

**BEFORE A BOARD OF INQUIRY
NORTHERN CORRIDOR IMPROVEMENTS PROPOSAL**

IN THE MATTER of the Resource Management Act 1991 (RMA)

AND

IN THE MATTER of a Board of Inquiry appointed under s149J of the RMA to consider notices of requirement and resource consent applications by the New Zealand Transport Agency for the Northern Corridor Improvements Proposal

**STATEMENT OF EVIDENCE OF MICHAEL TURNER HALL FOR KIWI SELF
STORAGE LIMITED**

TRAFFIC

DATED 25 MAY 2017

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1. Introduction

- 1.1 My full name is Michael Turner Hall. I have a Bachelor of Engineering with Honours from the University of Auckland, and am a Graduate member of the Institution of Professional Engineers New Zealand. I am currently employed as a transportation engineer at Traffic Design Group (“**TDG**”) and have held that position since 2013.
- 1.2 My work experience with TDG includes the transportation assessment and traffic modelling of numerous commercial, residential and institutional developments throughout Auckland. I have prepared traffic impact studies and Integrated Transport Assessments, designed parking and considered access arrangements.
- 1.3 I have been asked by representatives of Kiwi Self Storage Limited (“**Kiwi**”) to describe and assess the transportation issues related to its submission on the six Notices of Requirement (“**NOR’s**”) and 25 resource consent applications for the Northern Corridor Improvements project (“**NCI Project**”) as it relates to the Kiwi site at Holder Place.
- 1.4 I have visited Kiwi’s site at 12 Holder Place, Rosedale, Auckland (“**site**”) on two occasions. The first was on 4 April 2017 to undertake an initial view of the site layout and as part of this visit observed a bus driving through the Kiwi site. The second was on 18 May 2017 to collect video footage of vehicles moving through the site and to view the surveyed markings designating the proposed land take as part of the NCI project.

2. Code of Conduct

- 2.1 I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2014 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is entirely within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

3. **Scope of this evidence**

3.1 In my evidence I will discuss the following:

- (a) Existing visibility of the site;
- (b) Visibility Guidelines;
- (c) Design of the busway, motorway overbridge and shared path; and
- (d) The land take required as part of the project.

4. **Visibility of the site**

- 4.1 I have been engaged by Kiwi to review the proposed northern corridor design in order to reduce the visibility impacts on the site. Kiwi is concerned that the loss of visibility will result in reduced business associated with their self-storage activity located at 12 Holder Place which also has frontage, but not direct access to, the Auckland Northern Motorway section of State Highway One (“**SH1**”). The buildings within the site can be seen from both the northbound and southbound lanes on SH1.
- 4.2 Southbound traffic can first see the site, albeit briefly, from a location on the southbound carriageway of SH1 approximately 450m north of the site. Subsequently, the view of the site is then blocked by vegetation located on the eastern side of the motorway from about 400m north of the site through to approximately 200m from the site when visibility of the site is then re-established with clear views into the Kiwi buildings where the doors to the storage units are clearly visible to passing motorists. Attached as **Appendix A** is a series of photos showing visibility of the site when travelling south.
- 4.3 Northbound SH1 users are able to view the site from approximately 100m south of the site and to a point opposite the site itself. Attached as **Appendix B** is an image from Google Street View showing visibility of the site when travelling north. This image is of a better quality than what I was able to capture when undertaking a drive-by of the site on 24 May 2017.

