

M2 Hills Motorway: Eden Gardens

Proposed Digital Sign Traffic Safety Assessment

Manboom Signage

24 November 2022



Gold Coast

Suite 26, 58 Riverwalk Avenue
Robina QLD 4226
P: (07) 5562 5377

Brisbane

Level 2, 428 Upper Edward Street
Spring Hill QLD 4000
P: (07) 3831 4442

Sydney

Studio 203, 3 Gladstone Street
Newtown NSW 2042
P: (02) 9557 6202

W: www.bitziosconsulting.com.au

E: admin@bitziosconsulting.com.au

Copyright in the information and data in this document is the property of Bitzios Consulting. This document and its information and data is for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or in part for any purpose other than for which it was supplied by Bitzios Consulting. Bitzios Consulting makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or its information and data.

The assessment team has undertaken assessments of similar digital advertising sign proposals elsewhere in NSW and Australia. In addition to the use of NSW guidelines, our assessments are founded on road safety auditing principles and traffic safety risk assessments. Where a significant change in road safety risk has been identified due to the proposal, potential treatment measures to mitigate the change in risk have been suggested. However, the adoption of any or all the treatment measures does not warrant that the site is absolutely safe from incidents in the future whether they be related or unrelated to the proposed digital sign.

Document Issue History

| Report File Name | Prepared | Reviewed | Issued | Date | Issued to |
|--|------------------------|------------|-----------|------------|--|
| P5486.001R M2 Eden Gardens Macquarie Park Digital Sign TSA | A. Suriono / S. Daizli | D. Bitzios | S. Daizli | 8/08/2022 | Gerry Thorley, Digital Place Solutions gerry@digitalplacesolutions.com |
| P5486.002R M2 Eden Gardens Macquarie Park Digital Sign TSA | S. Daizli | S. Daizli | S. Daizli | 28/09/2022 | Gerry Thorley, Digital Place Solutions gerry@digitalplacesolutions.com |
| P5486.003R M2 Eden Gardens Macquarie Park Digital Sign TSA | S. Daizli | S. Daizli | S. Daizli | 19/10/2022 | Gerry Thorley, Digital Place Solutions gerry@digitalplacesolutions.com |
| P5486.004R M2 Eden Gardens Macquarie Park Digital Sign TSA | S. Daizli | S. Daizli | S. Daizli | 24/11/2022 | Gerry Thorley, Digital Place Solutions gerry@digitalplacesolutions.com |

CONTENTS

| | Page |
|---|-----------|
| 1. INTRODUCTION | 1 |
| 1.1 Background | 1 |
| 1.2 Methodology | 1 |
| 2. SIGN VIEWING LOCATIONS | 2 |
| 2.1 Viewing Approaches | 2 |
| 2.2 Driver Views | 2 |
| 3. DIGITAL SIGN SPECIFICATIONS | 3 |
| 4. LITERATURE REVIEW | 4 |
| 4.1 Context | 4 |
| 4.2 Relationships between Distraction and Crashes | 4 |
| 4.3 Relationships between Digital Sign Glances and Distraction | 6 |
| 4.4 The Relationship between Digital Signs and Crashes | 8 |
| 4.4.1 International Examples | 8 |
| 4.4.2 Local Examples | 9 |
| 4.5 Research Interpretation | 10 |
| 5. TRAFFIC SAFETY ASSESSMENT | 11 |
| 5.1 Key Assumptions | 11 |
| 5.2 Site Inspection | 11 |
| 5.3 Review of Crash Data | 11 |
| 5.4 Approach Sightline Assessments | 11 |
| 5.4.1 Description of Approaches | 11 |
| 5.4.2 Driver Sightline Assessment | 12 |
| 5.5 Compliance Assessment | 14 |
| 5.5.1 Industry and Employment SEPP Schedule 5 | 14 |
| 5.5.2 Transport for NSW Advertising Sign Safety Assessment Matrix | 14 |
| 5.5.3 Transport Corridor Outdoor Advertising and Signage Guidelines Table 3 | 15 |
| 6. CONCLUSIONS | 17 |
| REFERENCES | 18 |

Tables

| | |
|------------|--|
| Table 3.1: | Specifications and Site Information for the Proposed Digital Sign |
| Table 4.1: | Causes of Vehicle Crashes in NSW and Victoria |
| Table 4.2: | Pre and Post-installation Crash Data Comparison – M2 Digital Signs (2012-2021) |
| Table 5.1: | Approach Attributes – M2 northbound |
| Table 5.2: | Assessment against Industry and Employment SEPP Schedule 5 |
| Table 5.3: | Assessment against the Transport for NSW Advertising Sign Assessment Matrix |
| Table 5.4: | Assessment against the Signage Guidelines Digital Sign Criteria |

Figures

| | |
|-------------|--|
| Figure 1.1: | Location of the Proposed Digital Sign |
| Figure 2.1: | Driver Viewing Range to the Proposed Sign |
| Figure 2.2: | Daytime view from the M2 northbound |
| Figure 5.1: | In-vehicle viewing range and views along the M2 northbound |

Appendices

Appendix A: Proposed Development Plan

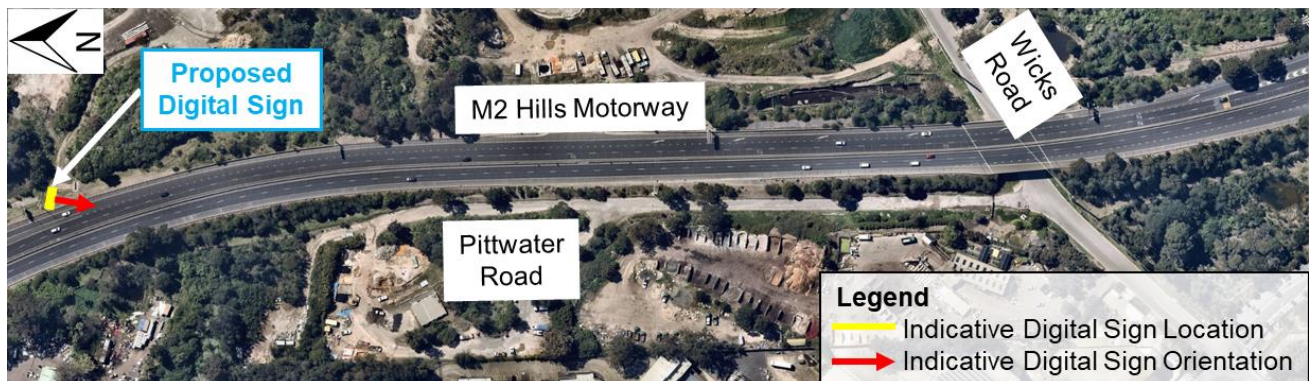
Appendix B: Existing M2 Digital Sign Crash Data Comparison Technical Note

Appendix C: Photo Montages

1. INTRODUCTION

1.1 Background

Manboom Signage is seeking development approval for the installation of a digital LED advertising sign. The sign is proposed to be located on the eastern side of the M2 Hills Motorway (M2), adjacent to the Lane Cove Road eastbound merge (referred to as Eden Gardens), in Macquarie Park as shown in Figure 1.1.



**Sign location is indicative.
Adapted from Nearmap*

Figure 1.1: Location of the Proposed Digital Sign

Bitzios Consulting has been engaged by Manboom Signage to undertake a traffic safety assessment of the proposal.

1.2 Methodology

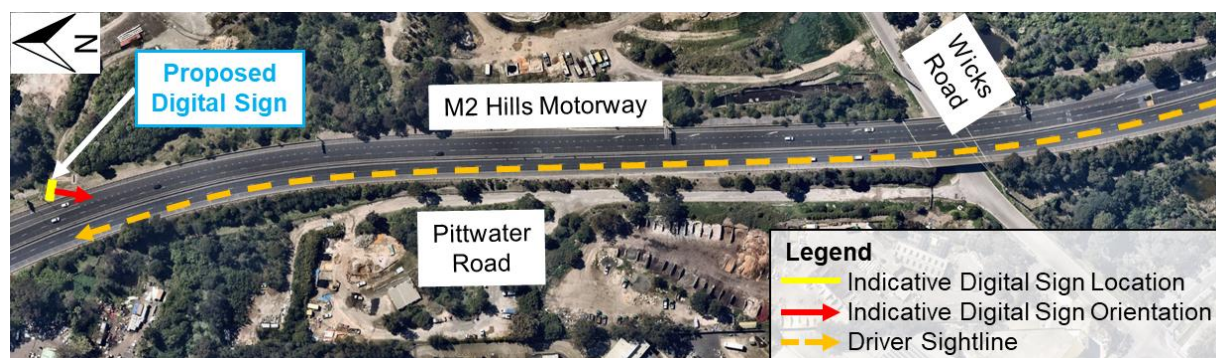
The process used to assess the impact of the proposal involved:

- A review of the viewing locations and sightlines to the proposed digital sign to define the geographical scope of the assessment
- A review of the proposed digital sign specifications
- A review of relevant research of the effects of digital signs on driver distraction in different driving circumstances
- A before versus after installation crash analysis study and documenting the results of 12-month post-opening safety assessments for nine other digital signs along the M2
- A site inspection during day conditions to understand the road user's perspective of the sign, then a driver sightline assessment using images captured from in-vehicle video recordings
- A first-principles safety assessment of the proposed digital sign, including reviewing road approaches, driver sightlines, surrounding environment and proximity of intersections
- A review of the most recently available five years of crash data in proximity to the sign
- An assessment of the proposed digital sign against:
 - State Environmental Planning Policy (Industry and Employment) 2021 (Industry and Employment SEPP)
 - The Transport for NSW Advertising Sign Safety Assessment Matrix
 - The *Transport Corridor Outdoor Advertising and Signage Guidelines: Assessing development applications under SEPP 64* (Department of Planning and Environment, November 2017) (Signage Guidelines).

2. SIGN VIEWING LOCATIONS

2.1 Viewing Approaches

The digital sign is proposed to face south (only) towards northbound drivers along the M2. The driver viewing range to the sign from this approach is illustrated in Figure 2.1 and demonstrates a relatively long distance on approach to the proposed sign from which it can be identified.



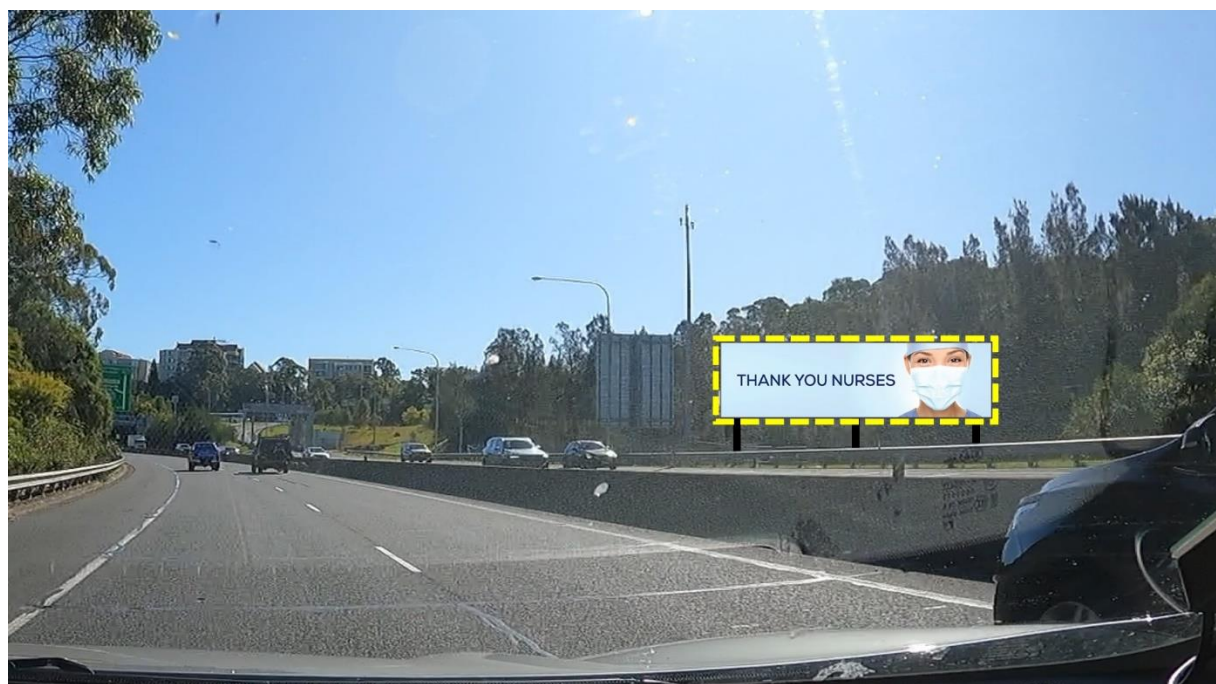
**Sign location is indicative. / Adapted from Nearmap*

Figure 2.1: Driver Viewing Range to the Proposed Sign

The ability to recognise the sign and to recognise its content are two different things. The sign could be identified as an object from approximately 535m away as shown in Figure 2.1, however, its content is only likely to be recognisable from about 200m away, depending on the content of the advertisement. The sign will appear at the windscreen as an object that is 6cm wide and 1.7cm high when 200m from it.

2.2 Driver Views

The northbound sign view from the M2 during the daytime period is shown in Figure 2.2.



**Sign location is indicative, not to scale and for illustration purposes only.*

Figure 2.2: Daytime view from the M2 northbound

3. DIGITAL SIGN SPECIFICATIONS

The specifications for the proposed digital sign, as well as other relevant site information, are summarised in Table 3.1. The proposed development plan is provided in **Appendix A**.

Table 3.1: Specifications and Site Information for the Proposed Digital Sign

| Attribute | Details |
|---|--|
| Location | Eastern side of the M2, adjacent to the Lane Cove Road eastbound merge (Eden Gardens), Macquarie Park, NSW |
| Local Government Area | Ryde |
| Land use zoning | SP2 Classified Road |
| Proposed facing direction | South |
| Proposed type of advertisement/sign | Freestanding advertisement – supersite |
| Proposed display format | Internally illuminated digital (LED) |
| Proposed visual screen size | 12.48m x 3.20m = 39.94m ² |
| Proposed advertising display area | 12.53m x 3.35m = 41.98m ² |
| Visual screen size greater than 20m ² ? | Yes |
| Visual screen size greater than 45m ² ? | No |
| Structure higher than 8m above the ground? | No |
| Is the site located within 250m of and visible from a classified road under the <i>Roads Act 1993</i> ? | Yes |
| Consent authority | NSW Minister for Planning |
| Does the sign contain moving parts? | No |
| Is it a Variable Message Sign? | No |
| Does it have any flashing or flickering content? | No |

4. LITERATURE REVIEW

4.1 Context

Crashes directly related to digital signs would typically fall into two categories:

- Crashes due to the collision of a vehicle with the mounting structure of a digital sign where the sign is placed in a location where there is a reasonable risk of this occurring
- Crashes which occur as a consequence of a driver being distracted by a digital sign.

The available *Digital Signage Guidelines* generally provide well-researched information on the location of 'clear zones' and other areas where there is a reasonable risk of an object being collided with by an errant vehicle. The linkages between driver distraction due to digital signs and crashes is less well dealt with in the available *Digital Signage Guidelines* and many of the criteria used have no direct relevance of the risk of distraction in time and in space on approach to digital signs located in different parts of the visual driving environment and in different driving environments.

