu	130	CAR1 NBD on SH 57 hit PEDESTRIAN walking with traffic	PEDESTRIAN2 Intoxicated non-driver, walking along road not keeping to side of rd, pedestrian wearing dark clothing	Dry	Dark	Fine	Unknown	Nil	1	0	0
57/0/5.786	200	N	QUEEN ST EAST	201250295	15/02/2012	Wed	1220	CAR1 SBD on SH 57 overtaking hit SUV2 turning right	CAR1 overtaking vehicle signaling right turn, misjudged intentions of another party, new driver showed inexperience ENV: entering or leaving other commercial	Dry	Bright Sun	Fine	Driveway	Nil	0	0	0

Note that there were no reported crashes within 50 metres of or at the SH57 / Meadowvale Drive intersection (or any within 50-250 metres south of Meadowvale Drive on SH57)

INSERT COLLISION DIAGRAM IN HERE

Appendix D Outline Plan Drawing

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FEASIBILITY REPORT	GC	PP	PP	30.11.12

	Name	Date
SURVEYED		
DESIGNED	G. Carin	11/12
DRAWN	G. Carin	11/12
CHECKED	P. Peet	11/12
REVIEWED	M. Oppenhuis	11/12
APPROVED	P. Peet	11/12

MWH

NZ TRANSPORT AGENCY WAKA KOTAHI

NZ TRANSPORT AGENCY
OTAKI TO LEVIN PFRs

STATE HIGHWAY 57 / QUEEN ST INTERSECTION
PLAN - OPTION 10 - 1

Status Stamp: **WORKING PLOT**
Date Stamp: **30 NOVEMBER 2012**
SCALES (A1) 1:1000
Drawing No.: 80500902 - 0106
Sheet No.: C001
Rev.: A

XREFS :

Appendix E Cost Estimates

Project Estimate - Form A

Project Name: SH 57 / Queen St Roundabout
Option 7 - 1

FE
Feasibility Estimate

Item	Description	Base Estimate	Contingency	Funding Risk
A	Nett Project Property Cost	30,000	6,000	9,900
	Investigation and Reporting			
	- Consultancy Fees	108,000	21,600	35,600
	- NZTA-Managed Costs	33,000	6,600	10,900
B	Total Investigation and Reporting	141,000	28,200	46,500
	Design and Project Documentation			
	- Consultancy Fees	135,000	27,000	44,600
	- NZTA-Managed Costs	44,000	8,800	14,500
C	Total Design and Project Documentation	179,000	35,800	59,100
	Construction			
	MSQA			
	- Consultancy Fees	162,050	32,410	53,500
	- NZTA-Managed Costs	36,000	7,200	11,880
	- Consent Monitoring Fees	4,000	800	1,320
	Sub Total Base MSQA	202,050	40,410	66,700
	Physical Works			
D1	*Environmental Compliance*	*50,000*	*10,000*	*16,500*
D2	*Earthworks*	*152,500*	*45,800*	*76,300*
D3	*Ground Improvements*	*0*	*0*	*0*
D4	*Drainage*	*254,875*	*51,000*	*84,100*
D5	*Pavement and Surfacing*	*970,550*	*194,100*	*320,300*
D6	*Bridges / Structures*	*0*	*0*	*0*
D7	*Retaining Walls*	*0*	*0*	*0*
D8	*Traffic Services*	*160,800*	*32,200*	*53,100*
D9	*Service Relocations*	*562,500*	*112,500*	*185,600*
D10	*Landscaping*	*100,000*	*20,000*	*33,000*
D11	*Traffic Management and Temporary Works*	*240,000*	*48,000*	*79,200*
D12	*Preliminary and General*	*250,000*	*50,000*	*82,500*
D13	*Extraordinary Construction Costs*	*0*	*0*	*0*
	Sub Total Base Physical Works	2,741,225	563,600	930,600
D	Total Construction & MSQA	2,943,275	604,010	997,300
E	Project Base Estimate (A+B+C+D)	3,293,275		
F	Contingency *(Assessed / Analysed)* (A+B+C+D)		674,010	
G	Project Expected Estimate (E+F)		3,967,285	
	Project Property Cost Expected Estimate		36,000	
	Investigation and Reporting Expected Estimate		169,200	
	Design and Project Documentation Expected Estimate		214,800	
	Construction Expected Estimate		3,547,285	
H	Funding Risk *(Assessed / Analysed)* (A+B+C+D)			1,112,800
I	95th Percentile Project Estimate (G+H)			5,080,085
	Project Property Cost 95th Percentile Estimate			45,900
	Investigation and Reporting 95th Percentile Estimate			215,700
	Design and Project Documentation 95th Percentile Estimate			273,900
	Construction 95th Percentile Estimate			4,544,585

