M2 Hills Motorway: Windsor Road Overpass

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

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 Windsor Road Baulkham Hills Digital Sign TSA	R. Jain / A. Suriono / S. Daizli	D. Bitzios	S. Daizli	19/10/2022	Gerry Thorley, Digital Place Solutions gerry@digitalplacesolutions.com
P5486.002R M2 Windsor Road Baulkham Hills Digital Sign TSA	S. Daizli	D. Bitzios	S. Daizli	24/11/2022	Gerry Thorley, Digital Place Solutions gerry@digitalplacesolutions.com

CONTENTS

Tables

Figures

Appendices

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 above the eastbound carriageway of the M2 Hills Motorway (M2) Windsor Road overpass in Baulkham Hills 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-west towards eastbound 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 585m 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 1.6cm high when 200m from it.

2.2 Driver Views

The eastbound 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 eastbound

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	M2 Windsor Road eastbound overpass, Baulkham Hills, NSW
Local Government Area	The Hills
Land use zoning	SP2 Classified Road
Proposed facing direction	South-west
Proposed type of advertisement/sign	Bridge 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	12.58m x 3.30m = 41.51m^2
Minimum vertical pavement clearance	5.30m
Visual screen size greater than 20m^2?	Yes
Visual screen size greater than 45m^2?	No
Structure higher than 8m above the ground?	Yes – overall height 8.60m
Is the site located within 250m of and visible from a classified road under the *Roads Act 1993*?	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 in 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 quantity 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 585m south-west 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**.

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 degree 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 **Appendix D** along with a detailed record list. The crash maps are presented in terms of degree and type (road user movement describing the first impact of the crash), with a degree summary provided in Table 5.1.

Table 5.1: Crash Degree Summary on Approach to the Site (2016-2020)

Year	Crash Degree					Total
	Fatal	Serious Injury	Moderate Injury	Minor/Other Injury	Non-casualty (towaway)	
2016	-	-	-	-	-	-
2017	-	-	-	-	-	-
2018	-	-	-	1	-	1
2019	-	-	-	-	-	-
2020	-	-	-	-	-	-
Total	**-**	**-**	**-**	**1**	**-**	**1**

As shown in the above table, **only one crash was reported between January 2016 and December 2020**. It occurred in March 2018 during dawn and in dry road surface conditions, approximately 65m before the Windsor Road overpass. The crash was classified as 'rear end' and resulted in minor injury.

The site is inherently safe, with practically no driving distractions and an exceptionally low cognitive load imposed on drivers.

5.4 Approach Sightline Assessments

5.4.1 Description of Approach

The eastbound approach in proximity to the proposed sign is described in Table 5.2.

Table 5.2: Approach Attributes – M2 eastbound

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 585m south-west 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 1.6cm high
Minimum duration of visibility	20s at free-flow speed

5.4.1 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 Eastbound

The eastbound approach along the M2 is generally straight and moderately uphill towards the Windsor Road overpass and proposed digital sign. The sign could be seen from approximately 585m away but would be very small and its content would be unrecognisable at this range. From about 200m away, the sign is still relatively small in the forward field of view, but drivers would be likely to be able to identify its advertising contents.

At this range, the retaining wall to the left means that there is nothing that the driver could be distracted by outside of the forward roadway and their vision would be centred on the road ahead with no transverse glances. There are no decisions to make on approach to the proposed digital sign either. Drivers would already know that they are in a 100km/h zone and the posted speed limit signs near the bridge are for reinforcement purposes only. In any case, they are directly in the forward view, for a long distance and would still be recognised even if a driver glanced to the digital sign.

A digital sign in the proposed location would not obstruct sightlines to, or influence the messaging of, traffic control devices or signs because there are none, except for the 100km/h speed limit reinforcement signs. There are no on-ramps or off-ramps in proximity to the approach to the sign. The decision point for the diverge movement to the Windsor Road eastbound off-ramp is approximately 585m back from the sign at which point the sign would be unrecognisable and smaller than a postage stamp in size at the windscreen. This means that the approach to the proposed digital sign does not require any rapid or complex decision making by drivers. It is a location of very low cognitive load and a location where a glance to the digital sign is in a field of view that allow for recognition of brake lights, indicators or moving vehicles to be unaffected by the presence of the sign.

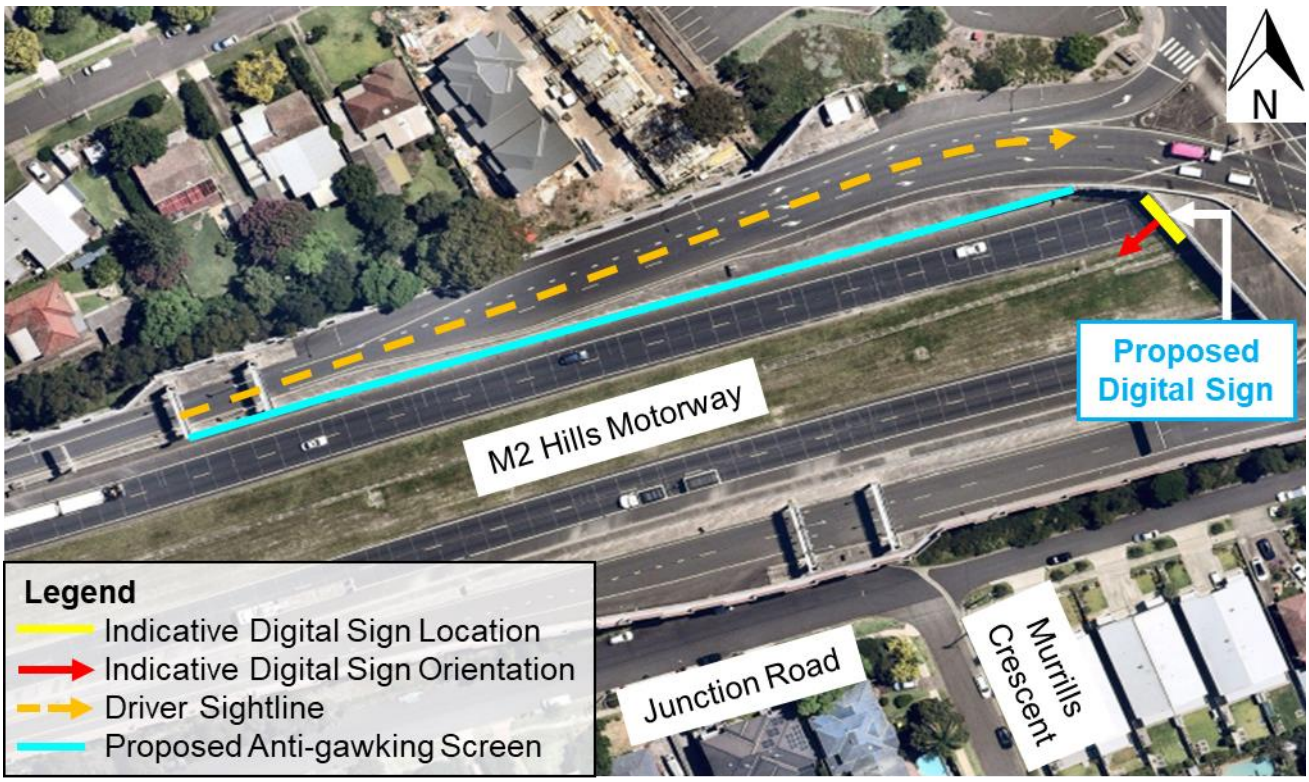
The in-vehicle sightlines from the M2 eastbound are shown in Figure 5.1, clearly demonstrating that all vehicle movements are in the same sightline as the digital sign, which means no risk of distraction away from the forward roadway when glancing to it.