5. Visibility Guidelines

- 5.1 The New Zealand Transport Agency's ("NZTA") "*Traffic Control Devices Manual, 2011, Part 3 Advertising Signs*" ("TCD 3") includes guidelines on industry good practice regarding the placement of advertising signage. Of particular relevance to the current site and its advanced visibility from SH1, Section 5.3 of the TCD 3 document includes recommended sight distances to be provided for motorists to be able to see, read and interpret a displayed roadside message clearly and safely.
- 5.2 The TCD 3 document is intended to be used for billboard signs that often include text as part of the image rather than buildings that do not include any text. Kiwi representatives have stated to me and will provide evidence to this hearing that a key part of their brand advertising message to passing motorists is the transparent windowed corner of their Holder Place site where the internal red doors to the storage units are clearly visible. I therefore consider the guidelines in the TCD 3 document to be conservative in this scenario as the 'message' being conveyed by the Kiwi buildings on site do not require assessment of any text message other than the Kiwi logo and the primary words "Secure Storage Units" located on the northern façade of the building visible to southbound motorists and passengers primarily.
- 5.3 The TCD 3 states that in a speed environment of 100km/h, such as a motorway like SH1, a driver has a 40° field of view - 20° either side of a "centreline of the road" if the driver is looking straight ahead. To make allowances for the driver to turn their head, 15° may be added to both the left and right hand sides of the field of view meaning an angle of 35° from the centre of the drivers' field of view.
- 5.4 In congested conditions, such as during peak hours, operating speeds of the motorway decreases significantly such as during the typical weekday morning, citybound commuter peak periods. At a speed of 50km/h, the driver's field of view increases to a total of 90° (or 45° either side of the centreline).
- 5.5 For southbound vehicles, the north-western corner of the building on-site is approximately 60m from the path of vehicles in the lane closest to the median. At a forward sight distance viewing position of 200m from the site, this creates

a viewing angle of 17° from the driver's position. This places the Kiwi site and associated branding messages clearly within the normal limits of a driver's field of view as set out in the industry-accepted guidance. The angle is reduced (i.e. even further within the range of acceptable fields of view) for vehicles in the leftmost lane of the Constellation Drive off-ramp and for the more southern parts of the Kiwi buildings.

- 5.6 For northbound drivers viewing the Kiwi site, the south-eastern corner of the building on-site is approximately 70m from the path of vehicles in the leftmost (kerbside) northbound lane. A forward sight distance of approximately 100m creates a viewing angle of approximately 35°. This is at the limit of the acceptable driver's field of view when allowing for a head-turn of 15°. The angle is reduced for vehicles in the rightmost (median) lane and for more northern parts of the on-site buildings. At lower operating speeds (such as during the weekday afternoon peak periods), where the driver's field of view increases, this site comes further into the accepted safe field of view for advertising messages.
- 5.7 I therefore conclude that the Kiwi site can currently be safely viewed by drivers traffic travelling in both directions on SH1 near the site. Obviously the sight distance restrictions do not apply to passengers in vehicles which may view the Kiwi site (and signage) for more extended periods.

6. **Proposed Busway Design**

- 6.1 The specimen design lodged by the NZTA for the NOR's and resource consents includes:
- (i) An extension to the Northern Busway along the eastern side of the SH1 carriageway;
 - (ii) A 4m wide shared-use (walking and cycling) path on the eastern side of the busway; and
 - (iii) New directional flyover ramps to connect SH1 directly to SH18.
- 6.2 The busway, shared path and southbound flyover from SH1 to SH18 will reduce visibility to the Kiwi Self Storage facility from the SH1 mainline traffic

lanes in the vicinity of the site and the Constellation Drive interchange. The exact extent of visibility reduction is not certain and will be based on renders to be provided by NZTA. The busway and shared path are proposed to be at a higher level than the existing ground level of the land between the site and the SH1 carriageway, hence the future increased elevation of the NCI structural and carriageway elements will reduce visibility to the lower parts of the site.

- 6.3 The specimen design lodged with the NOR's and resource consents indicates that the proposed NCI carriageway structure (and associated retaining wall to support the carriageway of the busway) at the northern end of the Kiwi site will be some 5.7m above the existing ground level and will result in less than 1m of the building (not including protruding signage) being above the surface level of the busway. The cross sections of the specimen design also show the busway at a higher elevation than the existing SH1 mainline. At the northern end of the site the busway is 1.1m above the mainline levels which increases to 1.9m at the southern end of the site.
- 6.4 The gradient of the busway and shared path adjacent to the site in the lodged specimen design is 5%. The busway is designed to integrate into the Constellation Drive Northern Busway Station and to bridge over Constellation Drive. It is my professional opinion that a bridge over Constellation Drive is critical to ensure that the busway achieves fast and reliable travel times for buses that use it in the future.
- 6.5 The busway and shared path design currently includes a 6.1m minimum clearance over Constellation Drive. This includes allowing for the 200mm depth of the deck and the 1525mm super-T concrete beams that will support the bridge deck.
- 6.6 The NZTA Bridge Manual 3rd Edition ("**Bridge Manual**") sets out the criteria for the design of bridges for use on State Highways. The Manual states that the desirable clearance for a bridge over a road is 6.0m above traffic lanes and 5.6m for shoulders and footpaths. The absolute minimum requirements are 4.9m and 4.5m for those respective situations.