Base Date of Estimate	21 Nov 2012	Cost Index
Estimate prepared by:	G. Corin	Signed
Estimate internal peer review by:	P. Peet	Signed
Estimate external peer review by:		Signed
Estimate approved by NZTA Project Manager:		Signed

Note: (1) These estimates are exclusive of escalation and GST.

Appendix F SIDRA output data

LANE SUMMARY

Site: SH57 Qn 2011PM

SH57 / Queen Street East
PM 4:15-5:15 with 4:30-4:45 PFP (4:30-5:30 is similar total flows)

Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Queen St East (Gladstone)																
Lane 1	6	32	10	48	0.0	299	0.160	100	27.7	LOS D	0.6	4.4	500	–	0.0	0.0
Approach	6	32	10	48	0.0		0.160		27.7	LOS D	0.6	4.4				
North East: SH57 (Shannon)																
Lane 1	10	0	0	10	0.0	1516[1]	0.007	100	13.2	LOS B	0.0	0.2	140	Turn Bay	0.0	0.0
Lane 2	0	242	0	242	8.9	1843	0.131	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 3	0	0	196	196	7.4	876	0.223	100	15.3	LOS C	0.9	6.8	80	Turn Bay	0.0	0.0
Approach	10	242	196	448	8.0		0.223		7.0	NA	0.9	6.8				
North West: Queen St East (Levin)																
Lane 1	165	0	0	165	6.9	1470	0.112	100	7.6	LOS A	0.4	2.7	500	–	0.0	0.0
Lane 2	0	55	20	75	6.7	271	0.277	100	27.0	LOS D	1.3	9.3	70	Turn Bay	0.0	0.0
Approach	165	55	20	240	6.6		0.277		13.7	LOS B	1.3	9.3				
South West: SH57 (SH1)																
Lane 1	27	0	0	27	0.0	1366	0.020	100	13.9	LOS B	0.1	0.5	140	Turn Bay	0.0	0.0
Lane 2	0	196	0	196	6.3	1850	0.106	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 3	0	0	10	10	0.0	900	0.011	100	13.6	LOS B	0.0	0.3	80	Turn Bay	0.0	0.0
Approach	27	196	10	232	7.0		0.106		2.2	NA	0.1	0.5				
Intersection				967	7.1		0.277		8.5	NA	1.3	9.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: SH57 Qn 2011PM (LILO)