[1]*Distances measured in Nearmap.*
[2]*Sign location is indicative, not to scale and for illustration purposes only.*

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

Windsor Road Eastbound Off-ramp

Drivers on the Windsor Road eastbound off-ramp could potentially see the sign within 195m of the Windsor Road signalised intersection from the toll gantry. To reduce the likelihood of drivers glancing at the sign, an anti-gawking screen could be installed along the viewpoint as shown in Figure 5.2.



**Sign location is indicative.*
Adapted from Nearmap

Figure 5.2: Proposed Anti-gawking Screen along the Windsor Road eastbound off-ramp

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 5.3. Whilst the criteria are quite generic, the basis for the responses to each criterion is provided next to them.

Table 5.3: 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 (except beyond the Windsor Road eastbound off-ramp), 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 5.4 details the assessment against the Transport for NSW Advertising Sign Safety Assessment Matrix.

Table 5.4: 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 above all surrounding objects/vehicles etc.	1	Low
B. Sign positioning relative to travel direction	The proposed sign will be positioned over the travel lanes on the M2 Windsor Road overpass and would be in the ordinary field of view. It will be visually prominent eastbound.	1	Low
C. It distracts a driver at a critical time	The proposed sign will not be located near any decision points. At the Windsor Road eastbound off-ramp diverge taper, some 300m before the overpass, the digital sign content would not be recognisable (less than 4cm wide in the windscreen).	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	A supersite static sign is located on the previous Watkins Road overpass, located approximately 575m away.	1	Low

5.5.3 Transport Corridor Outdoor Advertising and Signage Guidelines Table 3

Table 5.5 details the assessment against the digital sign criteria in Table 3 of the *Signage Guidelines*.

Table 5.5: 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: 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: 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 *Signage Guidelines*. Acceptable luminance levels for this zone as specified in Table 6 of the *Signage Guidelines* 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 *Environmental Planning and Assessment Act 1979*, 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 Windsor Road eastbound overpass of the M2 Hills Motorway (M2) in Baulkham Hills 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 above the road. There are no directions signs, no intersections, no traffic control devices and no views outside of the forward roadway because they are obscured by the retaining wall to the left
- 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-west and a glance to the sign will permit co-incident recognition of vehicle and cyclist movements in the forward view in a straight, flat road section with no on-ramps or off-ramps in this zone. There is no rapid multi-factor decision making 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 (the distance at which advertisements could be clearly recognised) showed an exceptionally low crash rate. Furthermore, the data does not identify an unusually high or inherently high crash risk on approach to the site that would deem the proposed location unsuitable
- A mitigation measure could include installing an anti-gawking screen along the Windsor Road eastbound off-ramp viewpoint to the sign from the toll gantry
- 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
  - Images not being mistaken for a traffic control device
  - 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
  - Maintaining a log of the sign's activity
  - A road safety check after 12 months but within 18 months of the sign's installation.

Given the above conclusions, the digital sign should be approved as proposed with the introduction of the anti-gawking screen worthy of consideration.

REFERENCES

Austroads (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/e3b6/2957b23906769969f4a00f8815fbe9bdce7e.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.