- 6.7 The desirable clearance becomes the minimum clearance for over-dimension routes, however based on my research of the defined over-dimensioned routes managed by NZTA and Auckland Transport, I can confirm that Constellation Drive is not an over-dimension route. The absolute minimum clearance required over Constellation Drive is therefore 4.9m.
- 6.8 The SH1 mainline currently bridges over Constellation Drive at a gradient of 5.6%, which buses are currently able to negotiate, and has a clearance of approximately 5.3m. No changes to this bridge structure are included as part of the proposed works. The proposed busway therefore has a shallower grade and a higher clearance over Constellation Drive than the existing SH1 mainline. Based on meetings I have attended with the NZTA designer Mr Gary Moore of Aurecon, I understand that the busway clearance over Constellation Drive is constrained by the need to provide sufficient forward sight distances for buses.
- 6.9 Mr Moore has indicated that the height of a nominal object on the road used in the Aurecon design is 0.2m and that the observation height of a bus driver is 1.8m above the road surface. These parameters are concordant with the AUSTROADS design guides and I agree that these values are appropriate for the busway design.
- 6.10 The vertical curve provided between the Constellation Drive Station and the grade adjacent to the site has been designed so that forward visibility is maintained for buses in both directions. Buses exiting from the Constellation Drive Station will undertake a series of turns when pulling away from the kerb after loading or unloading passengers. A horizontal curve combined with a vertical curve at the same time can result in a 'roller coaster' effect where the passengers experience a change in both the vertical and horizontal planes which can be uncomfortable. The Aurecon specimen design included in the NOR's and resource consents included a section of 42m to longitudinally (i.e. along the road rather than across the road or vertically) to separate the proposed specimen design's vertical curve from the horizontal curves. By allowing this vertical curve to start at the end of the horizontal curve (while still maintaining forward sight distance), the clearance of the bridge over

Constellation Drive can be reduced to 5.6m, which still satisfies the NZTA minimum requirements, and maintains the 5% gradient adjacent to the site.

- 6.11 The shift of the vertical curve to the south reduces the level of the busway by approximately 1.6m adjacent to the western face of the buildings on the Kiwi site, achieving a height of the busway and shared path some 4.2m above the existing ground level.
- 6.12 A further adjustment to the longitudinal grade along the centreline of the proposed busway between the Constellation Drive overbridge and the Kiwi site will allow for the busway to be constructed at an even lower level further reducing the impact of the height of the proposed busway retaining structure on the visibility to the Kiwi site.
- 6.13 The steepest grade on the existing sections of the Northern Busway is 5.34%. This gradient occurs at a location south of the Constellation Drive Station and north of Sunnynook Road, and involves a length of approximately 630m of the busway at this grade.
- 6.14 It is my opinion that the gradient of the busway can be increased to 5.34% adjacent to the Kiwi site to achieve a similar gradient to other local sections of the busway. This will not in my opinion result in the busway vehicles needing to ascend or descend at any more excessive grades than what they are already undertaking on other parts of the busway.
- 6.15 The modest increase in grade from 5.00% to 5.34% will allow for shallower grades to be provided north of the Kiwi site to allow for a smooth connection into the vertical sag curve some 300m north of the site.
- 6.16 The length of the proposed busway design at a 5% grade (as per the specimen design proposed by Aurecon on behalf of NZTA) is approximately 300m. If a steeper grade was to be developed past the Kiwi site this may also allow for a shorter length where the busway is at a 5% or higher grade. The rate of change of the vertical curve between the Constellation Drive Station and the site will also decrease if the grade is made steeper in order that sufficient forward sight distance is maintained.