The chain of events that is required to link a digital sign to increased crash rates is that:

- *A driver is aware of an external event (i.e. outside the vehicle) which is a digital sign display change and that the event distracts a driver sufficiently to lead to involuntary driver inattention which then leads to driver error at a critical time in a driving environment and driving circumstance that leads to a crash.*

As there is no body of research that links the installation of a digital sign or the conversion of a static sign to a digital sign to increased crash rates, the available research has been disaggregated into:

- The relationship between distractions (generally) and crashes
- The relationship between digital signs and distractions
- Studies which have attempted to interpret before v after installation crash statistics to see if there is a correlation of digital signs with crash rates (without defining a causal relationship).

Research on each of these topics is summarised below.

4.2 Relationships between Distraction and Crashes

It is important to note that distraction from digital or static billboards did not feature in the top 15 causes of driver distraction. As such, this data further validates the research consensus that there is no valid link between roadside advertising and increased crash risk. There is consensus in the literature that the majority of crashes which occur in urban areas are due to driver error. Victor et al. (2005) highlights that human error is the cause of up to 92.6 percent of accidents on the road. In order to minimise the risk of crashes drivers need to: be aware of external environmental influences, interpret the risks associated with these external environmental influences, make decisions, and carry out actions (Perez & Bertola 2011).

Even though human error is the cause of most crashes, Lam (2002) reviewed NSW crash data and found that out of 414,136 crashes, distraction was a factor in 15,059 (3.6%) of them. Distractions coming from outside the vehicle were determined to be a factor in only 2.5% of all crashes. This low influence of external distractions to crashes was reinforced by the Monash University Accident Research Centre (MUARC) carried out a study on crashes in Victoria and NSW between 2000 and 2011 and found the most common causes of crashes as summarised in Table 4.1. The most common cause of crashes was a combination of driver inattention and driver distraction. Distraction and inattention may occur separately. That is, a driver may be distracted but still attentive.

Table 4.1: Causes of Vehicle Crashes in NSW and Victoria

| Percentage of Crashes | Cause |
|-----------------------|-----------------------------|
| 13.5% | Intoxication |
| 11.8% | Fell asleep |
| 10.9% | Fatigued |
| 3.2% | Failed to look |
| 3.2% | Passenger interaction |
| 2.6% | Fell ill |
| 2.6% | Blacked out |
| 1.8% | Feeling stressed |
| 1.5% | Looked but failed to see |
| 1.4% | Animal or insect in vehicle |
| 0.9% | Using a mobile phone |
| 0.9% | Changing CD/cassette/radio |
| 0.9% | Adjusting vehicle systems |
| 0.9% | Looking at vehicle systems |
| 0.3% | Searching for objects |

Source: <http://www.keepyoureyesontheroad.org.au/pages/Accident-statistics-Cont>

Austroads (2013) provides a comprehensive review of research on the effect of roadside advertising on road crashes. It found from its extensive literature review that *“while looking at an external object appears to be quite risky behaviour when it is engaged in, it is not a frequent cause of crashes overall”*.

Many studies have been undertaken to determine the main causes of both driver distraction and driver inattention, and how they contribute to an increase in crashes. Regan et al. (2011, p.1771) describes driver distraction as a *“diversion of the mind, attention, etc., from a particular object or course; the fact of having one’s attention or concentration disturbed by something”*. This includes objects brought into the vehicle, vehicle systems, vehicle occupants, moving objects or animals in the vehicle, internalised activity, and external objects, events or activities (Perez & Bertola 2011). A broader definition of driver inattention is defined as *“when the driver’s mind has wandered from the driving task for some non-compelling reason”* (Regan et al. 2011, p.1772).

4.3 Relationships between Digital Sign Glances and Distraction

Samsa (2015) conducted a study that used eye tracking technology to track participant's natural eye movements and prioritisation behaviour whilst driving. Participants were each instructed to drive a single loop of the study route (14.6km section of a road through Brisbane and its surrounding suburbs to Woolloongabba) between 11am and 2pm. This study found that participants prioritised tasks based on the complexity of the driving demands, which was particularly evident during heavy traffic in AM and PM peak hours. The research found that in demanding driving environments, drivers will prioritise focussing on "on-road" factors such as the rate of cars braking and on pedestrian and cyclist movements over off-road factors such as billboards. Moreover, Samsa (2015) found no significant difference in driver prioritisation when comparing static billboards, digital billboards and on-premises signs. This research concluded that there is a smaller chance of driver distraction from digital billboards whilst driving in demanding environments.

The Samsa (2015) finding supported the US Department of Transport and Federal Highway Administration research (2012) which found that drivers look at the forward roadway between 73% and 85% of the time depending on the demands of the driving task. This study also found that where billboards are introduced, drivers may substitute saccades / glance fixations from other things towards billboard glances but the percentage of time fixating on the forward roadway is consistent.

Victor et al. (2005) revealed similar results when they undertook a much larger study that examined eye glance movement on the road during both light and heavy traffic flows. Data was collected via the EU project HASTE, which used "in vehicle information systems" (S-IVIS). Data was sourced from 119 participants across three separate experiments, from four separate driving routes. The study included an examination of auditory and visual tasks to test driver glance behaviour. The results showed that as driving tasks became more difficult, drivers increased their viewing time in the road centre, rather than on other visual tasks (such as observing signs) off-road.

Also, there are general misconceptions that drivers "stare" at digital billboards, that changing messages on digital billboards draw a driver's attention to them and that these influences alone lead to crashes. The literature suggests that instead of "staring" at billboards, drivers "glance" at billboards. The US Department of Transport and Federal Highway Administration (2012) found that the average glance duration to an electronic billboard was 0.335 seconds with a maximum of 1.335 seconds, well below the 2.0-second distraction time threshold that Austroads research (and other research) suggests as the critical time for increased crash risk. Smiley et. al. (2005) found an average glance length of 0.5 seconds for electronic billboards and that viewings of the electronic billboard were undertaken by up to 50% of drivers.

The research of Decker et al. (2015) supported the glance time findings of other studies. This research summarised the results of 8 studies and concluded that the "*range of mean glance durations was 0.27 to 0.953 s (mean, 0.51) for passive billboards and 0.27 to 1.0 s (mean, 0.54) for active billboards*". This research did note "*strong evidence of substantial variability among individual billboards in each category*".

Participant's glance behaviour was recorded and analysed in terms of the number of fixations and the duration of these fixations to both static and digital billboards in the work of Samsa (2015). Out of a total of 144 fixations toward four digital billboards, the average fixation duration was below 0.75 seconds. This is considered to be "*the equivalent minimum-perception reaction time to the slowing of a vehicle ahead*" (Samsa 2015, p.8). Less than 1% of the records presented an average fixation duration of above 0.75 seconds. This average was apparent for both static and digital sign types. Furthermore, Samsa's (2015) results showed that participants that fixated on a digital billboard for longer than 0.75 seconds tended to do so when travelling conditions were relaxed (i.e. car was stationary, or traffic was minimal).

Samsa's (2015) results followed those of Perez and Bertola (2011) which also used eye-tracking technology to survey driver behaviour when glancing to digital billboards. Perez and Bertola (2011) also found that the maximum glance duration off the centre of the road was 0.75 seconds and claimed that that these small glances away from the road generally occur when there is low demand from the road network, and that these glances are not likely to result in adverse or critical events. Overall, a number of studies have concluded that drivers glance at digital billboards at a mean rate of 0.5 seconds and almost all are less than 1.0 seconds.

The available literature confirms that:

- External sources have a minimal effect on driver distraction that led to crashes
- Driver distraction in general reduces as the driving environment becomes more complex because drivers prioritise their attention effort to higher risk tasks
- The number and duration of glances due to digital billboards that result in driver inattention to the scale that might influence the series of events that would lead to a crash is immeasurably small.

4.4 The Relationship between Digital Signs and Crashes

4.4.1 International Examples

Due to the relatively short time digital billboards have been present in Australia and the relatively few locations that they have been present (until recent years), there is limited before and after installation crash data in Australia that specifically targets identifying a relationship between digital signs and crash rates and under what conditions. A selection of international research is presented below.

Hawkins, Kuo and Lord (2012) was based on 135 “on-premises digital sign” locations and undertook statistical analysis of crash data for before and after each sign installation. The signs were located in California, North Carolina, Ohio, and Washington. This study concluded “that the installation of digital on-premises signs does not lead to a statistically significant increase in crashes on major roads”.

Tantala and Tantala (2010) was based on “26 existing, non-accessory, advertising digital billboards along routes with periods of comparison as long as 8 years in the greater Reading area, Berks County, Pennsylvania”. This research looked at both temporal and spatial crash details around the electronic signs and compared the data to 51 non-electronic signs. The digital signs had message duration times of 6, 8 or 10 seconds. This research concluded that:

- *“The before and after rates of accidents near the twenty digital billboards show an 11.1% decrease within 0.5 miles of all digital billboards over eight years near twenty locations. Similar decreases and trends in both averages and peaks are observed for both smaller and larger vicinity ranges, and for specific groups of locations by duration time.”*
- *“The accident statistics and metrics remain consistent, exhibiting statistically insignificant variations at each of the digital billboards. The metrics include the total number of accidents in any given month, the average number of accidents, the peak number of accidents in any given month, and the number of accident-free months. These conclusions account for variations in traffic-volume and other metrics.”*
- *“The statistical evaluation of the Empirical Bayes method and actual versus predicted results show that the total number of accidents is comparable to what would be statistically expected with or without the introduction of digital technology and that the safety near these locations is consistent with the model benchmarked by 77 locations within Berks County.”*

Pandey and Shafizadeh (2011) reviewed a range of traffic flow parameters upstream of electronic billboards on Highway 50 near Sacramento. The study concluded that *“the presence of the electronic billboard does not appear to have a significant negative impact in traffic performance (flow, speed, and lane occupancy) or incidents in the study section of the freeway”*.

4.4.2 Local Examples

Crash data ‘before-installation’ and ‘after-installation’ of digital signs has been analysed on approach to nine existing digital signs along the M2 at seven locations. The crash data has been compared to understand if there has been any change in crash rate or crash types on the visual approach to each digital sign, and to infer if any relationships exist between digital sign distraction and crash rates.

In addition, 12-month post-installation road safety checks of the digital signs were undertaken by Winning Traffic Solutions (WTS) and a summary of their recommendations have been included. The key findings follow, and the full assessment is included in **Appendix B**.

Summary of the Review of the Crash Data

The number of pre-installation and post-installation crashes between 2012 and 2021 within 200m of the nine existing digital signs is summarised in Table 4.2.

Table 4.2: Pre and Post-installation Crash Data Comparison – M2 Digital Signs (2012-2021)

| Site | Location | Installation Date | Pre-installation Crashes p.a. | Post-installation Crashes p.a. |
|------|---|-------------------|-------------------------------|--------------------------------|
| 1 | Delhi Road inbound, North Ryde | December 2017 | 1 | 1 |
| 2 | Delhi Road outbound, North Ryde | December 2017 | <1 | 0 |
| 3 | Lane Cove Road outbound, Macquarie Park | May 2017 | 0 | <1 |
| 4 | Murray Farm Road outbound, Cheltenham | July 2019 | <1 | 0 |
| 5 | Pennant Hills Road inbound, Carlingford | May 2017 | 2 | <1 |
| 6 | Barclay Road inbound, North Rocks | July 2018 | <1 | <1 |
| 7 | Barclay Road outbound, North Rocks | July 2018 | <1 | <1 |
| 8 | Ixion Street outbound, Baulkham Hills | November 2017 | 0 | 0 |
| 9 | Langdon Road inbound, Baulkham Hills | November 2017 | <1 | <1 |

Key findings when reviewing the data across all sites are:

- The M2 in locations that approach bridges is inherently safe with very low crash rates despite the relatively high volumes and high speeds of traffic on the M2
- Whilst there is a reduction in crashes on average post-installation of digital signs on the M2, there is no statistical causal relationship evident between the presence of digital signs and changing crash rates (up or down) where they have been installed.

Whilst each site is unique and should be assessed considering its particular circumstances, given the above conclusions, there is no evidentiary basis to claim that the installation of digital signs on bridges along the M2 will lead to a higher crash rate than currently exists.

Consensus of the Road Safety Check Findings

The 12-month post-installation road safety checks of the digital signs undertaken by WTS concluded that:

- All signs are not located near any distractions and driving task situations that would significantly increase road user safety risks on the road network
- Road user safety is not compromised by the placement and operation of the signs
- The objectives of the road safety checks, SEPP 64 and Section 3 of the *Signage Guidelines* have been met.

4.5 Research Interpretation

The chain of events that is required to link a digital sign to increased crash rates is: *a driver is aware of an external event (i.e. outside the vehicle) which is a digital sign display change and that the event distracts a driver sufficiently to lead to involuntary driver inattention which then leads to driver error in a driving environment at a critical instance in time that leads to a crash*".

The combination of probabilities of these events would be extremely difficult to quantify and aligns with the absence of a comprehensive body of research that links digital signs (to driver distraction leading to driver inattention leading to driver error) leading to an increased rate of crashes.

The literature review presented in this chapter has established an absence of a causal relationship between digital signs and driver distraction to the level that creates additional crashes. This absence of any relationship between the installation of digital signs and crashes was also evident in the review of nine existing digital signs along the M2.

Furthermore, there is also an absence of any correlation between new digital signs and increasing crash rates. There are currently over 2,000 digital roadside advertising signs in Australia and there has not been a single claim, as far as the industry is aware, of a digital sign being blamed for a crash.

Based on traffic crash risk management principles however, the criteria where digital signs should be considered with greater scrutiny are:

- Locations that are highly unusual in their configuration complexity, or
- Locations that are inherently unsafe anyway, based on crash records.

The proposed sign location does not meet either of the above criteria and is considered to be a very low risk to driver distraction, based on the summary of the research.

5. TRAFFIC SAFETY ASSESSMENT

5.1 Key Assumptions

The assessment of the proposed digital sign was undertaken on the basis that:

- There is currently no advertising sign at the subject site. Therefore, driver sightlines have been estimated based on information regarding where the proposed digital sign is to be installed
- The display of content will be static for a minimum dwell time of 25 seconds with a transition time of no more than 0.1 seconds based on the *Signage Guidelines* criteria
- Illumination/lighting levels for the digital sign will comply with the *Signage Guidelines* and maintain lighting levels to match the surrounding environment at the site.

5.2 Site Inspection

A site inspection was undertaken on Thursday, 28 July 2022 during daytime hours (around 12:30pm). The weather was clear and traffic conditions were moderate. In-vehicle video recordings were taken for further analysis and for use in compiling photo montages of the driver's perspective on the approaches to the site.

The photo montages can be found in **Appendix C**.

5.3 Review of Crash Data

Crash data for the relevant section of the M2 was obtained from Transport for NSW in order to assess the crash history in proximity to the subject site. The most recent five years of crash data at the time of the data request was for 2016-2020. Crashes involving vehicles travelling in the direction of and in view of the sign were used for the assessment. The viewing area of the proposed digital sign is from approximately 535m south along the M2, though it would only be clearly visible to drivers within 200m as described in Section 2.1. As such, crash data was only considered for crashes **within 200m on approach to the proposed sign location**.

Zero crashes were reported within this viewable sightline to the proposed digital sign. As such, the proposed sign would be in a very low prevailing crash risk location.