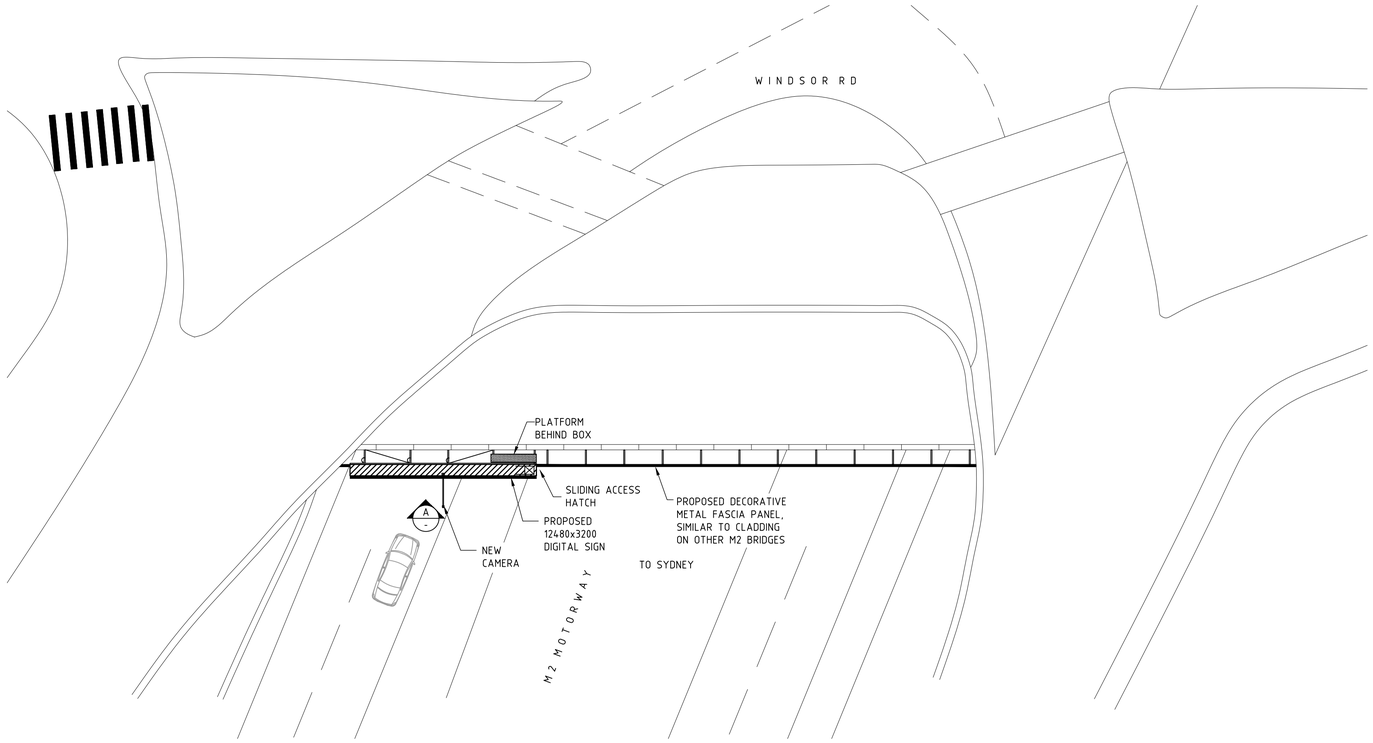
Tantala, M.W. & Tantala, A.M. (2010). A study of the relationship between digital billboards and traffic safety in the Greater Reading Area, Berks County, Pennsylvania. Submitted to the Foundation for Outdoor Advertising Research and Education (FOARE).

US Department of Transport Federal Highway Administration (2012). Driver visual behavior in the presence of commercial electronic variable message signs (CEVMS).

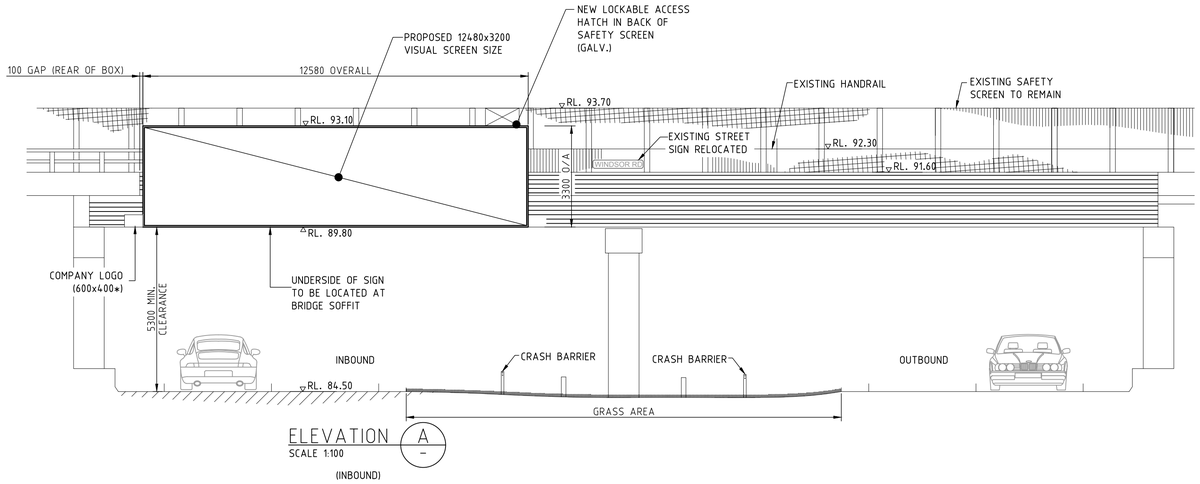
Victor, T.W., Harbluk, J.L. & Engstrom, J.A. (2005). Sensitivity of eye-movement measures to in-vehicle task difficulty. Transportation Research, vol. 8, no. 2, pp. 167-190.

Appendix A: Proposed Development Plan

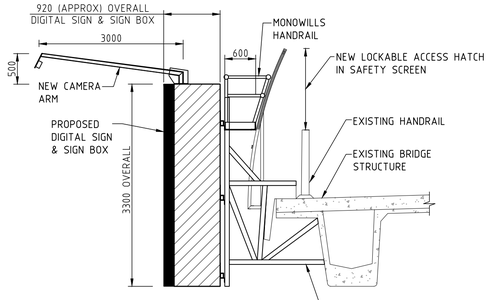
AERIAL PHOTO
NTS



PROPOSED SITE PLAN
SCALE 1:200

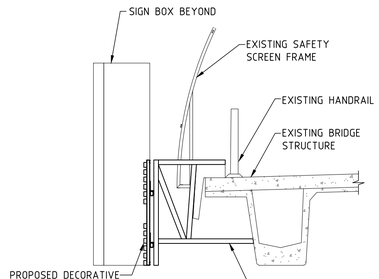


ELEVATION A
SCALE 1:100
(INBOUND)



SECTION 1
SCALE 1:50

FALL RESTRAINT CABLE TO BE FIXED BETWEEN SIGNBOX AND BRIDGE



SECTION 2
SCALE 1:50

NOTE: RL'S ARE APPROXIMATE

*LOGO DIMENSIONS NOMINAL

NOT FOR CONSTRUCTION

ISS	DATE	COMMENT
A	01/09/22	ISSUED FOR APPROVAL
B	06/10/22	ISSUED FOR APPROVAL

Dennis Bunt Consulting Engineers Pty Ltd
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: WINDSOR RD OVERPASS, BAULKHAM HILLS, INBOUND

TITLE: PROPOSED DIGITAL SIGNS
GENERAL ARRANGEMENT & SITE PLAN, ELEVATION & SECTION

DRAWN MT	DESIGN JL	DATE: Aug'22	
JOB NO: 22141-7		DWG NO: DA01	
SCALE @ A1: AS SHOWN		REV: B	

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

Issue History

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.