- 6.17 Based on the design produced by Aurecon, the shifting of the vertical curve over Constellation Drive to the south and adopting a 5.34% longitudinal gradient, results in the busway being some 2.1m below the notified specimen design adjacent to the western boundary of the site in line with the northern face of the northern building. This alternative would also be 0.5m below the design that included the shift of the vertical curve while maintaining the 5% grade.
- 6.18 I expect that the reduction in height of a retaining wall adjacent to the western boundary of the Kiwi site and the reduction in earth fill required would be cheaper and easier to build giving benefits to NZTA. Similarly, I would also expect that it is cheaper and easier to build a bridge, such as that proposed over Constellation Drive, which has a lower clearance. The exact quantity of savings would be able to be calculated by a suitably qualified quantity surveyor.
- 6.19 I consider that this proposed modification to the gradients of the proposed busway is suitable for the busway and would lead to an equivalent level of service and safety to that proposed within the specimen design by Aurecon.

7. **Light Rail**

- 7.1 In Mr Moore's evidence, he stated that the horizontal and vertical alignment of the busway will allow conversion to light rail transit in the future. No dates or project timelines are currently available for the potential conversion of the busway to light rail.
- 7.2 I am aware of other existing light rail networks in the world with gradients in excess of 5%, and in particular what gradients the vehicles on such networks are able to achieve. The table below summarises the maximum gradients on various networks around the world.

City	Maximum Gradient
Wurzburg, Germany	10.8%
Sheffield, UK	9%, 10% short section
Portland, USA	7%
Sacramento, USA	7%
Edinburgh, UK	7%
Gold Coast, Australia	7%, 10% short section
Sydney, Australia	7%

- 7.3 The table shows that a maximum grade of 7% or higher is not an uncommon occurrence for light rail networks.
- 7.4 A conversion of the busway into a light rail route will incorporate the existing 5.34% grade on the southern side of the Constellation Drive station. I expect that the vehicles purchased by the operator of the potential light rail network will be able to accommodate this existing grade and that such vehicles should be able to navigate another section at the same grade.
- 7.5 Auckland Transport in 2016 has prepared standards for the design of a light rail network. The standards state that the desirable maximum design gradient for the light rail network should not exceed 7% and the absolute maximum gradient should not exceed 8.5%.
- 7.6 Mr Moore has stated in meetings that these standards have been developed for the inner city environment such as Queen Street when the operating speed is 50km/h and are therefore not applicable to the northern busway where the design speed is 80km/h. No such restrictions are stated in the Auckland Transport standards.
- 7.7 I therefore consider that the proposed modification to the 5.34% grade is suitable for a light rail network if it is decided to convert the busway to a light rail route in the future.

8. Shared Path Design

- 8.1 A 5m wide shared use path is proposed within the specimen design to run adjacent to the eastern side of the busway, but is not proposed to extend beyond the Constellation Drive Bus Station.
- 8.2 The 5m width is concordant with the AUSTRROADS Guide to Road Design “*Part 6A: Pedestrians and Cyclist Paths*”. The proposed 5m width comprises of a 3m lane, which is the desirable minimum width for commuters, and 1m shoulders on each side of the path to separate cyclists from the walls protecting pedestrians and cyclists from falling off the path or from busway vehicles entering the shared path space. I consider that the width of the shared path is suitable for the intended purpose of the shared path.
- 8.3 Part 6A of the AUSTRROADS Guide to Road Design states that a 3% grade is the desirable maximum for cyclists to travel uphill. For grades above 3%, the desirable length of grade decreases significantly. At a 5% grade, the desirable length of gradient recommended by the AUSTRROADS guide is 75m and the acceptable length at this grade is 110m. However, at a longitudinal gradient of 5.34% (as per my earlier recommendation to match existing parts of the current busway), the desirable length reduces to 70m and the acceptable grade length reduces to 100m. The desirable and acceptable uphill grade lengths are therefore not significantly different between a 5% uphill gradient (as per the Aurecon specimen design) and a 5.34% grade (as per my recommendation) – being only between 5 and 10m.
- 8.4 For safety reasons in relation to the provision of facilities for cyclists travelling downhill, the AUSTRROADS Guide states that gradients in excess of 5% should not be provided unless it is unavoidable. This is particularly important if there are sharp horizontal curves or fixed objects at the bottom of the slope. The shared path design included in the specimen design however does not include any sharp turns, intersections of fixed objects within 200m of the bottom of the slope. Clear sight distance for downhill cyclists is provided which will allow riders to react to any uphill riders, pedestrians or other obstacles on the path. These factors do not prohibit the allowance of a gradient in excess of 5%.