5.4 Approach Sightline Assessments

5.4.1 Description of Approaches

The northbound approach in proximity to the proposed sign is described in Table 5.1.

Table 5.1: Approach Attributes – M2 northbound

| Attribute | Details |
|---|---|
| Posted speed limit | 100km/h |
| Decision points within view of the site | There are no decision points within view of the proposed advertising |
| Approach arrangement | 2 uninterrupted lanes (lanes 1 and 2) |
| Sight length | From approximately 535m south of the proposed sign, although the sign could only realistically be recognised from about 200m away. At this distance, the sign would appear at the windscreen at a size of 6cm wide x 1.7cm high |
| Minimum duration of visibility | 20s at free-flow speed |

5.4.2 Driver Sightline Assessment

Process

In-vehicle observations were undertaken to assess the subject site considering key decision points and the influence on or from traffic control devices. An assessment of still images taken from the driver's perspective with a windscreen-mounted camera is presented in the following section. It should be noted that the assessment was undertaken based on a standard passenger car and as such a driver's eye height may vary for larger and smaller vehicles.

The premise of the assessment is to ensure that the proposed location of the digital sign maintains a driver's sightline to traffic control devices and is not located as such that it may be confused with or confuse the interpretation of these traffic control devices.

The driver's cognitive load specific to the driving environment on approach to the proposed sign has also been considered. Typically, locations where digital signs could have a greater influence crash risk are locations where rapid, complex, multi-factor decision making is required.

M2 northbound

The northbound approach along M2 is straight and slightly uphill before with a long left-hand curve commencing approximately 220m before the proposed digital sign. The sign could be seen from approximately 535m away but would be very small and its content would be unrecognisable at this range. This location and orientation mean that drivers approaching the sign have a direct view of it in the same field of view that they would otherwise be looking towards. From about 200m, the sign is still relatively small in the field of view, but drivers would be likely to identify its advertising contents.

A digital sign in this location will not obstruct sightlines to, or influence the messaging of, traffic control devices or signs. Despite the 100km/h speed limit, the approach to it does not require rapid, complex decision making by drivers and is a location of very low cognitive load. There are no on-ramps or off-ramps in proximity to the approach to northbound the sign. All potential traffic control devices, signage and hazards that need to be recognised by drivers to make appropriate, timely decisions would be in the same forward view as the proposed sign and could be simultaneously recognised while glancing to it co-incidentally as the impending left-hand curve when its contents become clearer to drivers.

The in-vehicle sightlines from the M2 northbound are shown in Figure 5.1, clearly demonstrating that all vehicle movements are in the same sightline as the digital sign, which means no risk of 'missing' movements by forward vehicles when glancing to it.



¹Distances measured in Nearthmap.

²Sign location is indicative, not to scale and for illustration purposes only.

Figure 5.1: In-vehicle viewing range and views along the M2 northbound

5.5 Compliance Assessment

5.5.1 Industry and Employment SEPP Schedule 5

The assessment against Industry and Employment SEPP Schedule 5 is provided in Table 5.2. Whilst the criteria are quite generic, the basis for the responses to each criterion is provided next to them.

Table 5.2: Assessment against Industry and Employment SEPP Schedule 5

| Section | Criteria | Response |
|-----------|---|---|
| 8. Safety | Would the proposal reduce the safety for any public road? | No – The proposal would not reduce the safety to the public road because there are no crash-related risks apparent in the crash data. |
| | Would the proposal reduce the safety for pedestrians or bicyclists? | No – While cyclists are allowed on the M2, it is a high-difficulty environment, meaning few cyclists would use it and the shoulder is 3m wide. In any event, the change in cyclist safety risk associated with a digital sign installation is considered to be negligible. |
| | Would the proposal reduce the safety for pedestrians, particularly children, by obscuring sightlines from public areas? | No – No sightlines for pedestrians and children are obscured by the proposal as no pedestrians are allowed on the M2. |

5.5.2 Transport for NSW Advertising Sign Safety Assessment Matrix

Table 5.3 details the assessment against the Transport for NSW Advertising Sign Safety Assessment Matrix.

Table 5.3: Assessment against the Transport for NSW Advertising Sign Assessment Matrix

| Consideration | Response | Risk Rating | Risk Level |
|--|--|-------------|------------|
| A. It obscures a view of an object/vehicle/pedestrian that creates a hazard | The proposed sign will be located behind all surrounding objects/vehicles etc. | 1 | Low |
| B. Sign positioning relative to travel direction | The proposed sign will be positioned so that only glance appreciation is required. It will be visually prominent northbound. | 2 | Low |
| C. It distracts a driver at a critical time | The proposed sign will not be located near any decision points. | 1 | Low |
| D. It interferes with the effectiveness and safety of a traffic control device (e.g. traffic signs, traffic signals or other traffic control devices) | The proposed sign is unlikely to noticeably obstruct or interfere with any traffic control devices. | 1 | Low |
| E. Sign clutter | No other advertising sign is visible when a driver is in view of the subject site. | 1 | Low |

5.5.3 Transport Corridor Outdoor Advertising and Signage Guidelines Table 3

Table 5.4 details the assessment against the digital sign criteria in Table 3 of the *Signage Guidelines*.

Table 5.4: Assessment against the Signage Guidelines Digital Sign Criteria

| Criteria | Response |
|---|--|
| a. Each advertisement must be displayed in a completely static manner, without any motion, for the approved dwell time as per criterion (d) below. | Conditions can be imposed by the consent authority to ensure that the sign is completely static for the specified dwell time. |
| b. Message sequencing designed to make a driver anticipate the next message is prohibited across images presented on a single sign and across a series of signs. | Conditions can be imposed by the consent authority to ensure there is no message sequencing that creates driver anticipation for the next message on the proposed sign or with any other signs. |
| c. The image must not be capable of being mistaken: <ul style="list-style-type: none"> i. for a prescribed traffic control device because it has, for example, red, amber or green circles, octagons, crosses or triangles or shapes or patterns that may result in the advertisement being mistaken for a prescribed traffic control device ii. as text providing driving instructions to drivers. | Conditions can be imposed by the consent authority to ensure that sign content, design, imagery and messages neither replicate nor can be mistaken for a prescribed traffic control device or instruction to drivers. For example, advertisements must not instruct drivers to perform an action such as 'Stop'. |
| d. Dwell times for image display must not be less than: <ul style="list-style-type: none"> i. 10 seconds for areas where the speed limit is below 80km/h ii. 25 seconds for areas where the speed limit is 80km/h and over. | The minimum allowed dwell time is 25 seconds based on the posted speed limit of 100km/h. Conditions can be imposed by the consent authority to ensure this minimum dwell time. |
| e. The transition time between messages must be no longer than 0.1 seconds, and in the event of image failure, the default image must be a black screen. | Conditions can be imposed by the consent authority to ensure that the sign has a transition time of no more than 0.1 seconds and a black screen in the event of image failure. |
| f. Luminance levels must comply with the requirements in Section 3 below. | This area is Zone 3 as categorised in Section 3.3 of the <i>Signage Guidelines</i> . Acceptable luminance levels for this zone as specified in Table 6 of the <i>Signage Guidelines</i> are: no limit (full sun on face of signage), 6000cd/m ² (daytime), 700cd/m ² (twilight and inclement weather) and 350cd/m ² (night-time). Conditions can be imposed by the consent authority specifying maximum allowable luminance levels. |
| g. The images displayed on the sign must not otherwise unreasonably dazzle or distract drivers without limitation to their colouring or contain flickering or flashing content. | Conditions can be imposed by the consent authority to ensure that the sign's images comply with requirements to not contain flickering or flashing content. |
| h. The amount of text and information supplied on a sign should be kept to a minimum (e.g. no more than a driver can read at a short glance). | Conditions can be imposed by the consent authority to ensure that minimal text and information is supplied on a sign no more than a driver can read at a short glance. |
| i. Any sign that is within 250m of a classified road and is visible from a school zone must be switched to a fixed display during school zone hours. | N/A – The sign is not visible from a school zone. |

| Criteria | Response |
|---|---|
| j. Each sign proposal must be assessed on a case-by-case basis including replacement of an existing fixed, scrolling or tri-vision sign with a digital sign, and in the instance of a sign being visible from each direction, both directions for each location must be assessed on their own merits. | All relevant traffic directions have been assessed on their own merits. |
| k. At any time, including where the speed limit in the area of the sign is changed, if detrimental effect is identified on road safety post installation of a digital sign, RMS reserves the right to re-assess the site using an independent RMS-accredited road safety auditor. Any safety issues identified by the auditor and options for rectifying the issues are to be discussed between RMS and the sign owner and operator. | Noted. |
| l. Sign spacing should limit drivers' view to a single sign at any given time with a distance of no less than 150m between signs in any one corridor. Exemptions for low speed, high pedestrian zones or CBD zones will be assessed by RMS as part of their concurrence role. | No other sign is visible less than 150m. |
| m. Signs greater than or equal to 20sqm must obtain RMS concurrence and must ensure the following minimum vertical clearances; i. 2.5m from lowest point of the sign above the road surface if located outside the clear zone ii. 5.5m from lowest point of the sign above the road surface if located within the clear zone (including shoulders and traffic lanes) or the deflection zone of a safety barrier if a safety barrier is installed. If attached to road infrastructure (such as an overpass), the sign must be located so that no portion of the advertising sign is lower than the minimum vertical clearance under the overpass or supporting structure at the corresponding location. | Under Section 4.13(2) of the <i>Environmental Planning and Assessment Act 1979</i> , development to be determined by the Minister does not require TfNSW concurrence. Instead, the Minister is only required to consult with TfNSW. |
| n. An electronic log of a sign's operational activity must be maintained by the operator for the duration of the development consent and be available to the consent authority and/or RMS to allow a review of the sign's activity in case of a complaint. | Conditions can be imposed by the consent authority to ensure that an electronic log is kept for the duration of the consent and be available to the consent authority and/or TfNSW for review in case of a complaint. |
| o. A road safety check which focuses on the effects of the placement and operation of all signs over 20sqm must be carried out in accordance with Part 3 of the RMS Guidelines for Road Safety Audit Practices after a 12 month period of operation but within 18 months of the signs installation. The road safety check must be carried out by an independent RMS-accredited road safety auditor who did not contribute to the original application documentation. A copy of the report is to be provided to RMS and any safety concerns identified by the auditor relating to the operation or installation of the sign must be rectified by the applicant. In cases where the applicant is the RMS, the report is to be provided to the Department of Planning and Environment as well. | Conditions can be imposed by the consent authority for a road safety check to be carried out after 12 months but within 18 months of the sign's installation. |

6. CONCLUSIONS

The key conclusions from the traffic safety assessment to enable the installation of a digital LED advertising sign on the eastern side of the M2 Hills Motorway (M2) adjacent to the Lane Cove Road eastbound merge (referred to as Eden Gardens) in Macquarie Park are summarised as follows:

- There is currently no advertising sign at the site where the digital sign is proposed
- The proposed sign will not obstruct or interfere with the view of or restrict sight distances to any intersections, traffic control devices, vehicles or cyclists given its location on the roadside
- The driving approach to the proposed sign is relatively straight with no on-ramps or off-ramps in this zone
- The proposed sign is not expected to reduce the safety of any traffic or cyclist movements given its location. It will be located within a driver's ordinary field of view when approaching from the south and a glance to the sign will still permit co-incident recognition of vehicle and cyclist movements in the forward view in a free-flowing environment where rapid multi-factor decision making is not required
- The proposed sign is in the ordinary field of view of a driver, and therefore would not distract a driver's view from the forward roadway where driving-critical events could simultaneously be recognised in the extremely unlikely event that they occur
- A review of available five years of crash data within 200m of the site showed that **zero crashes were reported within the viewable area to it**. As such, this location is not inherently unsafe
- The proposed sign complies with the requirements of the Industry and Employment SEPP and Transport for NSW Advertising Sign Safety Assessment Matrix in terms of obscurity, positioning and sign clutter
- The proposed digital sign should be conditioned to comply with the requirements of the *Signage Guidelines* in terms of display and operational requirements, including:
 - Message displays remaining static
 - Sequencing of displays or messaging
 - Minimum dwell time
 - Transition of displays
 - Luminance levels
 - The use of flickering, flashing or moving content
 - Quantity/size of text used on message displays
 - A re-assessment of the digital sign should any detrimental effects on road safety be identified post-installation.

Given the above conclusions, the digital sign should be approved as proposed.