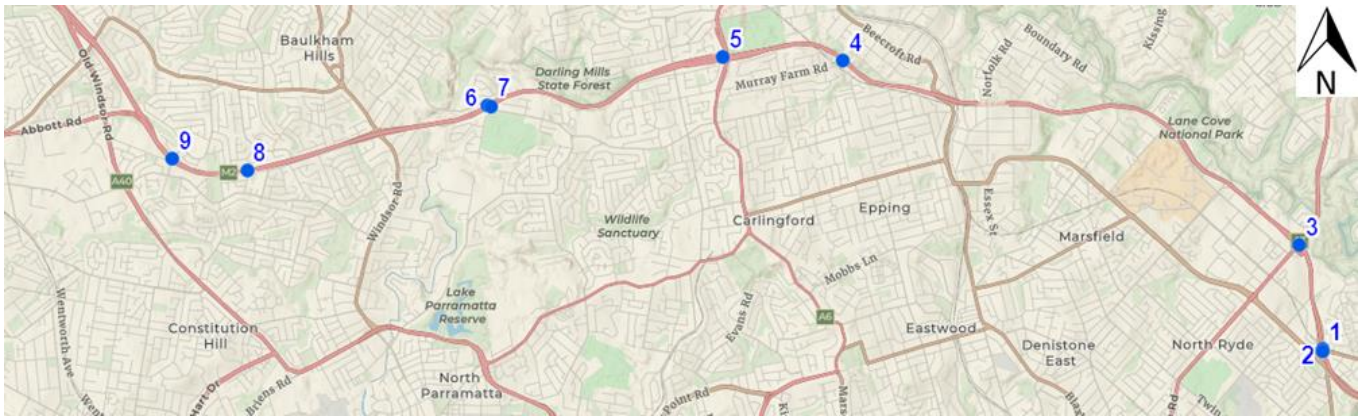
The analysis is directly relevant to the assessment of the potential change in crash rate or crash types post-installation of the nine new proposed digital signs because they are also on the M2 corridor at similar types of locations.

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.

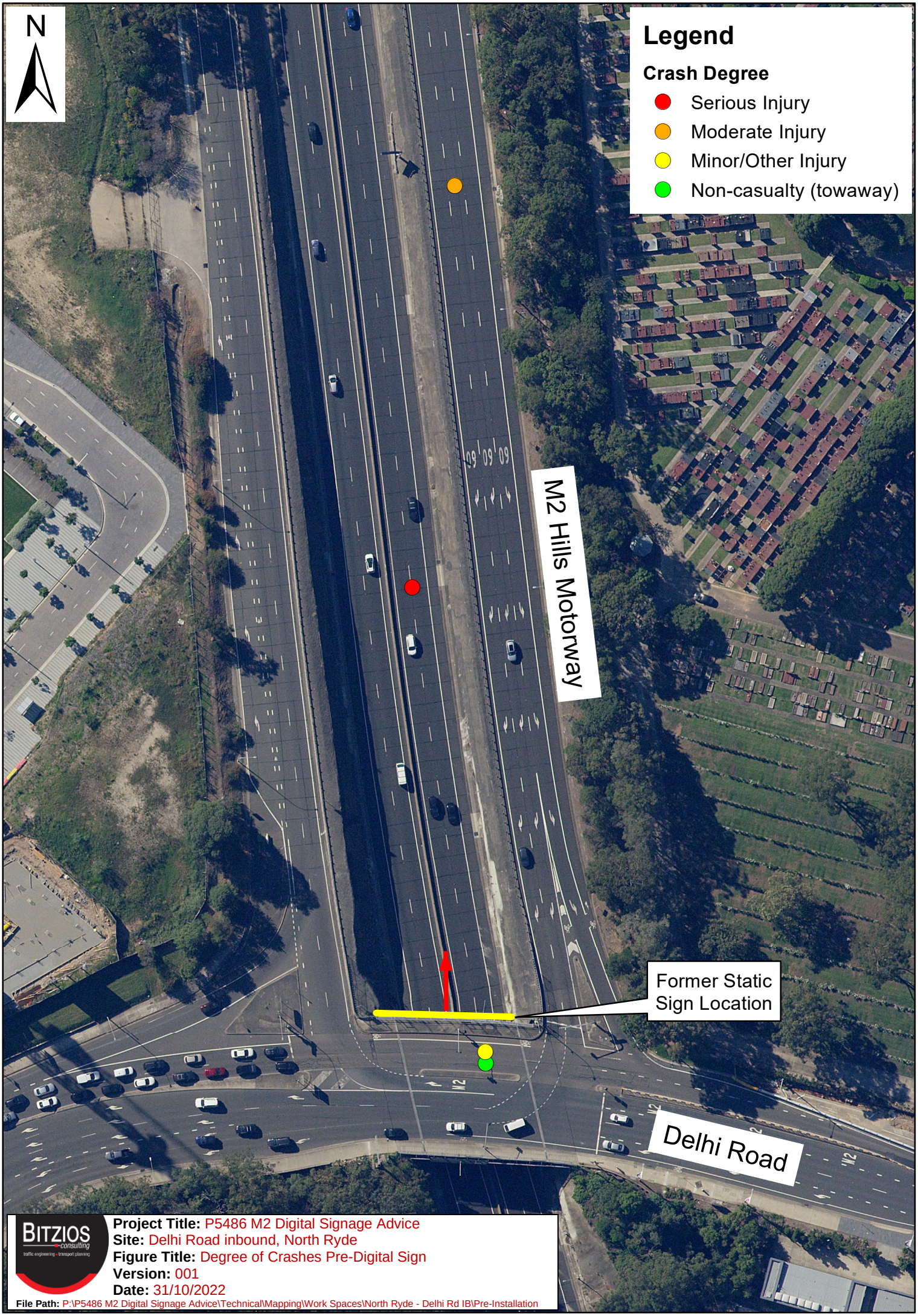
Whilst each site is unique and should be assessed on its particular circumstances, given the above conclusions, there is no evidentiary basis to claim that the installation of digital signs on bridges along the M2 will lead to a higher crash rate than currently exists unless the installation is in a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