- 8.5 It is my opinion that given the presence of clear sight distance, and the absence of sharp horizontal curves, intersections and fixed objects in the path proposed will allow for a steeper grade up to 5.34% in this area without any significant adverse safety effect compared with the Aurecon specimen design.
- 8.6 By way of an example, the Grafton Gully shared path adjacent to SH16 between Grafton and Parnell is an example of an existing shared path that includes gradients in excess of 5.34%. I have measured the gradients on the path and found that the maximum gradient was 12.3% in a location approximately 110m east of where the path passes underneath the Symonds Street on-ramp. The 12.3% measurement was taken within a 250m section where the average gradient over this length exceeds 5.4%. This steep section is itself part of a much longer 750m slope.
- 8.7 I also recorded other shorter sections along the Grafton Gully path with gradients in excess of 5.4% such as a 7.8% measurement on approach to Upper Queen Street and a 10.5% grade just north of the Wellesley Street underpass.
- 8.8 At the bottom end of the 750m slope, is the intersection between the Grafton Gully path and the connection to Wellesley Street. A horizontal curve is also present where the Grafton Gully path passes under Wellesley Street. I also measured the forward sight distance available to northbound cyclists. In general, the forward sight distance is very good however I measured that it decreases to 37m on approach to the Wellesley Street underpass due to the horizontal geometry of the path and the vegetation/structure adjacent to the path surface. In my opinion these factors reduce the level of safety on the path but nonetheless the path continues to offer a reasonable balance between the effective connection of cycling routes in this part of the city and the relative safety of path usage.
- 8.9 However, by comparison such restrictions and factors are not present as part of the proposed shared path adjacent to the Northern Busway Extension and the Kiwi site. I therefore consider that the proposed path, including the changes I recommend to gradient, conforms more closely to the AUSTROADS Part 6A guidelines than the existing Grafton Gully path.

- 8.10 On 22 May 2017, I undertook a search of the NZTA's Crash Analysis System for all reported crashes on the Grafton Gully shared path since it was opened to the public in September 2014. The search found that no crashes have occurred and been reported on the cycle path since its opening approximately three years ago.
- 8.11 The safety record on the path suggests that the shared path can operate safely despite the presence of factors that may reduce its level of safety. It is my opinion that the proposed shared path adjacent to the northern busway can also enjoy a similar or better safety record to Grafton Gully at a 5.34% grade.

9. **Land take of the site**

- 9.1 The proposed busway and cycle path design requires a strip of land approximately 0.3m in width to be taken from the Kiwi site, as measured in-line with the western face of the northern Kiwi building. A further 0.7m will be required during construction bringing the total land take to 1.0m from the current western retaining wall. The land take will have a noticeable effect on the operation of left-turning vehicles from the driveway between the two on-site buildings. Large storage units on the ground floor are accessed and serviced from this central driveway.
- 9.2 Kiwi organised two security cameras to record the types of vehicles that frequent the site. Multiple vehicles at 9m and 10m length were observed using the central driveway.
- 9.3 Currently large vehicles find the left turn out of the central driveway to be challenging and often require a reverse manoeuvre to complete the turn. Vehicles are currently permitted to park on either side of the driveway during loading and unloading. The reduction in width near this intersection may therefore result in further limitations to the types and sizes of vehicles that can service the larger ground floor units accessed from the central driveway.
- 9.4 I have undertaken a swept path analysis of a standard 8m rigid truck and an 11.5m rigid truck to undertake this turn. These vehicles are standard vehicle types used in general traffic engineering assessments of site developments around Auckland.