REFERENCES

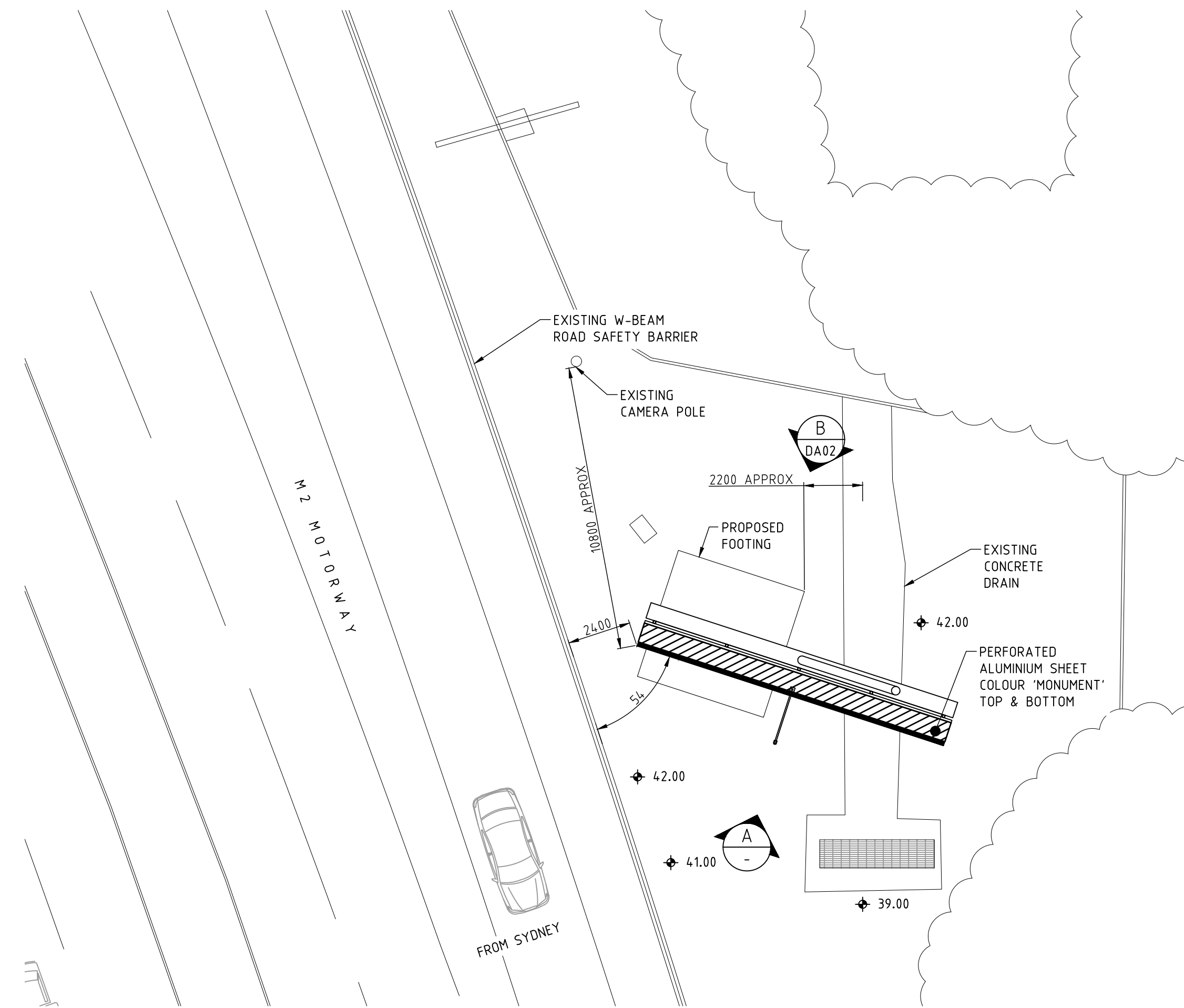
- Austroroads (2013). The Impacts of Roadside Advertising on Road Safety, AP-R420-13.
- Decker et al. (2015), The Impact of Billboards on Driver Visual Behavior: A Systematic Literature Review, National Center for Biotechnology Information, U.S. National Library of Medicine. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4411179/>
- Hawkins, H.G., Kuo, P-F & Lord, D. (2012). Statistical Analysis of the Traffic Safety Impacts 5 of On-Premise Digital Signs. https://pdfs.semanticscholar.org/e3b6/2957b23906769969f4a00f8815f9bdce7e.pdf?_ga=2.258010442.1941184793.1579676989-2095687016.1579676989
- Lam, L.T. (2002). Distractions and the risk of car crash injury: The effect of drivers' age. *Journal of Safety Research*, pp. 411-419.
- Perez, W., & Bertola, M.A. (2011). The effect of visual clutter on driver eye glance behaviour. *Proceedings of the Sixth International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design*, Olympic Valley –Lake Tahoe, CA. Retrieved from http://drivingassessment.uiowa.edu/sites/default/files/DA2011/Papers/027_PerezBertola.pdf.
- Regan, M.A., Hallett, C. & Gordon, C. (2011). Driver distraction and driver inattention: Definition, relationship and taxonomy. *Accident Analysis & Prevention*, vol. 43, no. 5, pp. 1771-1781.
- Samsa, C. (2015). Digital billboards “down under”. Are they distracting to drivers and can industry and regulators work together for a successful road safety outcome? *Proceedings of the 2015 Australasian Road Safety Conference*, Retrieved from <http://acrs.org.au/files/papers/arsc/2015/SamsaC%20199%20Digital%20billboards%20down%20under.pdf>.
- Smiley, A., Bhagwant, P., Bahar, G., Mollett, C., Lyon, C., Smahel, T. & Kelman, W.L. (2005). Traffic safety evaluation of video advertising signs. *Transportation Research Record: Journal of the Transportation Research Board*, 1937, pp 105-112.
- Tantala, M.W. & Tantala, A.M. (2010). A study of the relationship between digital billboards and traffic safety in the Greater Reading Area, Berks County, Pennsylvania. Submitted to the Foundation for Outdoor Advertising Research and Education (FOARE).
- US Department of Transport Federal Highway Administration (2012). Driver visual behavior in the presence of commercial electronic variable message signs (CEVMS).
- Victor, T.W., Harbluk, J.L. & Engstrom, J.A. (2005). Sensitivity of eye-movement measures to in-vehicle task difficulty. *Transportation Research*, vol. 8, no. 2, pp. 167-190.

Appendix A: Proposed Development Plan

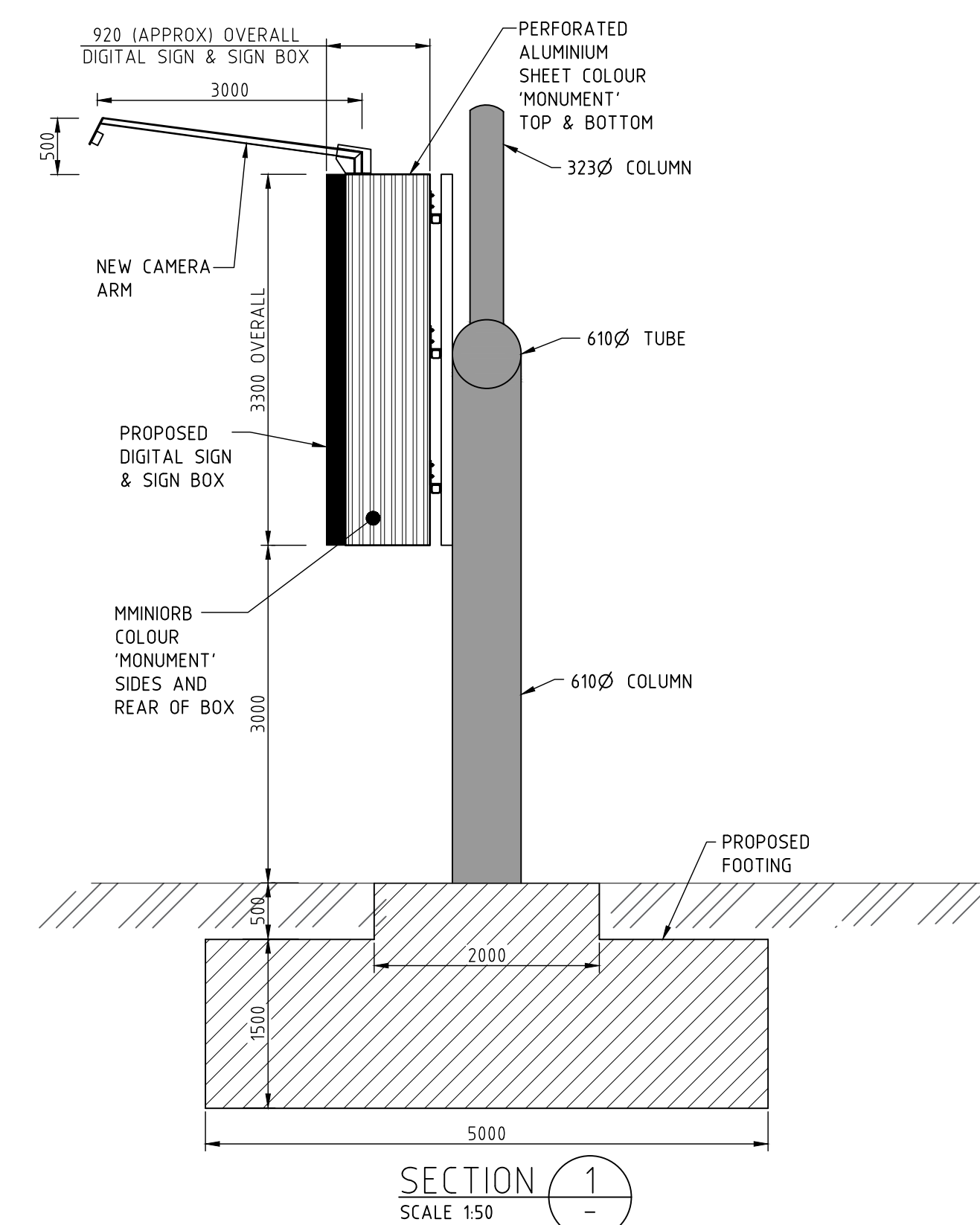
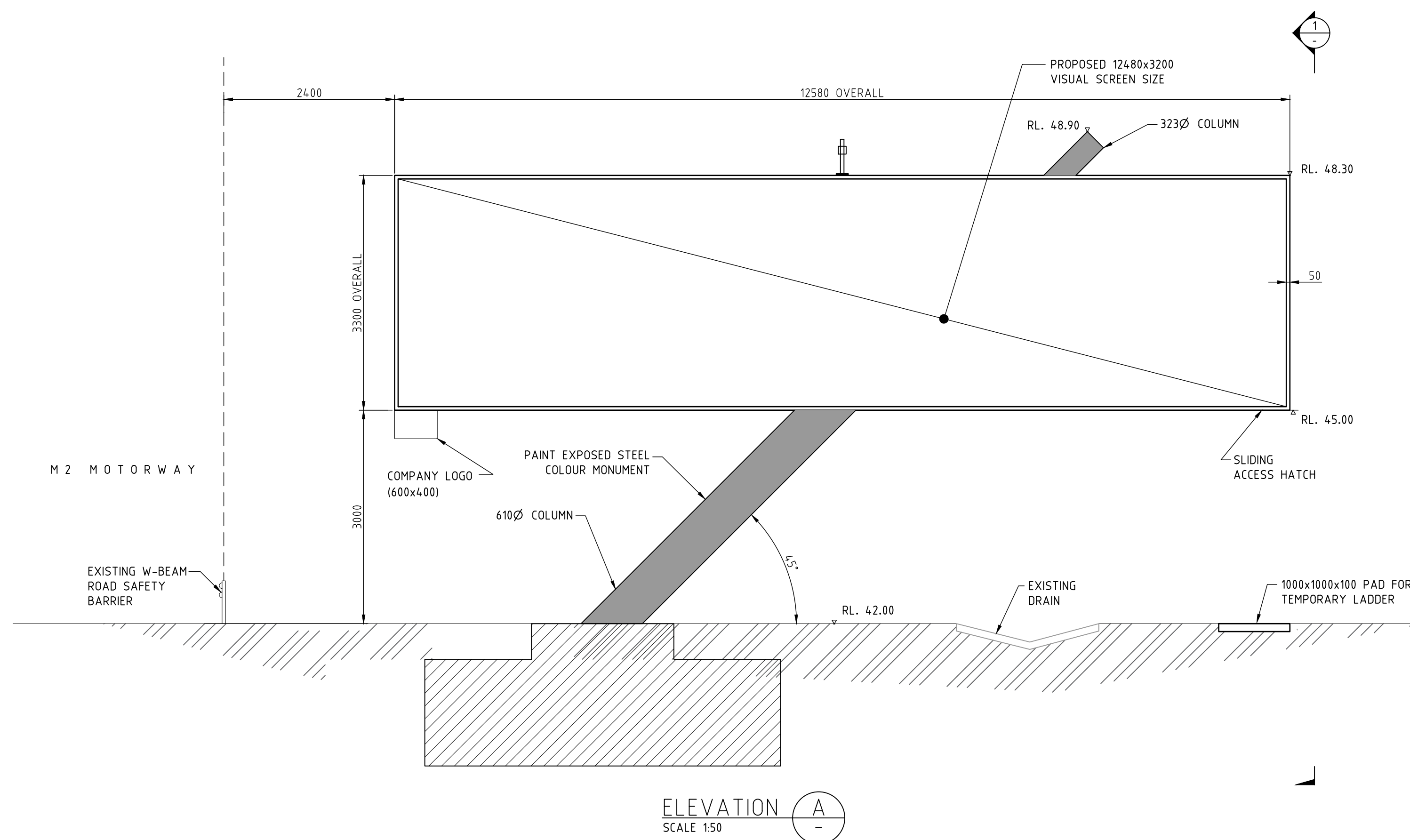




AERIAL PHOTO
NTS



PROPOSED SITE PLAN
SCALE 1:150



NOT FOR CONSTRUCTION

| ISS | DATE | COMMENT |
|-----|----------|---------------------|
| A | 16/09/22 | ISSUED FOR APPROVAL |
| | | |
| | | |
| | | |
| | | |

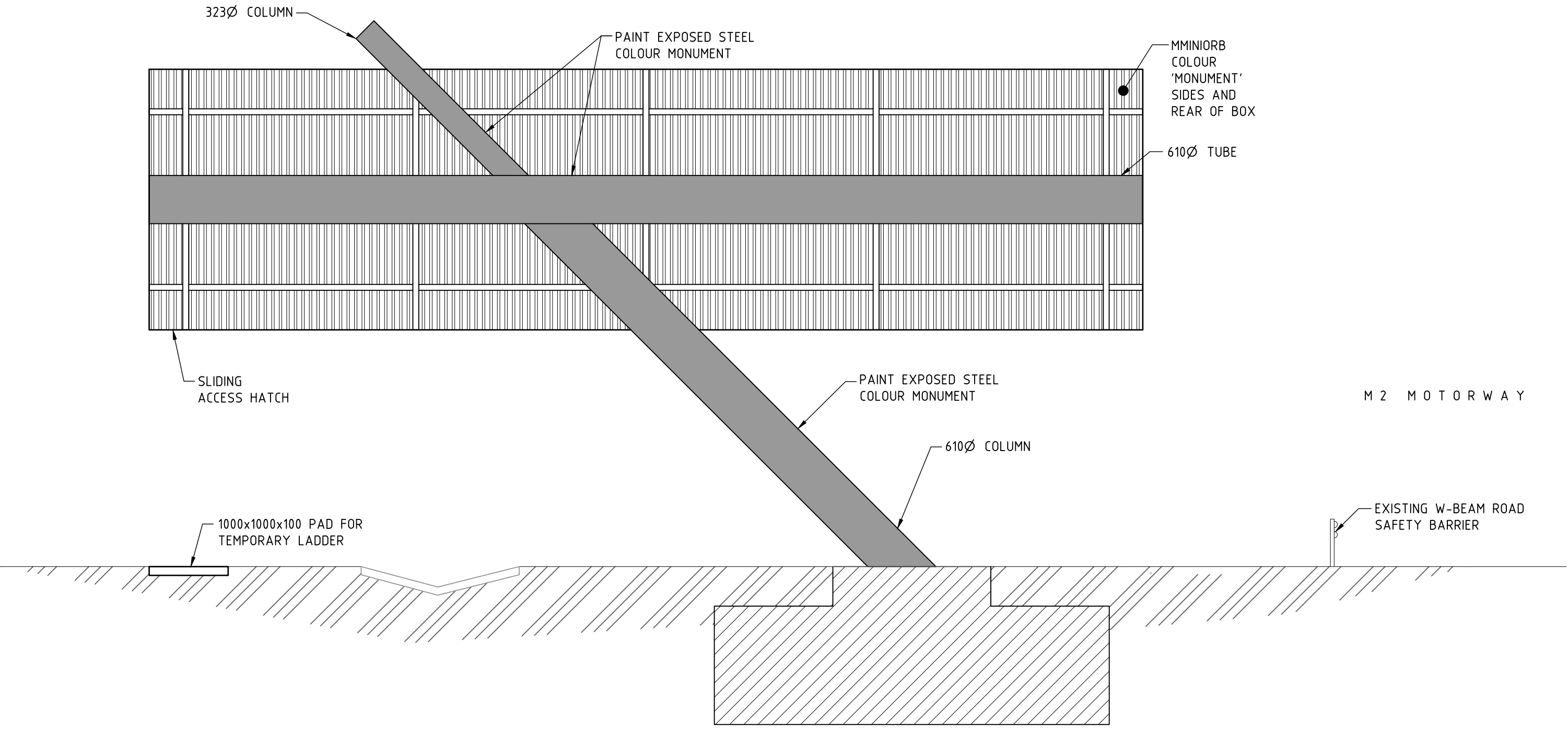


Suite 4, Building 7, 49 Frenchs Forest Road East,
Frenchs Forest, NSW 2086
P.O. Box 652, Forestville, NSW 2087
Ph: 02 9451 3455 Fax: 02 9451 3466
Email: info@dbce.com.au
ABN 23 039 013 724

| | |
|----------|--|
| CLIENT: | MANBOOM |
| PROJECT: | EDEN GARDENS MACQUARIE PARK, OUTBOUND |

| | |
|--------|---|
| TITLE: | PROPOSED DIGITAL SIGN GENERAL ARRANGEMENT & SITE PLAN, ELEVATION & SECTION |
|--------|---|


| | | | |
|-------------|--------------|---------|-------|
| DRAWN AU | DESIGN JL | DATE: | SEP22 |
| JOB NO: | 22141-9 | DWG NO: | DA01 |
| SCALE @ A1: | AS SHOWN | REV: | A |