SH57 / Queen Street East
2011 PM 4:15-5:15

Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Queen St East (Gladstone)																
Lane 1	6	32	10	48	0.0	1148	0.042	100	12.7	LOS B	0.2	1.1	500	–	0.0	0.0
Approach	6	32	10	48	0.0		0.042		12.7	LOS B	0.2	1.1				
North East: SH57 (Shannon)																
Lane 1	10	242	0	252	8.5	1778	0.142	100	10.8	LOS B	0.8	6.1	500	–	0.0	0.0
Lane 2	0	0	210	210	6.9	1370[1]	0.153	100	16.7	LOS B	0.8	6.2	110	Turn Bay	0.0	0.0
Approach	10	242	210	462	7.8		0.153		13.5	LOS B	0.8	6.2				
North West: Queen St East (Levin)																
Lane 1	165	0	0	165	6.9	1713	0.096	100	6.3	LOS A	0.6	4.1	110	Turn Bay	0.0	0.0
Lane 2	0	55	45	100	5.0	1315	0.076	100	8.5	LOS A	0.4	3.0	500	–	0.0	0.0
Approach	165	55	45	265	6.2		0.096		7.1	LOS A	0.6	4.1				
South West: SH57 (SH1)																
Lane 1	27	0	0	27	0.0	1306	0.020	100	12.5	LOS B	0.1	0.7	110	Turn Bay	0.0	0.0
Lane 2	0	196	10	206	7.9	1579	0.130	100	11.6	LOS B	0.7	5.5	500	–	0.0	0.0
Approach	27	196	10	232	7.0		0.130		11.7	LOS B	0.7	5.5				
Intersection				1007	6.8		0.153		11.4	LOS B	0.8	6.2				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: SH57 Qn 2041PM all36%

SH57 / Queen Street East
PM 4:15-5:15 with 4:30-4:45 PFP (4:30-5:30 is similar total flows)

Giveway / Yield (Two-Way)
Flow Scale Analysis (Practical Capacity): Results for Flow Scale (chosen as largest for any movement) = 136.0 %

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Queen St East (Gladstone)																
Lane 1	8	43	14	65	0.0	166	0.393	100	46.9	LOS E	1.7	11.8	500	--	0.0	0.0
Approach	8	43	14	65	0.0		0.393		46.9	LOS E	1.7	11.8				
North East: SH57 (Shannon)																
Lane 1	14	0	0	14	0.0	1516[1]	0.009	100	13.2	LOS B	0.0	0.2	140	Turn Bay	0.0	0.0
Lane 2	0	329	0	329	8.9	1843	0.178	100	0.0	LOS A	0.0	0.0	500	--	0.0	0.0
Lane 3	0	0	266	266	7.4	793	0.336	100	16.4	LOS C	1.6	11.8	60	Turn Bay	0.0	0.0
Approach	14	329	266	609	8.0		0.336		7.4	NA	1.6	11.8				
North West: Queen St East (Levin)																
Lane 1	224	0	0	224	6.9	1392	0.161	100	7.8	LOS A	0.5	4.0	500	--	0.0	0.0
Lane 2	0	75	27	102	6.7	157	0.650	100	57.6	LOS F	3.5	26.1	70	Turn Bay	0.0	0.0
Approach	224	75	27	326	6.8		0.650		23.4	LOS C	3.5	26.1				
South West: SH57 (SH1)																
Lane 1	36	0	0	36	0.0	1274	0.028	100	14.1	LOS B	0.1	0.8	140	Turn Bay	0.0	0.0
Lane 2	0	266	0	266	8.3	1850	0.144	100	0.0	LOS A	0.0	0.0	500	--	0.0	0.0
Lane 3	0	0	14	14	0.0	798	0.017	100	14.3	LOS B	0.1	0.4	60	Turn Bay	0.0	0.0
Approach	36	266	14	316	7.0		0.144		2.2	NA	0.1	0.8				
Intersection				1316	7.1		0.650		12.1	NA	3.5	26.1				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: SH57 Qn 2041PM all36%

SH57 / Queen Street East
2011 PM 4:15-5:15

Roundabout
Flow Scale Analysis (Practical Capacity): Results for Flow Scale (chosen as largest for any movement) = 136.0 %

