

# Technical Memorandum – EB3C and EB4 NOR S92 Query #T3 Response – Travel Time Variability Assessment

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## 1 Purpose

The purpose of this technical memorandum is to provide a response to the request for further information (RFI) relating to the notices of requirement (NOR) applications lodged for the Eastern Busway EB3C and EB4L. Specifically, this response addresses the Query #T3, which reads as follows:

*‘Traffic and Travel Variability Assessment. Please provide further information as to the assessment of future bus travel time reliability and comparison with the base/existing scenario (per Section 3.4.2).*

*Reason*

*In the earlier section of describing the current environment (Table 3, Sec 3.4.2) there is information provided on the variability of current (via a modelled scenario) of 2018 bus travel times. Later analysis and modelling of the effect of the project on bus travel times does not include any assessment of variability or “reliability”. One of the Project Objectives (Objective 4, Section 1.1.2) refers to improving reliability and the assessment more broadly pointing to avoiding the need for buses to share the roadway with general traffic. The assessment of bus travel time reliability should therefore be a key metric in supporting the project.’*

## 2 Response – Travel Time Variability Assessment

To avoid confusion and for clarification, the table referred to in the query above (Table 3, Section 3.4.2) in the Integrated Transport Assessment (ITA) shows the general traffic travel time variability from the Base model (2018), and not bus travel time variability.

However, for completeness, an assessment of bus and general traffic travel time variability is provided in the following sections.

The methodology to determine the variability in modelled travel times included calculating the 5<sup>th</sup> and 95<sup>th</sup> percentile travel times from the various AIMSUN model runs for each individual route, during the same AM and PM peak hours as per the ITA.

## 2.1 Do-Minimum General Traffic Travel Time Variability

For further context to *Table 3* in the ITA as well as the assessment in **Section 2.3** below, **Table 1** shows the modelled Do-Minimum (2028) general traffic travel time variability. The same four routes have been assessed here as per the ITA.

*Table 1: Do-Minimum model (2028) general traffic travel time variability*

AM Peak						
Route	Westbound			Eastbound		
	Do Minimum [min]	Variability + [min]	Variability - [min]	Do Minimum [min]	Variability + [min]	Variability - [min]
Botany - Pakūranga	24.7	5.9	-4.7	13.9	3.0	-3.1
Botany - SEART	20.9	4.7	-2.5	13.7	4.1	-2.3
Howick - Pakūranga	5.3	4.8	-1.9	4.7	2.8	-1.6
Howick - SEART	11.6	2.2	-2.9	8.0	4.2	-2.6
PM Peak						
Route	Westbound			Eastbound		
	Do Minimum [min]	Variability + [min]	Variability - [min]	Do Minimum [min]	Variability + [min]	Variability - [min]
Botany - Pakūranga	18.4	3.5	-2.2	24.6	3.3	-3.9
Botany - SEART	11.6	2.9	-1.7	24.5	2.9	-2.4
Howick - Pakūranga	4.7	1.3	-1.1	3.4	0.4	-0.3
Howick - SEART	5.0	0.4	-0.3	7.5	0.5	-0.5

As per the ITA, in the AIMSUN model, the routes from Botany to Pakūranga and Botany to SEART travel along the same section of Tī Rākau Drive up to the Tī Rākau Drive / Reeves Road / SEART intersection, and hence have the same travel time along this section of the corridor.

The Botany to Pakūranga route extends further north on Tī Rākau Drive and then turns left onto Pakūranga Road up to the Williams Avenue intersection, a distance of roughly 780m. Meanwhile, the Botany to SEART route extends up to the western abutment of Waipuna Bridge, a distance of roughly 1.4 km.

The Botany to Pakūranga route is shorter in distance but includes more signalised intersections when compared with the Botany to SEART route, and the travel time is significantly longer. The longer travel time is likely due to congestion on Tī Rākau Drive between Pakūranga Road and Reeves Road at the two signalised intersections, leading to large queues and delays. This is particularly evident in the PM peak in the westbound direction.

A similar trend is found for the travel routes from Howick, where the travel time from Howick to Pakūranga is significantly shorter than the route from Howick to SEART during the AM peak, and the travel time in the opposite direction takes longer in the PM peak.