ELEVATION B
SCALE 1:50
DA01

NOT FOR CONSTRUCTION

| ISS | DATE | COMMENT |
|-----|----------|---------------------|
| A | 16/09/22 | ISSUED FOR APPROVAL |
| | | |
| | | |
| | | |
| | | |
| | | |

| | | | | | |
|---|--|--|----------------------|--------------|--------------|
|  <div>Suite 4, Building 7, 49 Frenchs Forest Road East, Frenchs Forest, NSW 2086 P.O. Box 652, Forestville, NSW 2087 Ph: 02 9451 3455 Fax: 02 9451 3466 Email: info@dbce.com.au ABN 23 039 013 724</div> | CLIENT: MANBOOM | TITLE: PROPOSED DIGITAL SIGN ELEVATION | DRAWN AU | DESIGN JL | DATE: SEP'22 |
| | PROJECT: EDEN GARDENS MACQUARIE PARK, OUTBOUND | | JOB NO: 22141-9 | DWG NO: DA02 | |
| | | | SCALE @ A1: AS SHOWN | REV: A | |

Appendix B: Existing M2 Digital Sign Crash Data Comparison Technical Note



| File Name | Prepared | Reviewed | Issued by | Date | Issued to |
|--|------------------------|------------|-----------|------------|---------------------------------|
| P5486.001T M2 Digital Sign Pre_Post-Installation Crash Data Comparison | A. Suriono / S. Daizli | D. Bitzios | S. Daizli | 9/11/2022 | gerry@digitalplacesolutions.com |
| P5486.002T M2 Digital Sign Pre_Post-Installation Crash Data Comparison | S. Daizli | D. Bitzios | S. Daizli | 14/11/2022 | gerry@digitalplacesolutions.com |

M2 Hills Motorway

Digital Sign Pre-installation vs. Post-installation Crash Data Comparison

Executive Summary

Bitzios Consulting has been engaged by Manboom Signage to undertake traffic safety assessments for the installation of nine new digital LED advertising signs at eight locations along the M2 Hills Motorway (M2).

To inform these assessments, 'before-installation' versus 'after-installation' crash data has been analysed on approach to nine existing digital signs along the M2 at seven locations. The assessment has compared crashes before installation to after installation to understand if there has been any change in crash rate or crash types on the visual approach to each digital sign, and to infer if any relationships exist between digital sign distraction and crash outcomes.

12-month post-installation road safety checks of the digital signs were also undertaken by Winning Traffic Solutions (WTS).

Review of Crash Data

The number of pre-installation and post-installation crashes between 2012 and 2021 within 200m of the nine existing digital signs is summarised in Table ES.1.

Table ES.1: Pre-installation and Post-installation Crashes at Each Site (p.a.)

| Site | Location | Installation Date | Pre-installation Crashes p.a. | Post-installation Crashes p.a. |
|------|---|-------------------|-------------------------------|--------------------------------|
| 1 | Delhi Road inbound, North Ryde | December 2017 | 1 | 1 |
| 2 | Delhi Road outbound, North Ryde | December 2017 | <1 | 0 |
| 3 | Lane Cove Road outbound, Macquarie Park | May 2017 | 0 | <1 |
| 4 | Murray Farm Road outbound, Cheltenham | July 2019 | <1 | 0 |
| 5 | Pennant Hills Road inbound, Carlingford | May 2017 | 2 | <1 |
| 6 | Barclay Road inbound, North Rocks | July 2018 | <1 | <1 |
| 7 | Barclay Road outbound, North Rocks | July 2018 | <1 | <1 |
| 8 | Ixion Street outbound, Baulkham Hills | November 2017 | 0 | 0 |
| 9 | Langdon Road inbound, Baulkham Hills | November 2017 | <1 | <1 |

Key Findings

Key findings when reviewing the data across all sites are:

- The M2 in locations that approach bridges is inherently safe with very low crash rates given the volume and speed of traffic on the M2
- Whilst there is a reduction in crashes on average post-installation of digital signs on the M2, there is absolutely no statistical causal relationship evident between the presence of digital signs and changing crash rates (up or down) where they have been installed.

Whilst each site is unique and should be assessed on its particular circumstances, given the above conclusions, there is no evidentiary basis to claim that the installation of digital signs on bridges along the M2 will lead to a higher crash rate than currently exists unless the installation is in a substantially different context to signs assessed in this Technical Note.

1. Introduction

1.1 Background

Bitzios Consulting has been engaged by Manboom Signage to undertake traffic safety assessments for the installation of nine new digital LED advertising signs at eight locations along the M2 Hills Motorway (M2).

To inform these assessments, ‘before-installation’ versus ‘after-installation’ crash data has been analysed on approach to nine existing digital signs along the M2 at seven locations. The assessment has compared crashes before installation to after installation to understand if there has been any change in crash rate or crash types on the visual approach to each digital sign, and to infer if any relationships exist between digital sign distraction and crash outcomes.

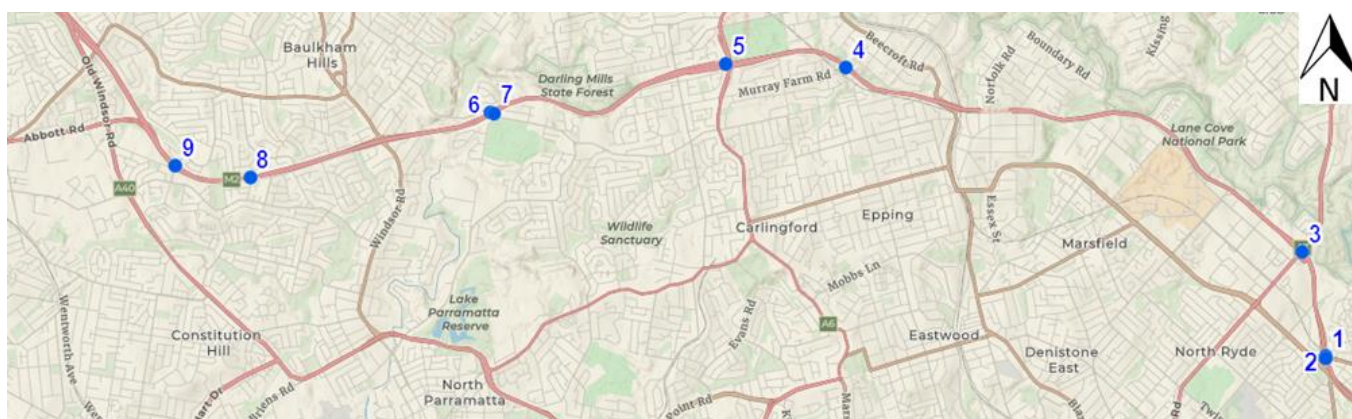
The analysis is directly relevant to the assessment of the potential change in crash rate or crash types post-installation of the nine new proposed digital signs because they are also on the M2 corridor at similar types of locations.

The existing digital sign sites for which the crash data analysis has been completed are listed in Table 1.1 and the site locations shown in Figure 1.1. All of the sites had static advertising signs in place for all or part of the pre-installation crash reporting period. Also, 12-month post-installation “road safety checks” of each digital sign were undertaken by Winning Traffic Solutions (WTS) and their key findings are also presented

Table 1.1: Existing M2 Digital Sign Sites for Crash Data Comparison

| Site | Location* | Sign Type | Installation Date |
|------|---|-----------|-------------------|
| 1 | Delhi Road inbound, North Ryde | Bridge | December 2017 |
| 2 | Delhi Road outbound, North Ryde | Bridge | December 2017 |
| 3 | Lane Cove Road outbound, Macquarie Park | Bridge | May 2017 |
| 4 | Murray Farm Road outbound, Cheltenham | Bridge | July 2019 |
| 5 | Pennant Hills Road inbound, Carlingford | Bridge | May 2017 |
| 6 | Barclay Road inbound, North Rocks | Bridge | July 2018 |
| 7 | Barclay Road outbound, North Rocks | Bridge | July 2018 |
| 8 | Ixion Street outbound, Baulkham Hills | Bridge | November 2017 |
| 9 | Langdon Road inbound, Baulkham Hills | Bridge | November 2017 |

*Inbound = sign faces drivers travelling towards the Sydney CBD.
Outbound = sign faces drivers travelling from the Sydney CBD.



Adapted from Charted Territory Map

Figure 1.1: Locations of the Existing Digital Signs

1.2 Crash Data Sources and Types

Crash data for the relevant sections of the M2 and parallel on-ramps and off-ramps was obtained from Transport for NSW. The most recent ten years of crash data at the time of the data request was for 2012-2021. Crashes involving vehicles travelling in the direction of and in view of the signs were used for the assessment. The relevant viewing range for all nine signs is from approximately 200m away along the M2 main carriageways, as well as the Delhi Road inbound off-ramp, Lane Cove Road outbound G-loop and Pennant Hills Road inbound off-ramp associated with the signs in those locations.

As per Rule 287 (3) of the Australian Road Rules, crashes are only recorded if they are reported to the police and when one of the following occurs:

- Any person is killed or injured
- Drivers involved in the crash do not exchange particulars
- When a vehicle involved in the crash is towed away.

The crash data was provided in the following crash severity categories:

- **Fatal** – a crash in which at least one person was killed
- **Serious injury** – a crash involving at least one person identified in a police report and matched to a health record indicating a hospital stay due to injuries sustained in a crash, or is identified as an iCare (Lifetime Care) participant AND no one was killed in the crash
- **Moderate injury** – a crash involving at least one person identified in a police report who is matched to a health record that indicates that they were treated at an emergency department but were not admitted for a hospital stay, or is matched to a CTP claim indicating a moderate or higher injury AND no one was killed or seriously injured
- **Minor/Other injury** – a crash involving at least one person identified as an injury in a police report who is not matched to a health record that indicates the level of injury severity, or is matched to a minor injury CTP claim AND no one was killed, seriously injured or moderately injured
- **Non-casualty (towaway)** – a crash in which no one was killed or injured but at least one motor vehicle was towed away.

The crash data was mapped using GIS software and is presented in **Attachment A** along with a detailed record list. The crash maps are presented in terms of severity and type which is the road user movement describing the first impact of the crash, with severity and type summaries for each site provided in the following sections. Key findings from the WTS road safety checks also are provided.

As only the month and year have been provided for the digital sign installation dates and crashes, crashes that occurred during the installation month were assumed to have occurred post-installation.

2. Site 1. Delhi Road inbound, North Ryde

2.1 Review of Crash Data

The pre-installation and post-installation crash severity summary on approach to the Delhi Road inbound sign is provided in Table 2.1.

Table 2.1: Crash Severity Summary on Approach to Site 1 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | - | - |
| 2013 | - | - | - | - | 1 | 1 |
| 2014 | - | - | - | 1 | - | 1 |
| 2015 | - | - | - | - | - | - |
| 2016 | - | 1 | 1 | - | - | 2 |
| Jan-Nov 2017 | - | - | - | - | - | - |
| Total | - | 1 | 1 | 1 | 1 | 4 |
| Post-installation | | | | | | |
| Dec 2017 | - | - | - | - | - | - |
| 2018 | - | - | 1 | - | - | 1 |
| 2019 | - | 2 | - | - | - | 2 |
| 2020 | - | - | - | - | 1 | 1 |
| 2021 | - | - | - | - | 1 | 1 |
| Total | - | 2 | 1 | - | 2 | 5 |

Source: Transport for NSW

As shown in the above table:

- There has been no substantial change in crash data post-installation (remaining at around 1 crash per year) and the site remains inherently safe
- 1 'rear end' crash in 2016 **pre-installation** resulted in serious injury. It occurred approximately 90m before the Delhi Road overpass. 2 of the other 3 crashes pre-installation were also 'rear end' and occurred in dry road surface and fine/overcast conditions
- There were 2 crashes in 2019 post-installation which resulted in serious injury, including:
 - 1 'rear end' crash approximately 40m before the Delhi Road overpass
 - 1 'U-turn' crash on the Delhi Road inbound off-ramp approximately 35m before the Delhi Road signalised intersection in darkness (*this crash is completely un-related to the digital sign as it is not distraction-influenced*).
- The other 3 crashes post-installation were all 'rear end' and occurred in dry road surface and fine/overcast conditions.

The data suggests that the digital sign had no tangible distraction influence on crashes.

2.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that:

- *“The subject signs are generally isolated from surrounding distractions (refer Figs 2 & 3 above) and sufficiently offset from road user activities not to cause a significant increase in the “risks” to road user safety within the operational road network.”*
- *“Taking into consideration the driving environment for both directions in the M2 Motorway containing few driver distractions, other than the signs, it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Signs.”*
- *“it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met.”*

3. Site 2. Delhi Road outbound, North Ryde

3.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Delhi Road outbound sign is provided in Table 3.1.

Table 3.1: Crash Severity Summary on Approach to Site 2 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | 1 | 1 |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | - | 1 | 1 |
| 2015 | - | - | - | - | - | - |
| 2016 | - | - | - | - | - | - |
| Jan-Nov 2017 | - | - | - | 1 | - | 1 |
| Total | - | - | - | 1 | 2 | 3 |
| Post-installation | | | | | | |
| Dec 2017 | - | - | - | - | - | - |
| 2018 | - | - | - | - | - | - |
| 2019 | - | - | - | - | - | - |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | - | - | - | - | - |

Source: Transport for NSW

As shown in the above table, no crashes were reported **post-installation** and the site remains inherently safe. 2 of the 3 crashes pre-installation were 'rear end', 1 of which occurred in wet road surface and rainy conditions.

The data suggests that the digital sign had no tangible distraction influence on crashes.

3.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- *"The subject signs are generally isolated from surrounding distractions (refer Figs 2 & 3 above) and sufficiently offset from road user activities not to cause a significant increase in the "risks" to road user safety within the operational road network."*
- *"Taking into consideration the driving environment for both directions in the M2 Motorway containing few driver distractions, other than the signs, it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Signs."*
- *"Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met."*

4. Site 3. Lane Cove Road outbound, Macquarie Park

4.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Lane Cove Road outbound sign is provided in Table 4.1.

Table 4.1: Crash Severity Summary on Approach to Site 3 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | - | - |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | - | - | - |
| 2015 | - | - | - | - | - | - |
| 2016 | - | - | - | - | - | - |
| Jan-May 2017 | - | - | - | - | - | - |
| Total | - | - | - | - | - | - |
| Post-installation | | | | | | |
| Jun-Dec 2017 | - | 1 | - | - | - | 1 |
| 2018 | - | - | - | - | 1 | 1 |
| 2019 | - | - | - | - | - | - |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | 1 | - | - | 1 | 2 |

Source: Transport for NSW

As shown in the above table:

- There has been no substantial change in crash data **post-installation** (less than 1 crash per year) and the site remains inherently safe
- Both crashes **post-installation** occurred on the Lane Cove Road G-loop (before it joins the M2) in wet road surface and rainy conditions, and after dark. The crashes were 'off carriageway right on left bend into object/parked vehicle'. Speed was a factor in both crashes
- There is no relationship between this type of crash in this location and distraction by the digital sign because it would be outside of the visual range when on the loop.