Road Safety Check Findings

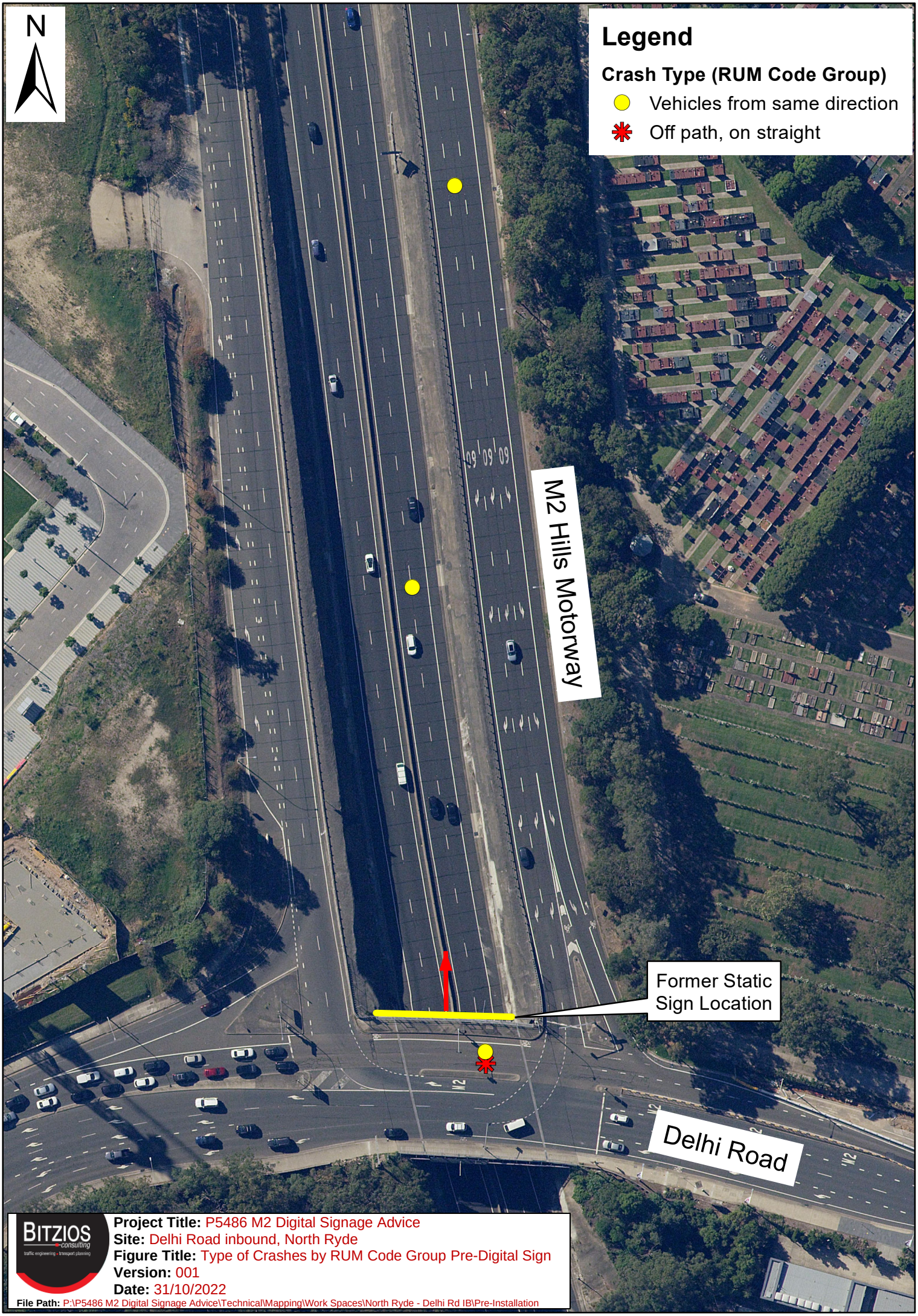
The 12-month post-installation road safety checks of the digital signs undertaken by Winning Traffic Solutions (WTS) concluded for all of the signs that:

- 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.