- 9.5 The analysis of the 8m truck demonstrated that it can complete this turn even allowing for the permanent removal of land for the busway and shared path. However it was not able to complete a turn without reverse manoeuvring if the extra land is taken and occupied by construction or related activities during the NCI Project's construction phase.
- 9.6 The 11.5m truck is currently only able to complete its turn with multiple short reverse manoeuvres. The permanent reduction in land area available results in even more reverse manoeuvres required. It is likely that assistance from the on-site staff would be required to assist the driver of the vehicle to complete their turn in this scenario. The land take required during the construction phase is significant enough to prevent an 11.5m truck from turning out of the central driveway.
- 9.7 It is my opinion therefore, that smaller vehicles within the Kiwi site can operate without significant effect as a result of the permanent land take. However, larger vehicles are likely to experience additional difficulty by needing to undertake additional turns and manoeuvres which can be managed but there will be an extra inconvenience to drivers particularly those less experienced with the site and those associated with larger vehicles. There will be more significant effects during the construction phase (when further land is required to facilitate the construction allowance) and that activity is expected to have further adverse effects on the operation and usability of the ground floor units.

10. **Conclusion**

- 10.1 For the reasons set out in this evidence, I consider that the gradient of the busway and shared path can be increased from the Aurecon specimen design gradient of 5% to 5.34%, (and clearance of the Constellation bridge reduced to 5.6m), in order to minimise the visual impacts on the site, without significant adverse effects being experienced by users and operators of the busway and shared path.
- 10.2 The permanent land take along the western boundary of the site will not significantly affect most vehicle operations within the site, but the additional land required during the construction period will have a significant effect on the ability for larger vehicles to manoeuvre within the Kiwi site. As a result, I expect

that the land take required during construction will also affect the operation of the central driveway between the on-site buildings.

MT Hall

Michael Turner Hall

25 May 2017

APPENDIX A

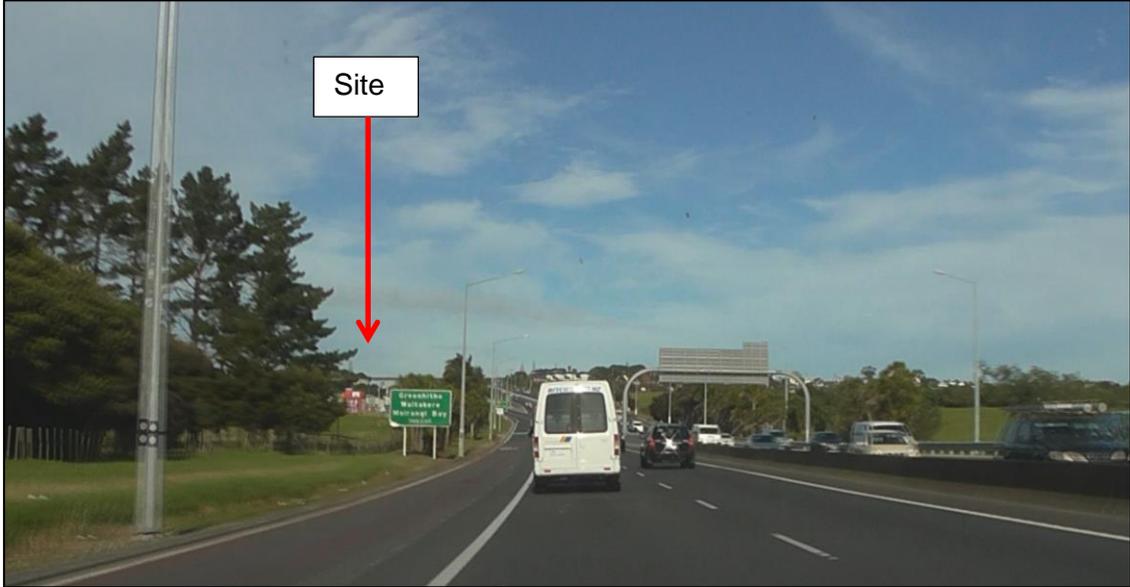


FIGURE 1: VIEW FROM APPROXIMATELY 450M NORTH OF THE SITE



FIGURE 2: HINDERED VIEW FROM APPROXIMATELY 300M NORTH OF THE SITE



FIGURE 3: VIEW FROM APPROXIMATELY 200M FROM THE SITE

APPENDIX B



FIGURE 4: VIEW FROM APPROXIMATELY 100M SOUTH OF THE SITE