The Botany to Pakūranga route is expected to have the highest travel time variability (being the longest route) of +5.9 min and -4.7 min in westbound direction during the AM peak, with less variability in the eastbound direction during the PM peak. This equates to between 20-25% travel time variability in an urban environment.

Compared to the data in *Table 3* in the ITA, as congestion on the network increases and as travel times get longer, the variability also increases. This trend is observed in nearly all the modelled routes.

## 2.2 Do-Minimum Bus Travel Time Variability

**Table 2** shows the modelled Do-Minimum (2028) bus travel time variability. The same bus routes have been assessed here as per the ITA.

Table 2: Do-Minimum scenario (2028) bus travel time variability

Modelled Route Extent	AM Peak					
	Westbound			Eastbound		
	Do-Minimum [min]	Variability + [min]	Variability - [min]	Do-Minimum [min]	Variability + [min]	Variability - [min]
70 – Botany bus station to Ellerslie Panmure Hwy / Clare Pl	42.3	3.5	-3.2	26.9	1.9	-1.6
351 – Botany bus station to Tī Rākau Dr / Harris Rd	16.2	6.8	-5.5	5.3	1.1	-0.6
352 – Tī Rākau Dr / Harris Rd to Panmure station	27.5	4.6	-3.4	18.7	1.8	-1.6
353 – Botany bus station to Tī Rākau Dr / Harris Rd	16.2	6.8	-5.5	5.3	1.1	-0.6
Modelled Route Extent	PM Peak					
	Westbound			Eastbound		
	Do-Minimum [min]	Variability + [min]	Variability - [min]	Do-Minimum [min]	Variability + [min]	Variability - [min]
70 – Botany bus station to Ellerslie Panmure Hwy / Clare Pl	35.7	4.9	-3.6	38.1	4.2	-3.0
351 – Botany bus station to Tī Rākau Dr / Harris Rd	8.2	1.5	-2.0	15.3	2.7	-1.7
352 – Tī Rākau Dr / Harris Rd to Panmure station	24.1	3.2	-2.7	20.9	2.5	-1.9
353 – Botany bus station to Tī Rākau Dr / Harris Rd	8.2	1.5	-2.0	15.3	2.7	-1.7

An overall trend is observed where bus travel time variability is higher for nearly all the bus services in the westbound direction, during both the AM and PM peaks, compared to the eastbound direction. This suggests that the westbound direction may be operating near capacity, and small fluctuations in demand could cause queues to build up. The 351 and 353 services experience relatively large travel time variability in the westbound direction during the AM peak (+6.8 min), compared to the eastbound direction. This further highlights potential capacity constraints on Tī Rākau Drive between Te Irirangi Drive and Harris Road.

Compared to the general traffic travel time data in **Table 1**, buses have a higher travel time and variability on sections of the network where no bus priority is available. This is not unexpected as buses stop at bus stops as well as intersections. Also, buses travel in the kerbside lanes in the existing environment, and on average experience a higher side-friction effect from driveways fronting Tī Rākau Drive.

## 2.3 EB2/EB3/EB4 General Traffic Travel Time Variability

Table 3 shows the modelled general traffic travel time variability upon completion of EB2, EB3 and EB4.

Table 3: EB2/EB3/EB4 general traffic travel time variability

AM Peak						
Route	Westbound			Eastbound		
	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]
Botany - Pakūranga	14.7	4.2	-2.6	13.6	4.2	-3.0
Botany - SEART	15.0	4.9	-4.1	12.8	3.7	-2.3
Howick - Pakūranga	6.6	4.0	-1.1	4.4	1.0	-0.5
Howick - SEART	6.6	2.5	-1.2	5.4	2.1	-1.1
PM Peak						
Route	Westbound			Eastbound		
	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]
Botany - Pakūranga	12.7	1.1	-1.1	16.4	2.9	-3.6
Botany - SEART	10.2	0.8	-0.6	17.4	2.7	-3.0
Howick - Pakūranga	3.8	0.3	-0.2	4.0	0.2	-0.4
Howick - SEART	2.8	0.1	-0.1	8.1	1.4	-1.1

The vast majority of the modelled general traffic routes are expected to experience reduced or roughly similar travel time variability upon completion of EB2, EB3 and EB4, in both directions in the AM and PM peaks.