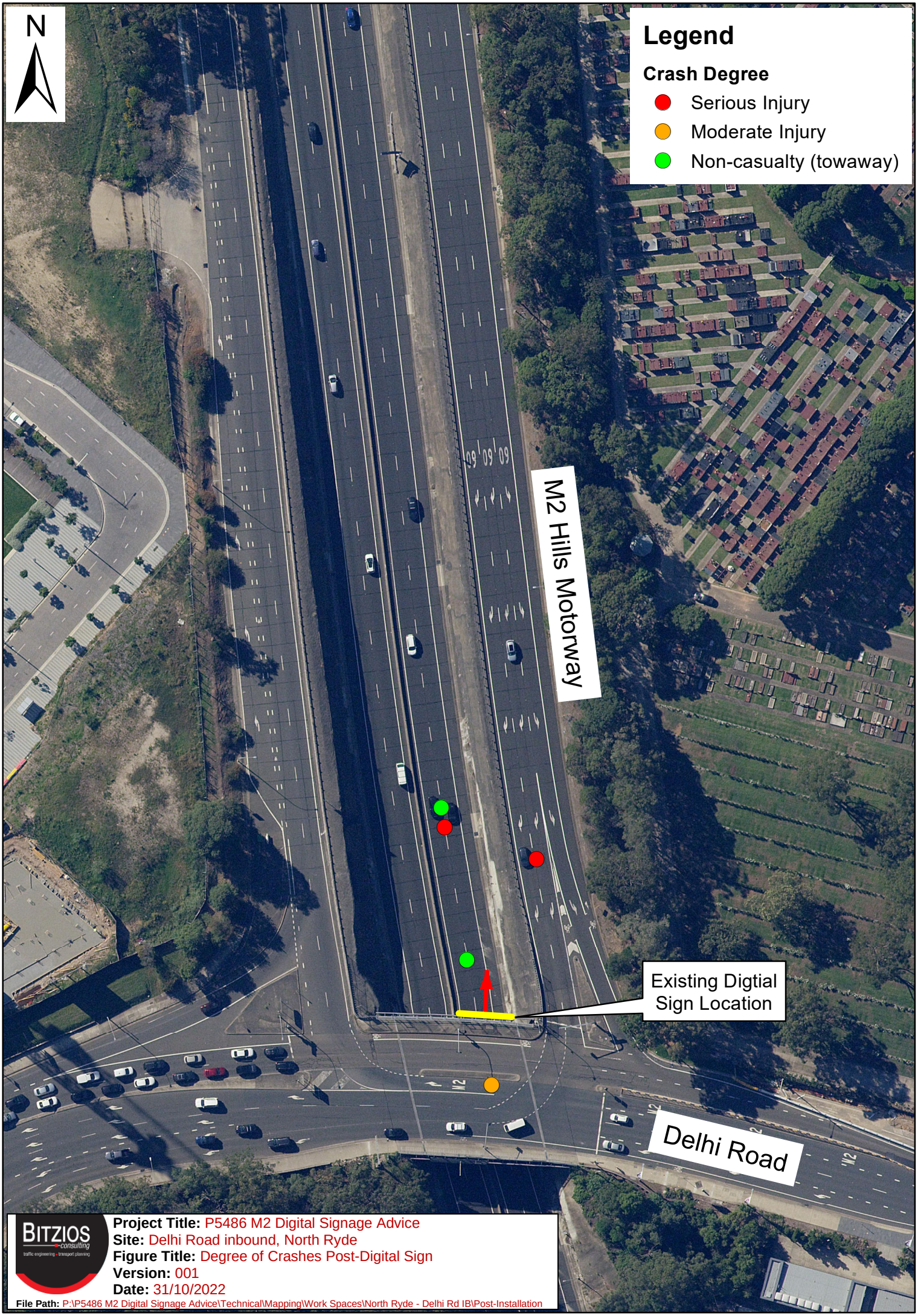
Attachment A: Crash Data



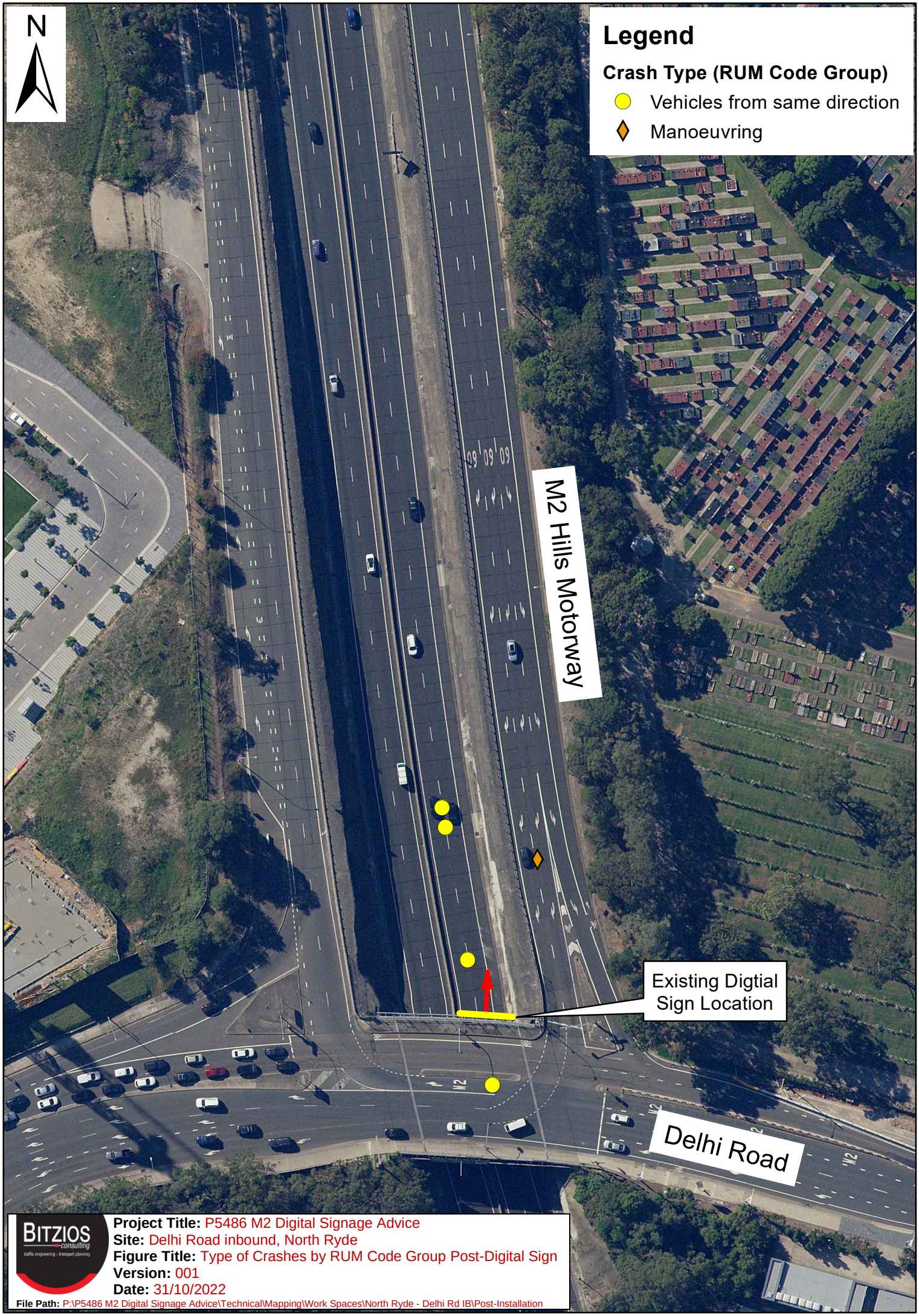
Project Title: P5486 M2 Digital Signage Advice
Site: Delhi Road inbound, North Ryde
Figure Title: Degree of Crashes Pre-Digital Sign
Version: 001
Date: 31/10/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\North Ryde - Delhi Rd IB\Pre-Installation