4.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- *“The subject sign is generally isolated from surrounding distractions (refer Figs 2 above), sufficiently offset from road user activities and observed displays are considered do not hold drivers attention beyond “glance appreciation” (Item E2) so as not to cause a significant increase in the “risks” to road user safety within the operational road network.”*
- *“Though not a hazard under definition, it is considered the subject sign does not present as a significant road user risk. The influence of the sign and assumed low usage of the shared shoulder/bicycle lane should not distract driver appreciation and awareness under such circumstances of potential vehicle conflict.”*
- *“Taking into consideration the driving environment for westbound travel in the M2 Motorway containing few driver distractions, other than the sign and bicycles, it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Sign.”*
- *“Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met.”*

5. Site 4. Murray Farm Road outbound, Cheltenham

5.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Murray Farm Road outbound sign is provided in Table 5.1.

Table 5.1: Crash Severity Summary on Approach to Site 4 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | 1 | 1 |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | - | - | - |
| 2015 | - | - | - | - | - | - |
| 2016 | - | - | - | - | - | - |
| 2017 | - | 1 | - | - | - | 1 |
| 2018 | - | - | - | - | - | - |
| Jan-Jul 2019 | - | - | - | - | - | - |
| Total | - | 1 | - | - | 1 | 2 |
| Post-installation | | | | | | |
| Aug-Dec 2019 | - | - | - | - | - | - |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | - | - | - | - | - |

Source: Transport for NSW

As shown in the above table:

- No crashes were reported **post-installation** (albeit for a shorter period) and the site remains inherently safe
- 1 'lane change right' crash in 2017 **pre-installation** resulted in serious injury. It occurred approximately 90m before the Murray Farm Road overpass.

5.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- *The subject sign is generally isolated from surrounding distractions (refer Fig. 2 above), sufficiently offset from road user activities and observed displays are considered do not hold driver's attention beyond "glance appreciation" (Item E2 of Conditions) so as not to cause a significant increase in the "risks" to road user safety within the operational road network."*
- *In relation to the M2 Warning Sign "No Dangerous Goods in Tunnel", located approximately 300m before the subject advertising sign, "the advertising sign (being lit) could be a distraction in the first instance but not to a detrimental extent of the M2 warning sign being missed or to cause an accident".*
- *In relation to the Advance Direction sign, located approximately 80m before the subject advertising sign, "Given the nature of this sign and its intent as a "guidance" sign, it is considered the advertising sign, though a possible distraction in the first instance, would not be to the detrimental extent of the sign being missed or to cause an accident".*
- *"Taking into consideration the driving environment for westbound travel in the M2 Motorway containing few driver distractions, other than the sign and bicycles in the vicinity of the subject advertising sign, it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Sign."*
- *"Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met."*

6. Site 5. Pennant Hills Road inbound, Carlingford

6.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Pennant Hills Road inbound sign is provided in Table 6.1.

Table 6.1: Crash Severity Summary on Approach to Site 5 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | 1 | 2 | 3 |
| 2013 | - | - | 1 | - | 3 | 4 |
| 2014 | - | - | - | - | - | - |
| 2015 | - | 1 | - | - | 2 | 3 |
| 2016 | - | - | - | - | - | - |
| Jan-Apr 2017 | - | - | - | - | 1 | 1 |
| Total | - | 1 | 1 | 1 | 8 | 11 |
| Post-installation | | | | | | |
| May-Dec 2017 | - | - | - | - | - | - |
| 2018 | - | - | - | - | 1 | 1 |
| 2019 | - | - | - | - | - | - |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | - | - | - | 1 | 1 |

Source: Transport for NSW

As shown in the above table:

- The site remains inherently safe **post-installation**. The sole crash **post-installation** was a 'rear end' and resulted in a tow-away
- 9 of the 12 crashes **pre-installation** were 'rear end', including:
 - 1 in 2015, right below the Pennant Hills Road overpass. It occurred in dry road surface and fine conditions, and resulted in serious injury
 - 8 resulting in a tow-away, 1 of which occurred in wet road surface and rainy conditions.

The data suggests that the likelihood of a crash on approach to a bridge that may or may not have a static or a digital sign attached to it has absolutely no relationship to the presence of the sign and rather is a function of a range of other causes.

6.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- *"The subject sign is generally isolated from surrounding distractions (refer Figs 2 above), sufficiently offset from road user activities and observed displays are considered do not hold drivers attention beyond "glance appreciation" (Item E2) so as not to cause a significant increase in the "risks" to road user safety within the operational road network."*
- *"Though not a hazard under definition, it is considered the subject sign does not present as a significant road user risk. The influence of the sign and assumed low usage of the shared shoulder/bicycle lane and presence of buses should not distract driver appreciation and awareness under such circumstances of potential vehicle conflict."*
- *"Taking into consideration the driving environment for eastbound travel in the M2 Motorway containing few driver distractions, other than the sign and low volume bicycles and bus usage, it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Sign."*
- *"Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met."*

7. Site 6. Barclay Road inbound, North Rocks

7.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Barclay Road inbound sign is provided in Table 7.1.

Table 7.1: Crash Severity Summary on Approach to Site 6 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | 1 | 1 |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | - | - | - |
| 2015 | - | - | - | - | - | - |
| 2016 | - | - | - | - | - | - |
| 2017 | - | - | 1 | 1 | 1 | 3 |
| Jan-Jun 2018 | - | - | - | - | - | - |
| Total | - | - | 1 | 1 | 2 | 4 |
| Post-installation | | | | | | |
| Jul-Dec 2018 | - | - | 1 | - | - | 1 |
| 2019 | - | - | - | 1 | 1 | 2 |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | - | 1 | 1 | 1 | 3 |

Source: Transport for NSW

As shown in the above table:

- There has been no substantial change in crash data **post-installation** (remaining at less than 1 crash per year) and the site remains inherently safe
- There were 3 off carriageway into object/parked vehicle, 2 'rear end' and 2 'lane change left' crashes between January 2012 and December 2021. These types of crashes usually involve in-vehicle distraction because out of vehicle views typically allow for brake lights or adjacent vehicles to be observed at the same time.

7.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- "The subject signs are generally isolated from surrounding distractions (refer Figs 2 & 3 above) and sufficiently offset from road user activities (i.e. adjacent Bus Stops, emergency telephones) not to cause a significant increase in the "risks" to road user safety within the operational road network."*
- "Taking into consideration the driving environment for both directions in the M2 Motorway containing a "changed road environment (Bus interchange), it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Signs."*
- "Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met."*

8. Site 7. Barclay Road outbound, North Rocks

8.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Barclay Road outbound sign is provided in Table 8.1.

Table 8.1: Crash Severity Summary on Approach to Site 7 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | - | - |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | - | - | - |
| 2015 | - | - | 1 | - | - | 1 |
| 2016 | - | - | - | - | - | - |
| 2017 | - | - | - | 1 | 1 | 2 |
| Jan-Jun 2018 | - | - | 1 | - | - | 1 |
| Total | - | - | 2 | 1 | 1 | 4 |
| Post-installation | | | | | | |
| Jul-Dec 2018 | - | - | - | - | - | |
| 2019 | - | - | - | - | - | - |
| 2020 | - | - | - | - | 1 | 1 |
| 2021 | - | - | - | - | - | - |
| Total | - | - | - | - | 1 | 1 |

Source: Transport for NSW

As shown in the above table, the site remains inherently safe **post-installation**. The sole crash post-installation was a 'other same direction' crash and resulted in a tow-away.

8.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- "The subject signs are generally isolated from surrounding distractions (refer Figs 2 & 3 above) and sufficiently offset from road user activities (i.e. adjacent Bus Stops, emergency telephones) not to cause a significant increase in the "risks" to road user safety within the operational road network."
- "Taking into consideration the driving environment for both directions in the M2 Motorway containing a "changed road environment (Bus interchange), it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Signs."
- "Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met."

9. Site 8. Ixion Street outbound, Baulkham Hills

9.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Ixion Street outbound sign is provided in Table 9.1.

Table 9.1: Crash Severity Summary on Approach to Site 8 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | - | - |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | - | - | - |
| 2015 | - | - | - | - | - | - |
| 2016 | - | - | - | - | - | - |
| Jan-Oct 2017 | - | - | - | - | - | - |
| Total | - | - | - | - | - | - |
| Post-installation | | | | | | |
| Nov-Dec 2017 | - | - | - | - | - | - |
| 2018 | - | - | - | - | - | - |
| 2019 | - | - | - | - | - | - |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | - | - | - | - | - |

Source: Transport for NSW

As shown in the above table, **zero crashes have been reported at the site** between January 2012 and December 2021.

9.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- *“The subject sign is generally isolated from surrounding distractions (refer Figs 2 above), sufficiently offset from road user activities and observed displays are considered do not hold drivers attention beyond “glance appreciation” (Item E2) so as not to cause a significant increase in the “risks” to road user safety within the operational road network.”*
- *“Though not a hazard under definition, it is considered the subject sign does not present as a significant road user risk. The influence of the sign and assumed low usage of the shared shoulder/bicycle lane should not distract driver appreciation and awareness under such circumstances of potential vehicle conflict.”*
- *“Taking into consideration the driving environment for westbound travel in the M2 Motorway containing few driver distractions, other than the sign and bicycles it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Sign.”*
- *“Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met.”*

10. Site 9. Langdon Road inbound, Baulkham Hills

10.1 Review of Crash Data

A pre-installation and post-installation crash severity summary on approach to the Langdon Road inbound sign is provided in Table 10.1.

Table 10.1: Crash Severity Summary on Approach to Site 9 (2012-2021)

| Year | Crash Severity | | | | | Total |
|-------------------|----------------|----------------|-----------------|--------------------|------------------------|-------|
| | Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway) | |
| Pre-installation | | | | | | |
| 2012 | - | - | - | - | - | - |
| 2013 | - | - | - | - | - | - |
| 2014 | - | - | - | 1 | - | 1 |
| 2015 | - | - | - | - | - | - |
| 2016 | - | - | - | 1 | - | 1 |
| Jan-Oct 2017 | - | - | - | - | - | - |
| Total | - | - | - | 2 | - | 2 |
| Post-installation | | | | | | |
| Nov-Dec 2017 | - | - | - | - | - | - |
| 2018 | - | - | - | - | - | - |
| 2019 | - | - | 1 | 1 | - | 2 |
| 2020 | - | - | - | - | - | - |
| 2021 | - | - | - | - | - | - |
| Total | - | - | 1 | 1 | - | 2 |

Source: Transport for NSW

As shown in the above table:

- There has been no substantial change in crash data post-installation (remaining at less than 1 crash per year) and the site remains inherently safe
- All crashes were 'rear end'.

10.2 Road Safety Check Findings

Key findings from the 12-month road safety check were that :

- *“The subject sign is generally isolated from surrounding distractions (refer Figs 2 above), sufficiently offset from road user activities and observed displays are considered do not hold drivers attention beyond “glance appreciation” (Item E2) so as not to cause a significant increase in the “risks” to road user safety within the operational road network.”*
- *“It is noted that west of the subject sign a merging lane is provide in the eastbound carriageway to accommodate traffic loading to the M2 Motorway from Abbott Road. This merge taper ends some 120 metres prior to the sign and driver decision to select a gap in the traffic stream and make the merge manoeuvre is well outside the influence of the subject sign.”*
- *“Though not a hazard under definition, it is considered the subject sign does not present as a significant road user risk. The influence of the sign and assumed low usage of the shared shoulder/bicycle lane should not distract driver appreciation and awareness under such circumstances of potential vehicle conflict.”*
- *“Taking into consideration the driving environment for eastbound travel in the M2 Motorway containing few driver distractions, other than the sign and low volume bicycles, it is considered road user safety is not unduly compromised by the placement and operation of the subject Digital Advertising Sign.”*
- *“Therefore, it is considered the Road Safety Objectives SEPP 64 Transport Corridor Outdoor Advertising and Signage Guidelines - Section 3 Advertising and Road Safety have been met.”*

11. Conclusions

Review of Crash Data

The number of pre-installation and post-installation crashes between 2012 and 2021 within 200m of nine existing digital signs at seven locations along the M2 Hills Motorway (M2) is summarised in Table 11.1.

Table 11.1: Pre-installation and Post-installation Crashes at Each Site (p.a.)

| Site | Location | Pre-installation Crashes p.a. | Post-installation Crashes p.a. |
|------|---|-------------------------------|--------------------------------|
| 1 | Delhi Road inbound, North Ryde | 1 | 1 |
| 2 | Delhi Road outbound, North Ryde | <1 | 0 |
| 3 | Lane Cove Road outbound, Macquarie Park | 0 | <1 |
| 4 | Murray Farm Road outbound, Cheltenham | <1 | 0 |
| 5 | Pennant Hills Road inbound, Carlingford | 2 | <1 |
| 6 | Barclay Road inbound, North Rocks | <1 | <1 |
| 7 | Barclay Road outbound, North Rocks | <1 | <1 |
| 8 | Ixion Street outbound, Baulkham Hills | 0 | 0 |
| 9 | Langdon Road inbound, Baulkham Hills | <1 | <1 |

Key findings when reviewing the data across all sites are:

- The M2 in locations that approach bridges is inherently safe with very low crash rates given the volume and speed of traffic on the M2
- Whilst there is a reduction in crashes on average post-installation of digital signs on the M2, there is absolutely no statistical causal relationship evident between the presence of digital signs and changing crash rates (up or down) where they have been installed.

Whilst each site is unique and should be assessed on its particular circumstances, given the above conclusions, there is no evidentiary basis to claim that the installation of digital signs on bridges along the M2 will lead to a higher crash rate than currently exists unless the installation is in a substantially different context to the other nine signs assessed in this Technical Note.

Road Safety Check Findings

The 12-month post-installation road safety checks of the digital signs undertaken by Winning Traffic Solutions (WTS) concluded for all of the signs that:

- All signs are not located near any distractions and driving task situations that would significantly increase road user safety risks on the road network
- Road user safety is not compromised by the placement and operation of the signs
- The objectives of the road safety checks, SEPP 64 and the *Transport Corridor Outdoor Advertising and Signage Guidelines* Section 3 have been met.