A marginal increase in travel time variability of +1.2 min is expected for the eastbound Botany – Pakūranga route in the AM peak, compared to the Do-Minimum. This is due to the network being optimised to prioritise westbound movements during the AM peak.

The eastbound Howick – SEART route is also expected to experience a marginal increase in variability of +0.9 min in the PM peak. However, this still equates to a variability of roughly 17%.

Travel time variability is not to be confused with travel time savings. As stated in the ITA, in terms of travel time (journey time) and benefits of the proposed busway, improvements are expected in nearly all of the routes, particularly in the eastbound direction as a result of the completion of EB3C and EB4 in addition to the travel time improvements from EB2 and EB3R.

## 2.4 EB3C/EB4i/EB4L Bus Travel Time Variability

Table 4 shows the modelled bus travel time variability upon completion of EB2, EB3 and EB4.

Table 4: EB2/EB3/EB4 bus travel time variability

AM Peak						
Modelled Route Extent	Westbound			Eastbound		
	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]
70 – Botany bus station to Ellerslie Panmure Hwy / Clare Pl	25.3	3.0	-3.5	25.5	2.0	-2.3
351 – Botany bus station to Tī Rākau Dr / Harris Rd	7.2	1.3	-0.9	7.9	1.8	-1.0
352 – Tī Rākau Dr / Harris Rd to Panmure station	20.0	5.0	-3.7	21.0	3.4	-2.8
353 – Botany bus station to Tī Rākau Dr / Harris Rd	7.2	1.3	-0.9	7.9	1.8	-1.0
705 – Botany Rd / Golfland Dr to Panmure station	26.8	2.9	-2.7	-	-	-
706 – Botany bus station to Panmure station	21.8	1.8	-2.3	-	-	-
PM Peak						
Modelled Route Extent	Westbound			Eastbound		
	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]
70 – Botany bus station to Ellerslie Panmure Hwy / Clare Pl	25.4	2.4	-1.7	27.0	2.8	-2.0
351 – Botany bus station to Tī Rākau Dr / Harris Rd	8.5	1.8	-1.4	9.0	2.2	-1.9
352 – Tī Rākau Dr / Harris Rd to Panmure station	20.8	3.6	-2.4	28.0	4.0	-2.6
353 – Botany bus station to Tī Rākau Dr / Harris Rd	8.5	1.8	-1.4	9.0	2.2	-1.9
705 – Botany Rd / Golfland Dr to Panmure station	-	-	-	27.5	2.8	-3.7
706 – Botany bus station to Panmure station	-	-	-	23.0	2.7	-2.4

Similar to the general traffic travel time variability in **Table 3**, the vast majority of the modelled bus routes are expected to experience reduced or roughly similar variability upon completion of EB2, EB3 and EB4, in both directions in the AM and PM peaks.

Travel time variability of the 70 service is expected to reduce in nearly all directions compared to the Do-Minimum, during both the AM and PM peaks, while remaining roughly similar eastbound in the AM peak. The highest variability being +3.0 min or 12%.

The 351 and 353 service variability are expected to reduce in the peak directions (AM = westbound, PM = eastbound), with more significant reductions in variability in the AM peak. Variability in the off-peak directions is expected to remain roughly similar.

Although the 352 service travel time variability is expected to remain roughly similar in the westbound direction, increases in variability are expected in the eastbound direction during both peak periods. The highest increase being +1.6 min in the AM peak, compared to the Do-Minimum. As per the ITA, this is due to its longer route, the two additional intersections the service has to pass through, as well as the operation of the Tī Rākau Drive / Burswood Drive / Greenmount Drive intersection. However, overall the highest variability is +5.0 min or 25%.

Again, with regard to travel time (journey time) and benefits of the busway, improvements in travel times are expected ranging from moderate to significant for the existing bus services upon completion of the Project.