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



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



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

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

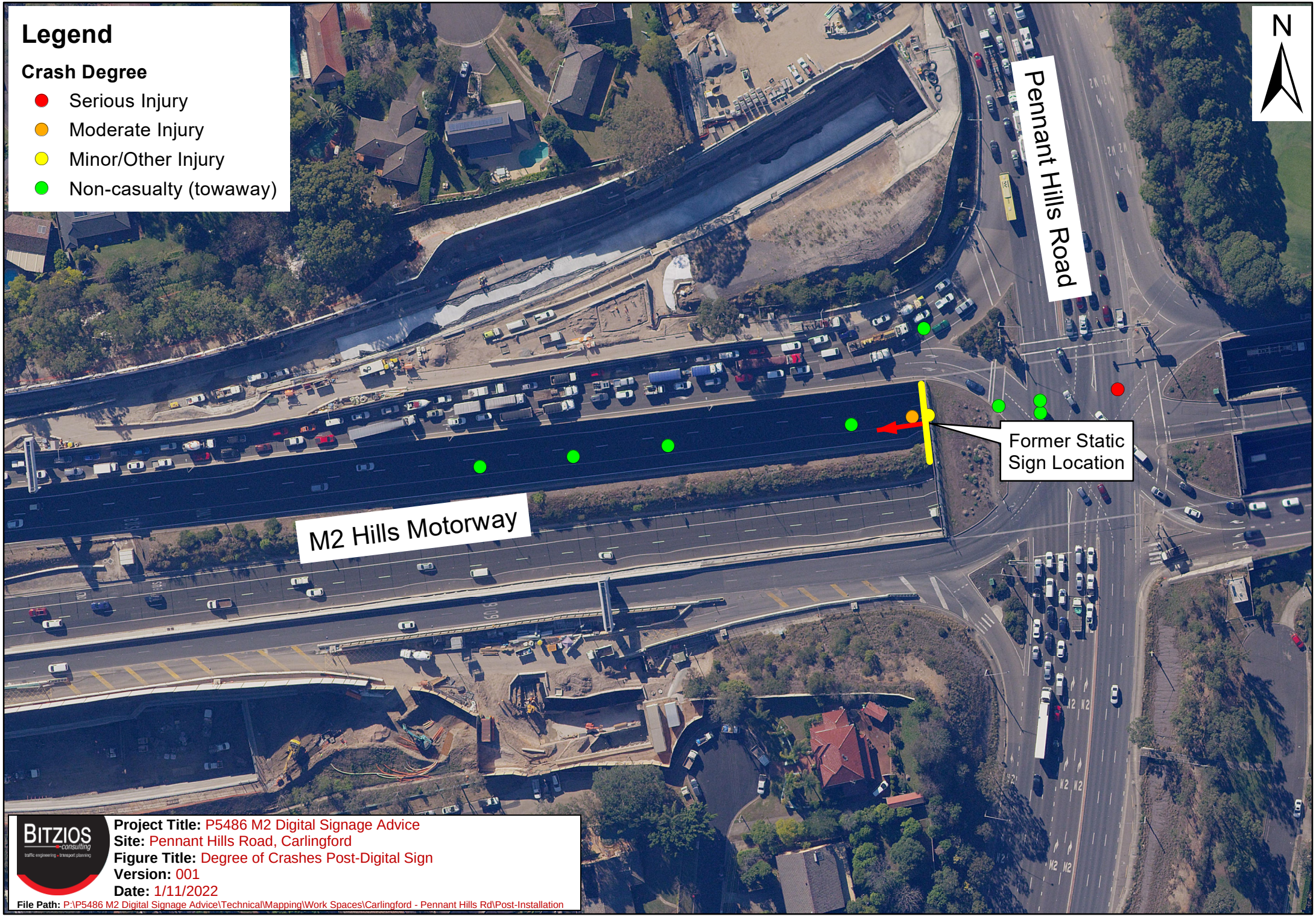
Project Title: P5486 M2 Digital Signage Advice
Site: Lane Cove Road outbound, Macquarie Park
Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign
Version: 001
Date: 31/10/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Macquarie Park - Lane Cove Rd OB

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

BITZIOS consulting
traffic engineering • transport planning

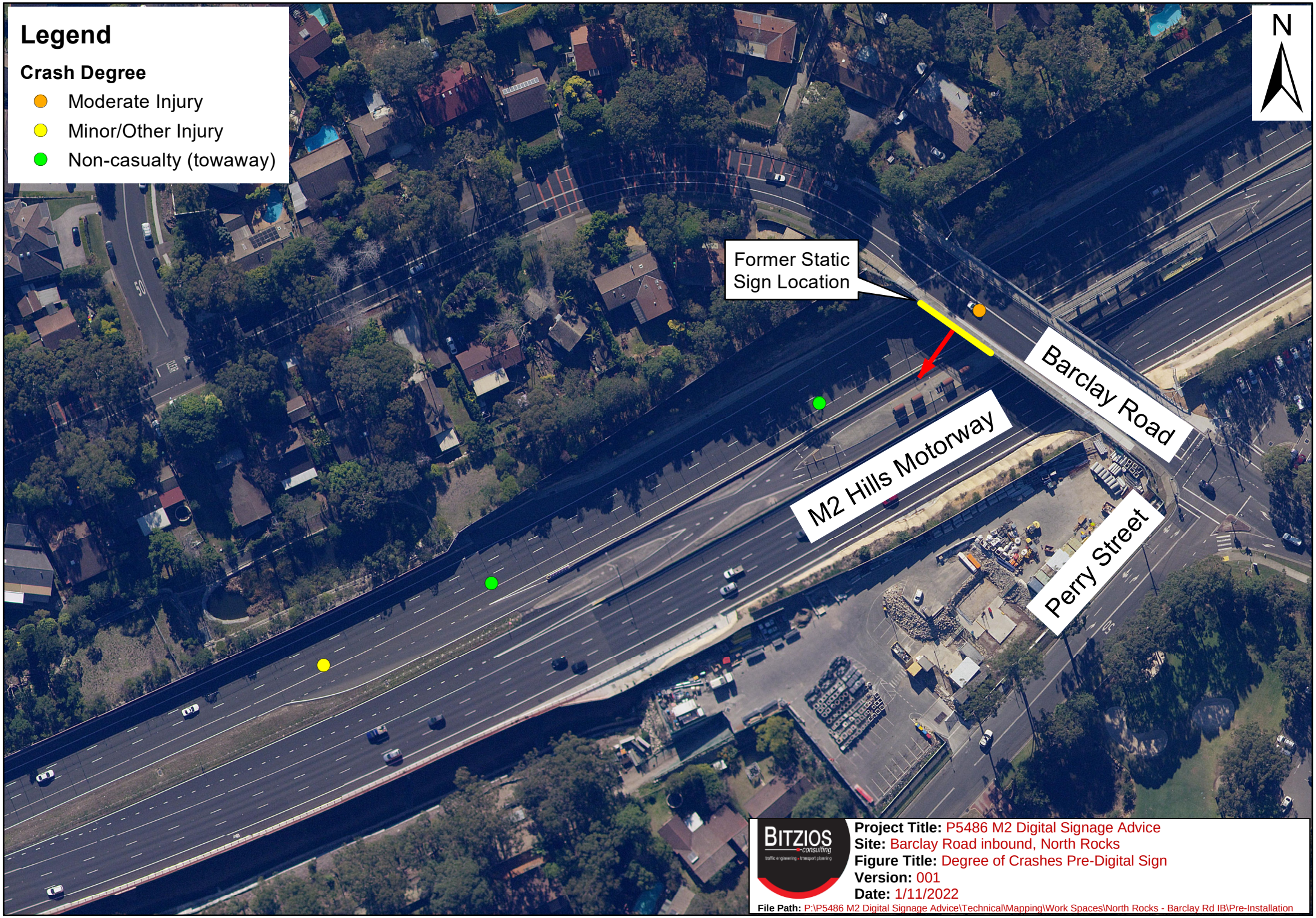
Project Title: P5486 M2 Digital Signage Advice
Site: Murray Farm Road outbound, Cheltenham
Figure Title: Type of Crashes by RUM Code Group Pre-Digital Sign
Version: 001
Date: 1/11/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Cheltenham - Murray Farm Rd OB