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Queen St East (Gladstone)																
Lane 1	8	43	14	65	0.0	1058	0.061	100	13.1	LOS B	0.2	1.7	500	--	0.0	0.0
Approach	8	43	14	65	0.0		0.061		13.1	LOS B	0.2	1.7				
North East: SH57 (Shannon)																
Lane 1	14	329	0	343	8.5	1732	0.198	100	10.9	LOS B	1.2	9.1	500	--	0.0	0.0
Lane 2	0	0	286	286	6.9	1349	0.212	100	16.9	LOS B	1.3	9.3	110	Turn Bay	0.0	0.0
Approach	14	329	286	628	7.8		0.212		13.7	LOS B	1.3	9.3				
North West: Queen St East (Levin)																
Lane 1	224	0	0	224	6.9	1628	0.138	100	6.6	LOS A	0.9	6.4	110	Turn Bay	0.0	0.0
Lane 2	0	75	61	136	5.0	1229	0.111	100	8.9	LOS A	0.6	4.6	500	--	0.0	0.0
Approach	224	75	61	360	6.2		0.138		7.5	LOS A	0.9	6.4				
South West: SH57 (SH1)																
Lane 1	36	0	0	36	0.0	1246	0.029	100	12.9	LOS B	0.2	1.1	110	Turn Bay	0.0	0.0
Lane 2	0	266	14	280	7.9	1492	0.187	100	12.0	LOS B	1.2	8.7	500	--	0.0	0.0
Approach	36	266	14	316	7.0		0.187		12.1	LOS B	1.2	8.7				
Intersection				1369	6.8		0.212		11.6	LOS B	1.3	9.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

LANE SUMMARY

Site: SH57 Qn 2041PM 54+36%

SH57 / Queen Street East
PM 4:15-5:15 with 4:30-4:45 PFP (4:30-5:30 is similar total flows)

Giveway / Yield (Two-Way)
Design Life Analysis (Practical Capacity): Results for 18 years

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Queen St East (Gladstone)																
Lane 1	8	43	14	65	0.0	137	0.475	100	57.6	LOS F	2.0	14.3	500	--	0.0	0.0
Approach	8	43	14	65	0.0		0.475		57.6	LOS F	2.0	14.3				
North East: SH57 (Shannon)																
Lane 1	14	0	0	14	0.0	1516[1]	0.009	100	13.2	LOS B	0.0	0.2	140	Turn Bay	0.0	0.0
Lane 2	0	373	0	373	8.9	1843	0.202	100	0.0	LOS A	0.0	0.0	500	--	0.0	0.0
Lane 3	0	0	266	266	7.4	753	0.354	100	17.0	LOS C	1.8	13.0	60	Turn Bay	0.0	0.0
Approach	14	373	266	652	8.1		0.354		7.2	NA	1.8	13.0				
North West: Queen St East (Levin)																
Lane 1	224	0	0	224	6.9	1352	0.166	100	8.0	LOS A	0.5	4.1	500	--	0.0	0.0
Lane 2	0	75	27	102	6.7	129	0.791	100	81.9	LOS F	4.7	34.9	70	Turn Bay	0.0	0.0
Approach	224	75	27	326	6.8		0.791		31.1	LOS D	4.7	34.9				
South West: SH57 (SH1)																
Lane 1	36	0	0	36	0.0	1274	0.028	100	14.1	LOS B	0.1	0.8	140	Turn Bay	0.0	0.0
Lane 2	0	301	0	301	8.3	1850	0.163	100	0.0	LOS A	0.0	0.0	500	--	0.0	0.0
Lane 3	0	0	14	14	0.0	747	0.018	100	14.6	LOS B	0.1	0.4	60	Turn Bay	0.0	0.0
Approach	36	301	14	351	7.1		0.163		2.0	NA	0.1	0.8				
Intersection				1395	7.2		0.791		13.8	NA	4.7	34.9				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