Furthermore, the following measures have been included in the traffic signal design for the Project:

- Some form of priority is provided for buses, to balance the delays to vehicles and pedestrians
- Extending the current bus phase to enable an approaching bus to pass through the intersection
- Allowing the bus phase to interrupt once per cycle when a bus is on approach to the intersection
- Bus priority added in the form of approach and departure loops following review of traffic modelling
- Managing bus priority through SCATS using advance calls and departure loop inputs at each site
- Queue detection loops are provided on an as-needed basis only and in collaboration with AT

The above measures have been designed to adjust bus priority to suit traffic conditions and flow patterns, and to avoid blockage to busway movements and to operate intersections efficiently. Therefore, there will be opportunities to further improve upon the modelled bus travel time and variability.

## 2.5 Minimum Requirements (MR) for Public Transport Travel Time and Variability

As per clause 3.9.2 of the Minimum Requirements (MR) for the Project, the objective for the AMETI Programme is to provide infrastructure that delivers a travel time for buses of 20 min between Botany and Panmure, equating to a speed of 25kph. Note that the requirement of 20 min was based on a travel time for buses from Williams Avenue to Panmure of 4 min and allowing a 2 min interchange between Panmure Bus station and Rail station. This travel time between Williams Avenue (bus arriving) and Panmure has been adopted as the basis for meeting the travel time requirement for buses between Botany station and Williams Avenue station.

Using the AIMSUN models available to the Alliance described in *Section 3.6* of the MR, the Alliance shall ensure that The Project Design (including but not limited to the infrastructure requirements, traffic signal operations and bus pre-emption systems) meets, as far as practicable, the following (**Table 5**) busway performance requirements between Botany Town Centre Station and Williams Avenue bus station (in EB1) in both directions to meet the target 25kph speed for buses using the busway.

*Table 5: Performance requirements for busway services between Botany Town Centre and the Williams Avenue bus stop in EB1*

Performance Indicator	Morning (7:00 – 9:30am) and evening peak (4:00 – 6:30pm)
Average of the modelled bus speeds per 15-minute interval (from the time the bus departs the station at the start of the route to the time that the bus arrives at the station at the end of the route)	Less than or equal to 16 mins
Variability of the modelled bus speeds per 15-minute interval	Less than or equal to +/-3.2 mins (20%) of the average of the modelled bus speeds per 15-minute interval

Note – Eastern Busway Alliance will use best endeavours to achieve a travel time less than 16 minutes. The travel time of 16 minutes is for when the entire busway from Pakuranga Town Centre to Botany Town Centre is completed

Therefore, the goal of the Project is to provide a public transport trip from Botany Town Centre to Britomart Station of 40 min based on the Ultimate Outcome Scheme. Based on the travel time of the different segments of the trip as shown in **Table 6**, the travel time between Botany Town Centre and Williams Avenue is required to be no longer than 16 min, with a variability of +/- 20% (3.2 min).

*Table 6: Botany to Britomart travel time segmentation*

Botany Station to Williams Avenue	Williams Avenue to Panmure Bus Station	Transfer from Panmure bus station to train station	Panmure to Britomart by train	Total Travel Time
16	4	2	18	40

**Table 7** shows the modelled busway travel time variability as per the MR, upon completion of EB2, EB3 and EB4.

Table 7: Minimum Requirement bus travel time variability

AM Peak						
Route	Westbound			Eastbound		
	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]
Botany – Williams Ave	14.8	1.7	-2.0	15.5	2.0	-1.8
PM Peak						
Route	Westbound			Eastbound		
	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]	EB2/EB3/EB4 [min]	Variability + [min]	Variability - [min]
Botany – Williams Ave	14.4	1.3	-1.9	16.4	1.4	-1.3

From the results in **Table 7**, the average bus travel time in the AM peak period westbound is 14.8 min, and 15.5 min eastbound. In the PM peak period, the average bus travel time westbound is 14.4 min, and 16.4 min eastbound. The morning peak travel times are within the specified 16 min and therefore conform to the goal of a 40 min Botany Station to Britomart Station travel time.

The afternoon peak travel time of 16.4 min eastbound does not meet the specified 16 min. However, this marginable departure of 0.4 min is considered reasonable given that the MR is based on the Ultimate Outcome Scheme.

Travel time variability is also expected to meet the MR of less than or equal to +/- 20% (3.2 min).