Attachment A: Crash Data



Legend

Crash Degree

- Serious Injury
- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)

M2 Hills Motorway

Former Static
Sign Location

Delhi Road

BITZIOS
consulting
traffic engineering • transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Delhi Road inbound, North Ryde

Figure Title: Degree of Crashes Pre-Digital Sign

Version: 001

Date: 31/10/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Ryde - Delhi Rd IB\Pre-Installation



Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- * Off path, on straight

M2 Hills Motorway

Former Static
Sign Location

Delhi Road

BITZIOS
consulting
traffic engineering • transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Delhi Road inbound, North Ryde

Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign

Version: 001

Date: 31/10/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Ryde - Delhi Rd IB\Pre-Installation



Legend

Crash Degree

- Serious Injury
- Moderate Injury
- Non-casualty (towaway)

M2 Hills Motorway

Existing Digital
Sign Location

Delhi Road

BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice
Site: Delhi Road inbound, North Ryde
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 31/10/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Ryde - Delhi Rd IB\Post-Installation



Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- ◆ Manoeuvring

M2 Hills Motorway

Existing Digital
Sign Location

Delhi Road

BITZIOS
consulting
traffic engineering • transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Delhi Road inbound, North Ryde

Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign

Version: 001

Date: 31/10/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Ryde - Delhi Rd IB\Post-Installation



Legend

Crash Degree

- Serious Injury
- Non-casualty (towaway)

Lane Cove Road

Existing Digital
Sign Location

M2 Hills Motorway

BITZIOS
consulting

traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice
Site: Lane Cove Road outbound, Macquarie Park
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 31/10/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Macquarie Park - Lane Cove Rd OB



Legend

Crash Type (RUM Code Group)

★ Off path, on curve or turning

Lane Cove Road

Existing Digital
Sign Location

M2 Hills Motorway

BITZIOS
consulting
traffic engineering • transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Lane Cove Road outbound, Macquarie Park

Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign

Version: 001

Date: 31/10/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Macquarie Park - Lane Cove Rd OB



Legend

Crash Degree

- Serious Injury
- Non-casualty (towaway)



BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice
Site: Murray Farm Road outbound, Cheltenham
Figure Title: Degree of Crashes Pre-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Cheltenham - Murray Farm Rd OB



Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- * Off path, on straight



BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Murray Farm Road outbound, Cheltenham

Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign

Version: 001

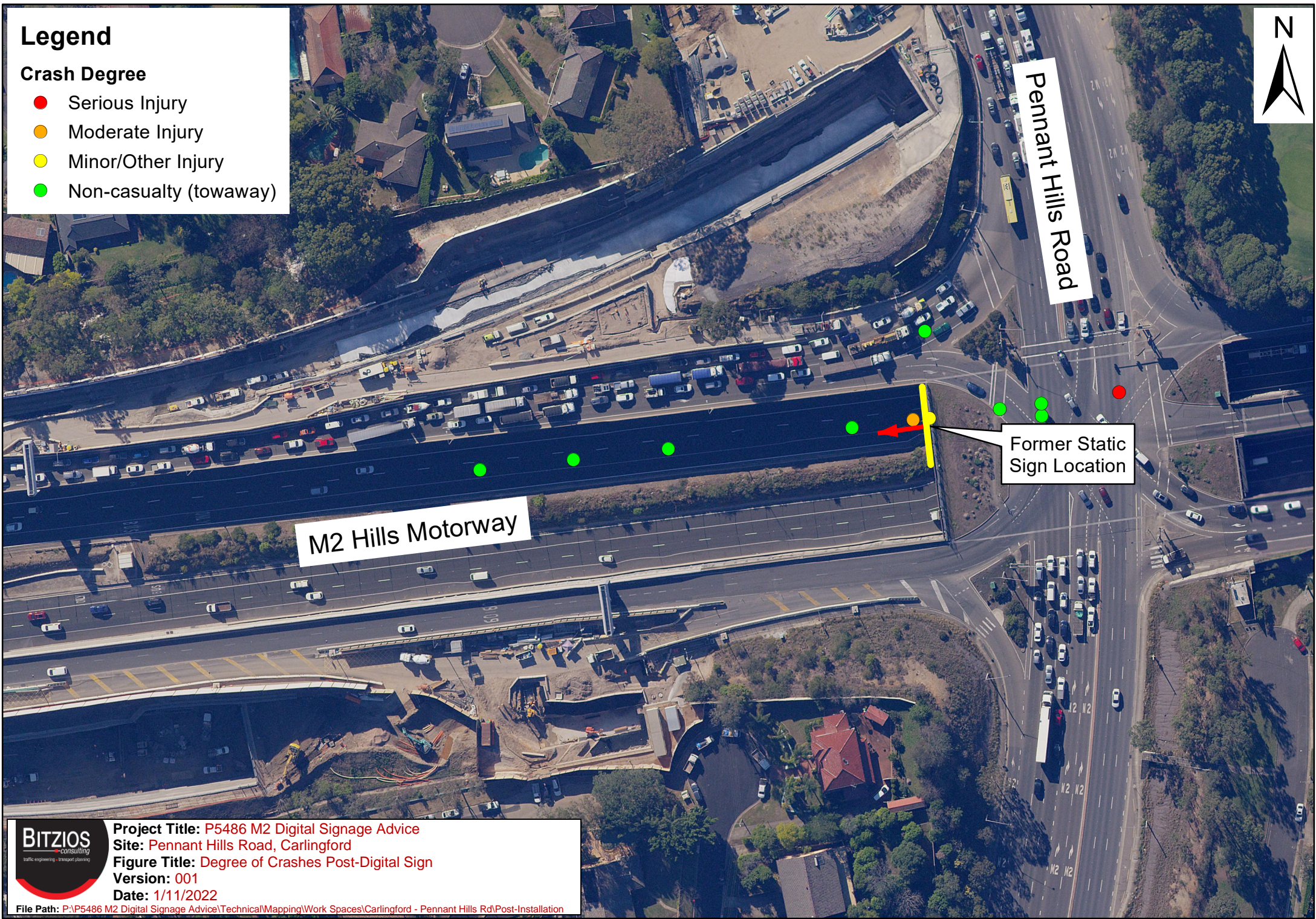
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Cheltenham - Murray Farm Rd OB

Legend

Crash Degree

- Serious Injury
- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)



Project Title: P5486 M2 Digital Signage Advice
Site: Pennant Hills Road, Carlingford
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Carlingford - Pennant Hills Rd\Post-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- ✱ Off path, on straight
- ★ Off path, on curve or turning



BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Pennant Hills Road, Carlingford

Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign

Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Carlingford - Pennant Hills Rd\Pre-Installation

Legend

Crash Degree

- Non-casualty (towaway)



BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Pennant Hills Road, Carlingford

Figure Title: Degree of Crashes Post-Digital Sign

Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Carlingford - Pennant Hills Rd\Post-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction



Project Title: P5486 M2 Digital Signage Advice

Site: Pennant Hills Road, Carlingford

Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign

Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Carlingford - Pennant Hills Rd\Post-Installation

Legend

Crash Degree

- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)



Former Static
Sign Location

Barclay Road

M2 Hills Motorway

Perry Street



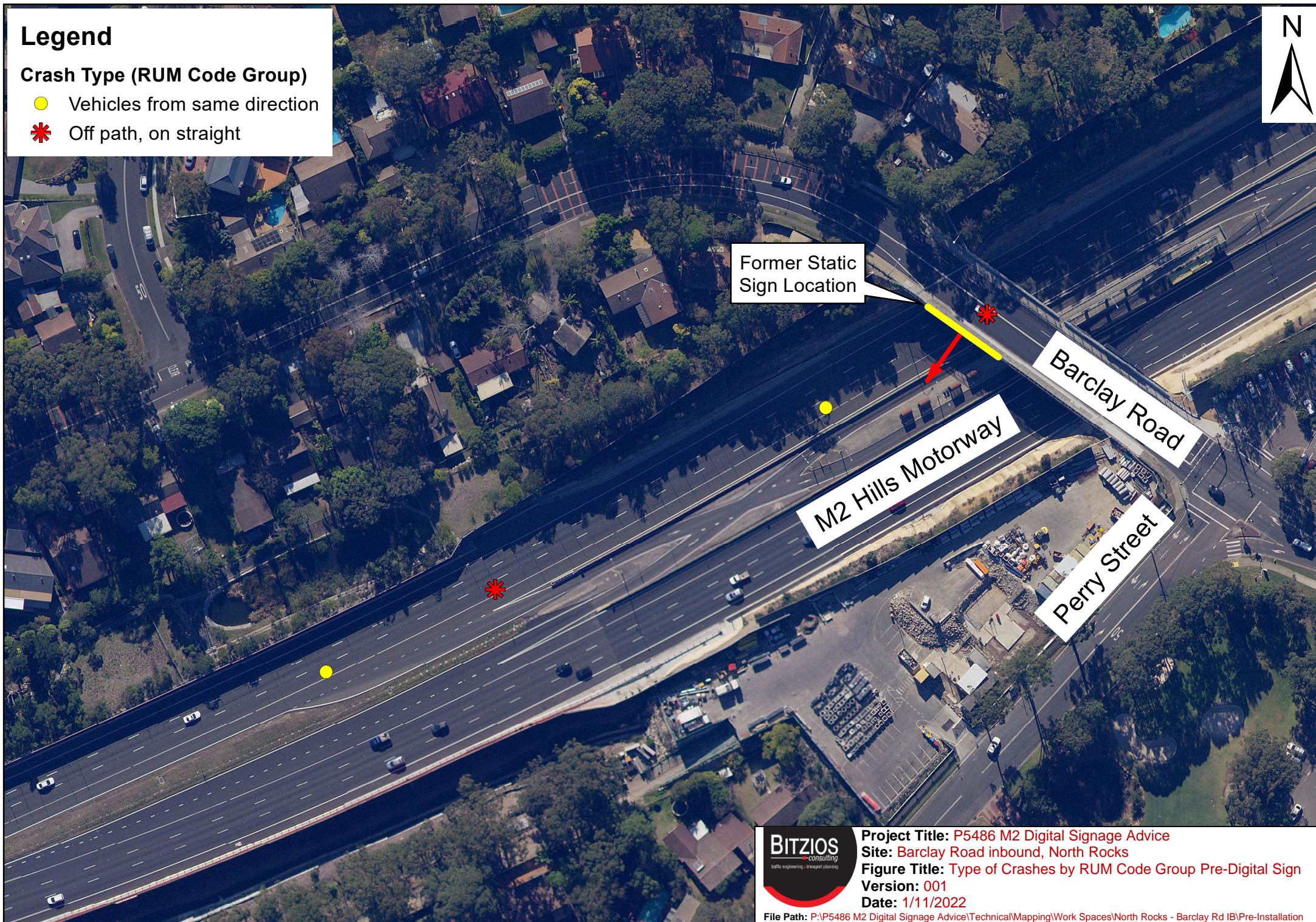
Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road inbound, North Rocks
Figure Title: Degree of Crashes Pre-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd IB\Pre-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- * Off path, on straight



Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road inbound, North Rocks
Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign
Version: 001
Date: 1/11/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd IB\Pre-Installation

Legend

Crash Degree

- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)



Existing Digital
Sign Location

Barclay Road

M2 Hills Motorway

Perry Street



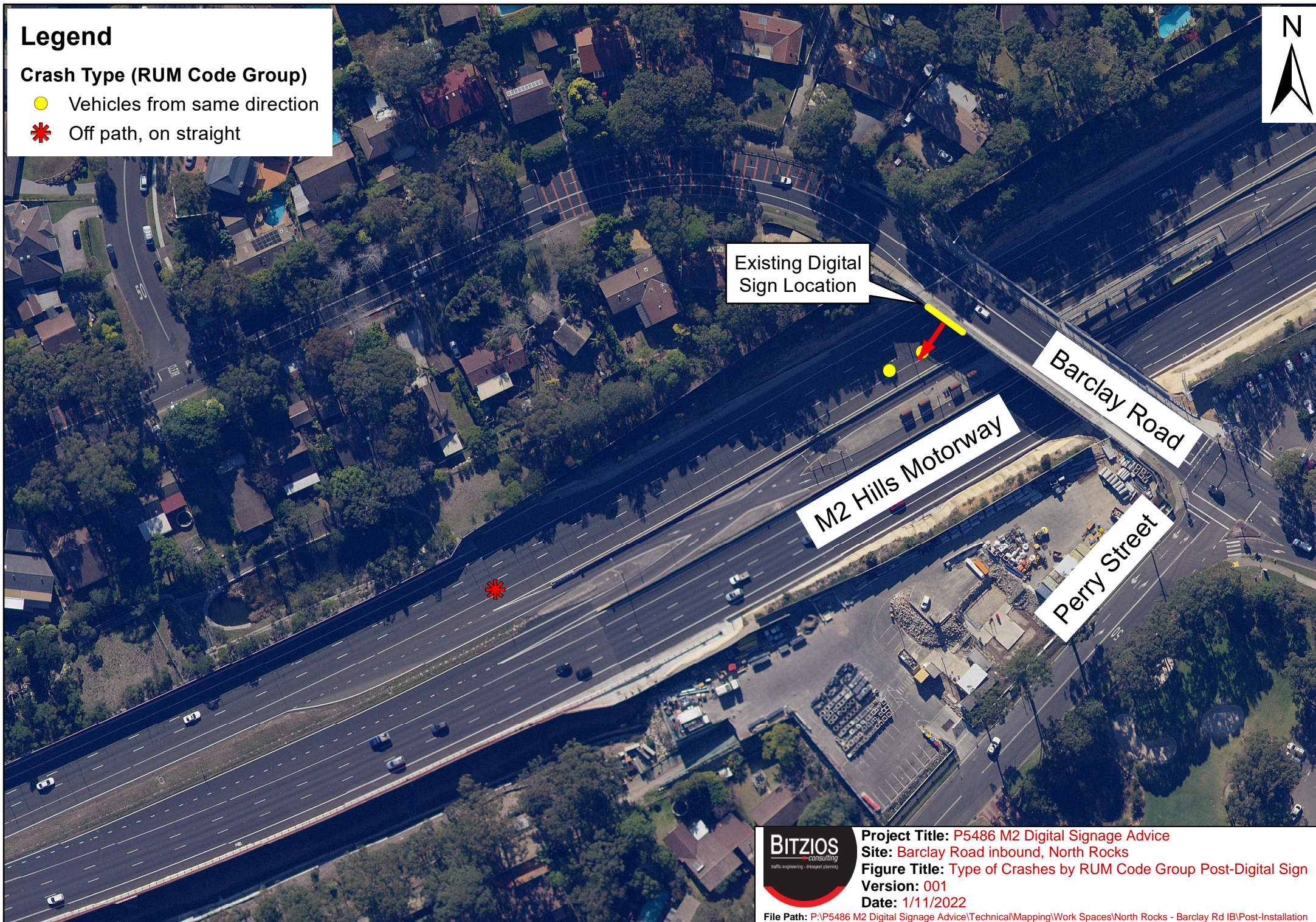
Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road inbound, North Rocks
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd IB\Post-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- ✱ Off path, on straight



Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road inbound, North Rocks
Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd IB\Post-Installation

Legend

Crash Degree

- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)



Barclay Road

M2 Hills Motorway

Former Static Sign Location



Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road outbound, North Rocks
Figure Title: Degree of Crashes Pre-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd OB\Pre-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction
- ★ Off path, on curve or turning



Barclay Road

M2 Hills Motorway

Former Static
Sign Location



Project Title: P5486 M2 Digital Signage Advice

Site: Barclay Road outbound, North Rocks

Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign
Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd OB\Pre-Installation

Legend

Crash Degree

- Non-casualty (towaway)



Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road outbound, North Rocks
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd OB\Post-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction



Project Title: P5486 M2 Digital Signage Advice

Site: Barclay Road outbound, North Rocks

Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign
Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Rocks - Barclay Rd OB\Post-Installation

Legend

Crash Degree

● Minor/Other Injury



Project Title: P5486 M2 Digital Signage Advice

Site: Langdon Road inbound, Baulkham Hills

Figure Title: Degree of Crashes Pre-Digital Sign

Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Baulkham Hills - Langdon Rd IB\Pre-Installation

Legend

Crash Type (RUM Code Group)

- Vehicles from same direction



BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice

Site: Langdon Road inbound, Baulkham Hills

Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign

Version: 001

Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Baulkham Hills - Langdon Rd\Pre-Installation