LANE SUMMARY

Site: SH57 Qn 2041PM 54+36%

SH57 / Queen Street East
2011 PM 4:15-5:15

Roundabout
Design Life Analysis (Practical Capacity): Results for 18 years

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Queen St East (Gladstone)																
Lane 1	8	43	14	65	0.0	1034	0.063	100	13.2	LOS B	0.3	1.8	500	--	0.0	0.0
Approach	8	43	14	65	0.0		0.063		13.2	LOS B	0.3	1.8				
North East: SH57 (Shannon)																
Lane 1	14	373	0	386	8.6	1730	0.223	100	10.9	LOS B	1.4	10.6	500	--	0.0	0.0
Lane 2	0	0	286	286	6.9	1349	0.212	100	16.9	LOS B	1.3	9.4	110	Turn Bay	0.0	0.0
Approach	14	373	286	672	7.9		0.223		13.5	LOS B	1.4	10.6				
North West: Queen St East (Levin)																
Lane 1	224	0	0	224	6.9	1592	0.141	100	6.7	LOS A	0.9	6.6	110	Turn Bay	0.0	0.0
Lane 2	0	75	61	136	5.0	1193	0.114	100	9.1	LOS A	0.7	4.8	500	--	0.0	0.0
Approach	224	75	61	360	6.2		0.141		7.6	LOS A	0.9	6.6				
South West: SH57 (SH1)																
Lane 1	36	0	0	36	0.0	1245	0.029	100	12.9	LOS B	0.2	1.1	110	Turn Bay	0.0	0.0
Lane 2	0	301	14	315	8.0	1491	0.211	100	12.0	LOS B	1.3	9.9	500	--	0.0	0.0
Approach	36	301	14	351	7.1		0.211		12.1	LOS B	1.3	9.9				
Intersection				1448	6.9		0.223		11.7	LOS B	1.4	10.6				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Appendix G Economic Analysis Worksheets

MWH

Simplified Procedure 3 - General Road Improvements

GENERAL ROADING IMPROVEMENT WORKS:
EVALUATION SUMMARY

WORKSHEET 1

1 Evaluator(s) Dhimantha Ranatunga / Jon England
Reviewer(s) David Wanty

2 Project / Package Details

Approved Organisation Name	NZTA
Project / Package Name	Otaki to Levin: SH57 / Queen Street East PFR
Your Reference	Z1925700
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce crashes

3 Location

Brief description of location: State Highway 57, Levin, from 250m south of Meadowvale Drive to 250m north of Queen Street East 57/0/4.820 to 57/0/5.835

4 Alternatives and Options

Describe the Do Minimum	Maintain existing asset
Summarise the options assessed	Option 1: Install a 48m central island diameter roundabout at the intersection of SH57 and Queen Street East including making the Meadowvale Drive / SH57 intersection LILO.

5 Timing

Time Zero (assumed construction start date)	1 July 2013
Expected duration of construction (Months)	6

6 Economic Efficiency

Date economic evaluation completed (mm/yyyy)	22 November 2012
Base date for costs	1 July 2013
AADT at Time Zero	8460
Traffic Growth Rate at Time Zero (%)	1.2%

Existing Roughness	3.20	IRI or NAASRA		Existing Traffic Speed	100	km/hr	(est)
Predicted Roughness	2.50	IRI or NAASRA		Predicted Traffic Speed	100	km/hr	
Length of Job Before Improvements	0.50	km		Posted Speed Limit	100	km/hr	
Length of Job After Improvements	0.50	km		Road Type	Rural Strategic		
Length of new highway	0.00	km		Gradient Before Improvements	1 - 3%		
Length of existing highway used	0.50	km		Gradient After Improvements	1 - 3%		

7 PV Cost of Do Minimum — **Cost $** $0 — **A**

8 PV Cost of the preferred Option — **Cost $** $3,808,594 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$ -$552,580	C	x Update Factor^{TT}	1.33	= $	-$734,931	W
PV VOC & CO2 savings:	$ -$3,521,253	D	x Update Factor^{VOC}	1.04	= $	-$3,662,103	Y
PV Accident Cost savings:	$ $2,602,537	E	x Update Factor^{AC}	1.17	= $	$3,044,968	Z

10 B/C Ratio = $\frac{W + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{-734931 + -3662103 + 3044968}{3808594 - 0}$ = **-0.36**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{[(-734931+-3662103)/12.09+3044968/11.19] \times 0.9259}{3808594 - 0}$ =