Legend

Crash Degree

- Moderate Injury
- Minor/Other Injury



BITZIOS
consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice
Site: Langdon Road inbound, Baulkham Hills
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 1/11/2022

File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Baulkham Hills - Langdon Rd\B\Post-Installation



| M2 overpass | Crash ID | Degree of crash - detailed | RUM - code | RUM - description | Year of crash | Month of crash | Day of week of crash | Time of crash | Surface condition | Weather | Natural lighting | Street of crash | Street type | Distance | Direction | Identifying feature | Identifying feature type | Town | Type of location | Latitude | Longitude | Speeding involved in crash | Fatigue involved in crash | Key Traffic Unit direction of travel |
|------------------------------|----------|----------------------------|------------|-----------------------|---------------|----------------|----------------------|---------------|-------------------|----------|------------------|-----------------|-------------|----------|-------------------|---------------------|--------------------------|--------------------|------------------|------------|------------|----------------------------|---------------------------|--------------------------------------|
| Barclay Road eastbound | 810488 | Non-casualty (towaway) | 30 | Rear end | 2012 | September | Thursday | 0920 | Dry | Fine | Daylight | M2 HILLS | EXP | 50 | South | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.764669 | 151.013863 | No or unknown | No or unknown | North |
| Barclay Road eastbound | 1146509 | Moderate Injury | 71 | Off rd left => obj | 2017 | August | Tuesday | 1620 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.764446 | 151.014329 | No or unknown | No or unknown | East |
| Barclay Road eastbound | 1147395 | Non-casualty (towaway) | 73 | Off rd right => obj | 2017 | August | Monday | 1355 | Dry | Fine | Daylight | M2 HILLS | EXP | 150 | West | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.765103 | 151.012912 | No or unknown | No or unknown | East |
| Barclay Road eastbound | 1160711 | Minor/Other Injury | 35 | Lane change left | 2017 | December | Wednesday | 1910 | Dry | Overcast | Daylight | M2 HILLS | EXP | 200 | West | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.765300 | 151.012425 | No or unknown | No or unknown | East |
| Barclay Road eastbound | 1170653 | Moderate Injury | 73 | Off rd right => obj | 2016 | July | Friday | 2245 | Dry | Fine | Darkness | M2 HILLS | EXP | 150 | West | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.765103 | 151.012912 | No or unknown | No or unknown | West |
| Barclay Road eastbound | 1193998 | Non-casualty (towaway) | 30 | Rear end | 2019 | February | Friday | 1815 | Dry | Fine | Daylight | M2 HILLS | EXP | 1500 | East | WINDSOR ROAD | OP | NORTH ROCKS | Dual freeway | -33.764580 | 151.014047 | No or unknown | No or unknown | East |
| Barclay Road eastbound | 1210486 | Minor/Other Injury | 35 | Lane change left | 2019 | July | Wednesday | 0910 | Dry | Fine | Daylight | M2 HILLS | EXP | 20 | West | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.764536 | 151.014141 | No or unknown | No or unknown | East |
| Barclay Road westbound | 1084581 | Moderate Injury | 33 | Lane sideswipe | 2015 | July | Monday | 0630 | Wet | Raining | Daylight | M2 HILLS | EXP | 100 | East | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.764143 | 151.015029 | No or unknown | No or unknown | West |
| Barclay Road westbound | 1157548 | Non-casualty (towaway) | 81 | Off left/bt bnd=>obj | 2017 | December | Sunday | 2210 | Dry | Fine | Darkness | M2 HILLS | EXP | 200 | East | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.763897 | 151.016448 | Yes | Yes | West |
| Barclay Road westbound | 1166598 | Moderate Injury | 33 | Lane sideswipe | 2018 | February | Tuesday | 1800 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | BARCLAYS ROAD | OP | NORTH ROCKS | Dual freeway | -33.764592 | 151.014572 | No or unknown | No or unknown | West |
| Barclay Road westbound | 1168313 | Minor/Other Injury | 30 | Rear end | 2017 | October | Thursday | 1930 | Dry | Fine | Darkness | M2 HILLS | EXP | 1200 | East | WINDSOR ROAD | TO | NORTH ROCKS | Dual freeway | -33.763885 | 151.018473 | No or unknown | No or unknown | West |
| Barclay Road westbound | 1242467 | Non-casualty (towaway) | 33 | Other, same direction | 2020 | September | Friday | 1810 | Dry | Fine | Darkness | M2 HILLS | EXP | 30 | East | BARCLAY ROAD | OP | NORTH ROCKS | Dual freeway | -33.764373 | 151.015087 | No or unknown | No or unknown | West |
| Deihi Road northbound | 786444 | Non-casualty (towaway) | 30 | Rear end | 2012 | February | Tuesday | 1825 | Dry | Overcast | Daylight | M2 HILLS | EXP | 50 | South | DEHLI ROAD | OP | NORTH RYDE | Dual freeway | -33.794464 | 151.135138 | No or unknown | No or unknown | North |
| Deihi Road northbound | 1017260 | Non-casualty (towaway) | 71 | Off rd left => obj | 2014 | March | Sunday | 1230 | Wet | Raining | Daylight | M2 HILLS | EXP | 0 | Right on the spot | DEHLI ROAD | OP | NORTH RYDE | Dual freeway | -33.794524 | 151.136002 | No or unknown | No or unknown | North |
| Deihi Road northbound | 1155986 | Minor/Other Injury | 30 | Rear end | 2017 | September | Friday | 1500 | Dry | Fine | Daylight | M2 HILLS | EXP | 100 | North | CIPPING ROAD | OP | NORTH RYDE | Dual freeway | -33.795401 | 151.136532 | No or unknown | No or unknown | North |
| Deihi Road southbound | 1000609 | Non-casualty (towaway) | 71 | Off rd left => obj | 2013 | December | Thursday | 0800 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | DEHLI ROAD | OP | MACQUARIE PARK | Dual freeway | -33.793898 | 151.136065 | No or unknown | No or unknown | South |
| Deihi Road southbound | 1054881 | Minor/Other Injury | 30 | Rear end | 2014 | October | Tuesday | 0710 | Dry | Overcast | Daylight | M2 HILLS | EXP | 0 | Right on the spot | DEHLI ROAD | OP | MACQUARIE PARK | Dual freeway | -33.793890 | 151.136065 | No or unknown | No or unknown | East |
| Deihi Road southbound | 1104583 | Serious Injury | 30 | Rear end | 2016 | March | Friday | 0735 | Dry | Fine | Daylight | M2 HILLS | EXP | 100 | North | DEHLI ROAD | OP | MACQUARIE PARK | Dual freeway | -33.792986 | 151.135894 | No or unknown | No or unknown | South |
| Deihi Road southbound | 1115345 | Moderate Injury | 30 | Rear end | 2016 | September | Thursday | 1300 | Dry | Fine | Daylight | M2 HILLS | EXP | 200 | North | DEHLI | RD | MACQUARIE PARK | Other | -33.792023 | 151.135994 | No or unknown | No or unknown | South |
| Deihi Road southbound | 1184091 | Moderate Injury | 30 | Rear end | 2018 | September | Tuesday | 0707 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | DEHLI ROAD | OP | NORTH RYDE | Dual freeway | -33.793855 | 151.136080 | No or unknown | No or unknown | South |
| Deihi Road southbound | 1193205 | Serious Injury | 30 | Rear end | 2019 | January | Friday | 0830 | Dry | Fine | Daylight | M2 HILLS | EXP | 50 | North | DEHLI ROAD | OP | MACQUARIE PARK | Dual freeway | -33.793453 | 151.135970 | No or unknown | No or unknown | South |
| Deihi Road southbound | 1203608 | Serious Injury | 40 | U turn | 2019 | April | Saturday | 2138 | Dry | Fine | Darkness | M2 HILLS | EXP | 30 | North | DEHLI | RD | MACQUARIE PARK | Other | -33.793515 | 151.136185 | No or unknown | No or unknown | North |
| Deihi Road southbound | 1226707 | Non-casualty (towaway) | 30 | Rear end | 2020 | July | Saturday | 1700 | Dry | Overcast | Dusk | M2 HILLS | EXP | 3000 | East | CHRISTIE ROAD | OP | MACQUARIE PARK | Dual freeway | -33.793415 | 151.135862 | No or unknown | No or unknown | East |
| Deihi Road southbound | 1274709 | Non-casualty (towaway) | 30 | Rear end | 2021 | October | Thursday | 0655 | Dry | Fine | Daylight | M2 HILLS | EXP | 20 | North | DEHLI ROAD | OP | MACQUARIE PARK | Dual freeway | -33.793712 | 151.136022 | No or unknown | No or unknown | South |
| Lane Cove Road westbound | 1146232 | Serious Injury | 85 | Off r/bt bnd=>obj | 2017 | August | Sunday | 1950 | Wet | Raining | Darkness | M2 HILLS | EXP | 200 | South | LANE COVE ROAD | TO | MACQUARIE PARK | Other | -33.782255 | 151.133216 | Yes | Yes | North |
| Lane Cove Road westbound | 1177733 | Non-casualty (towaway) | 85 | Off r/bt bnd=>obj | 2018 | August | Monday | 1950 | Wet | Raining | Darkness | M2 HILLS | EXP | 220 | East | LANE COVE | RD | MACQUARIE PARK | Other | -33.782890 | 151.133184 | Yes | Yes | East |
| Langdon Road eastbound | 1036784 | Minor/Other Injury | 30 | Rear end | 2014 | August | Thursday | 0720 | Dry | Fine | Daylight | M2 HILLS | EXP | 200 | East | ABBOTT ROAD | TO | BAULKHAM HILLS | Dual freeway | -33.770399 | 150.967538 | No or unknown | No or unknown | East |
| Langdon Road eastbound | 1106157 | Minor/Other Injury | 30 | Rear end | 2016 | June | Tuesday | 0700 | Dry | Fine | Daylight | M2 HILLS | EXP | 10 | West | LANGDON ROAD | OP | BAULKHAM HILLS | Dual freeway | -33.770936 | 150.965262 | No or unknown | No or unknown | East |
| Langdon Road eastbound | 1204693 | Moderate Injury | 30 | Rear end | 2019 | April | Monday | 1350 | Dry | Fine | Daylight | M2 HILLS | EXP | 100 | West | LANGDON ROAD | OP | BAULKHAM HILLS | Dual freeway | -33.770395 | 150.967497 | No or unknown | No or unknown | East |
| Langdon Road eastbound | 1211985 | Minor/Other Injury | 30 | Rear end | 2019 | August | Thursday | 0815 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | LANGDON ROAD | OP | BAULKHAM HILLS | Dual freeway | -33.770564 | 150.965305 | No or unknown | No or unknown | East |
| Murray Farm Road westbound | 808031 | Non-casualty (towaway) | 71 | Off rd left => obj | 2012 | August | Friday | 1730 | Dry | Fine | Dusk | M2 HILLS | EXP | 0 | Right on the spot | MURRAY FARM RD | OP | BEECROFT | Dual freeway | -33.758983 | 151.065997 | No or unknown | No or unknown | North |
| Murray Farm Road westbound | 1137101 | Serious Injury | 34 | Lane change right | 2017 | May | Friday | 1620 | Dry | Overcast | Daylight | M2 HILLS | EXP | 100 | East | MURRAY FARM ROAD | OP | CHELTENHAM | Dual freeway | -33.759547 | 151.066776 | No or unknown | No or unknown | West |
| Pennant Hills Road eastbound | 795168 | Non-casualty (towaway) | 30 | Rear end | 2012 | May | Sunday | 2130 | Dry | Fine | Darkness | M2 HILLS | EXP | 100 | West | CUMBERLAND HIG | OP | WEST PENNANT H | Dual freeway | -33.758797 | 151.047574 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 813039 | Minor/Other Injury | 30 | Rear end | 2012 | September | Tuesday | 0715 | Dry | Fine | Daylight | M2 HILLS | EXP | 30 | West | CUMBERLAND HWY | OP | CARLINGFORD | Dual freeway | -33.758668 | 151.048596 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 813122 | Non-casualty (towaway) | 30 | Rear end | 2012 | August | Thursday | 0930 | Dry | Fine | Daylight | M2 HILLS | EXP | 150 | West | CUMBERLAND HIG | OP | WEST PENNANT H | Dual freeway | -33.758792 | 151.047310 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 837753 | Non-casualty (towaway) | 30 | Rear end | 2013 | May | Friday | 0725 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | CUMBERLAND HIG | OP | WEST PENNANT H | Dual freeway | -33.758633 | 151.048921 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 843910 | Non-casualty (towaway) | 30 | Rear end | 2013 | July | Wednesday | 0600 | Dry | Fine | Daylight | M2 HILLS | EXP | 50 | West | CUMBERLAND HIG | OP | WEST PENNANT H | Dual freeway | -33.758690 | 151.048374 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 854281 | Non-casualty (towaway) | 30 | Rear end | 2013 | October | Friday | 0610 | Dry | Overcast | Daylight | M2 HILLS | EXP | 100 | West | CUMBERLAND HIGHWAY | OP | WEST PENNANT HILLS | Dual freeway | -33.758741 | 151.047849 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 856102 | Moderate Injury | 85 | Off r/bt bnd=>obj | 2013 | October | Tuesday | 0945 | Dry | Fine | Daylight | M2 HILLS | EXP | 30 | West | CUMBERLAND HWY | OP | CARLINGFORD | Dual freeway | -33.758672 | 151.048549 | No or unknown | No or unknown | West |
| Pennant Hills Road eastbound | 1065354 | Non-casualty (towaway) | 73 | Other straight | 2015 | March | Friday | 2200 | Dry | Fine | Darkness | M2 HILLS | EXP | 0 | Right on the spot | CUMBERLAND HIGHWAY | OP | CARLINGFORD | Dual freeway | -33.758646 | 151.048797 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 1073215 | Serious Injury | 30 | Rear end | 2015 | June | Monday | 0620 | Dry | Fine | Daylight | M2 HILLS | EXP | 0 | Right on the spot | CUMBERLAND HIGHWAY | OP | CARLINGFORD | Dual freeway | -33.758607 | 151.049138 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 1086729 | Non-casualty (towaway) | 30 | Rear end | 2015 | November | Monday | 1730 | Dry | Fine | Dusk | M2 HILLS | EXP | 0 | Right on the spot | CUMBERLAND HIGHWAY | OP | CARLINGFORD | Dual freeway | -33.758633 | 151.048917 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 1139198 | Non-casualty (towaway) | 33 | Lane sideswipe | 2017 | April | Saturday | 0545 | Dry | Overcast | Dawn | M2 HILLS | EXP | 50 | West | CUMBERLAND HIGHWAY | TO | WEST PENNANT HILLS | Other | -33.758461 | 151.048992 | No or unknown | No or unknown | East |
| Pennant Hills Road eastbound | 1189237 | Non-casualty (towaway) | 30 | Rear end | 2018 | December | Thursday | 1840 | Wet | Raining | Daylight | M2 HILLS | EXP | 0 | Right on the spot | CUMBERLAND HIGHWAY | OP | CARLINGFORD | Dual freeway | -33.758633 | 151.048921 | No or unknown | No or unknown | East |

Appendix C: Photo Montages



1. M2 Hills Motorway northbound approach – Lane 1 (Day)



2. M2 Hills Motorway northbound approach – Lane 2 (Day)