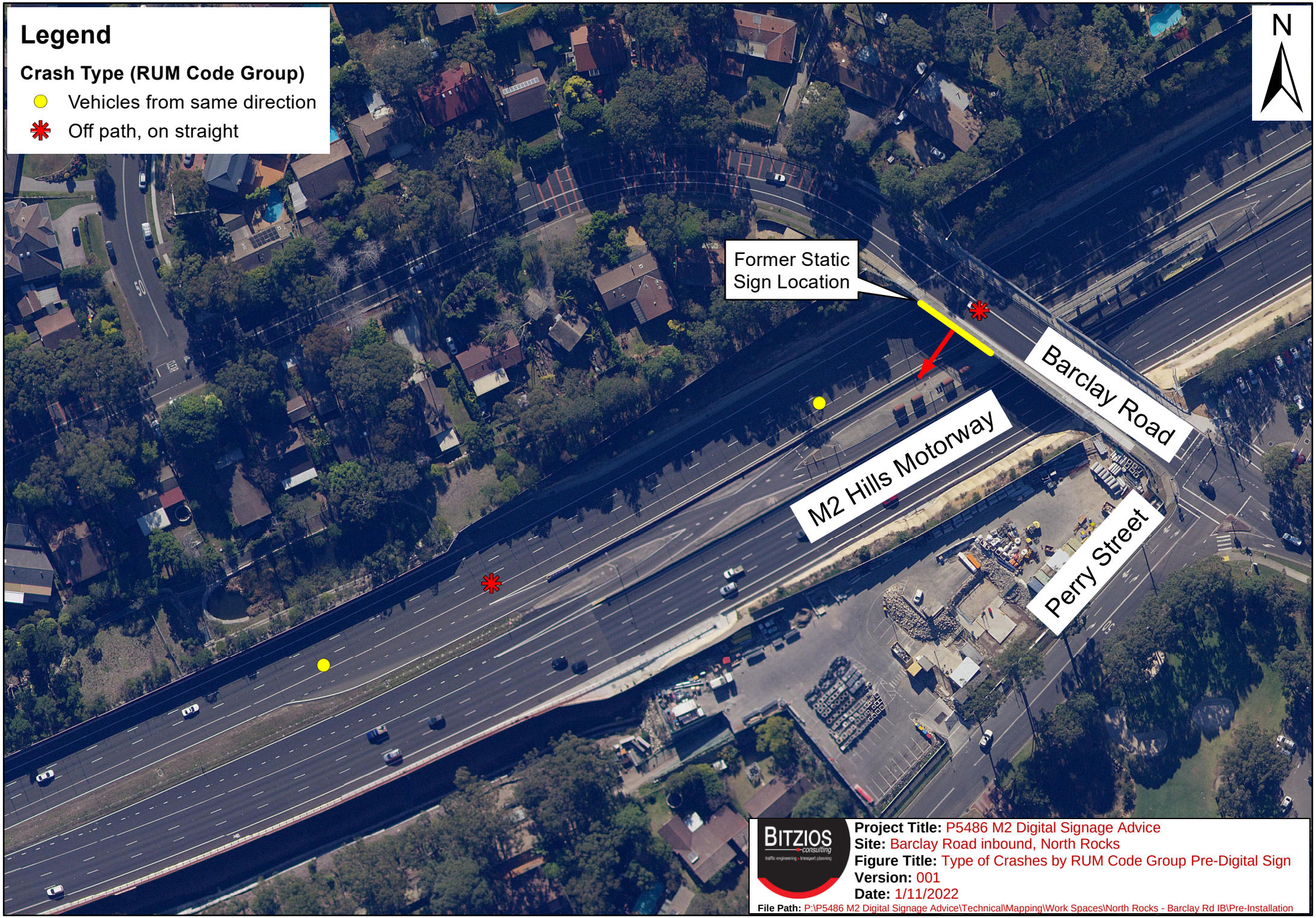

Legend
Crash Degree
Serious Injury
Moderate Injury
Minor/Other Injury
Non-casualty (towaway)
N
Pennant Hills Road
Former Static Sign Location
M2 Hills Motorway
BITZIOS consulting
traffic engineering + transport planning
Project Title: P5486 M2 Digital Signage Advice
Site: Pennant Hills Road, Carlingford
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

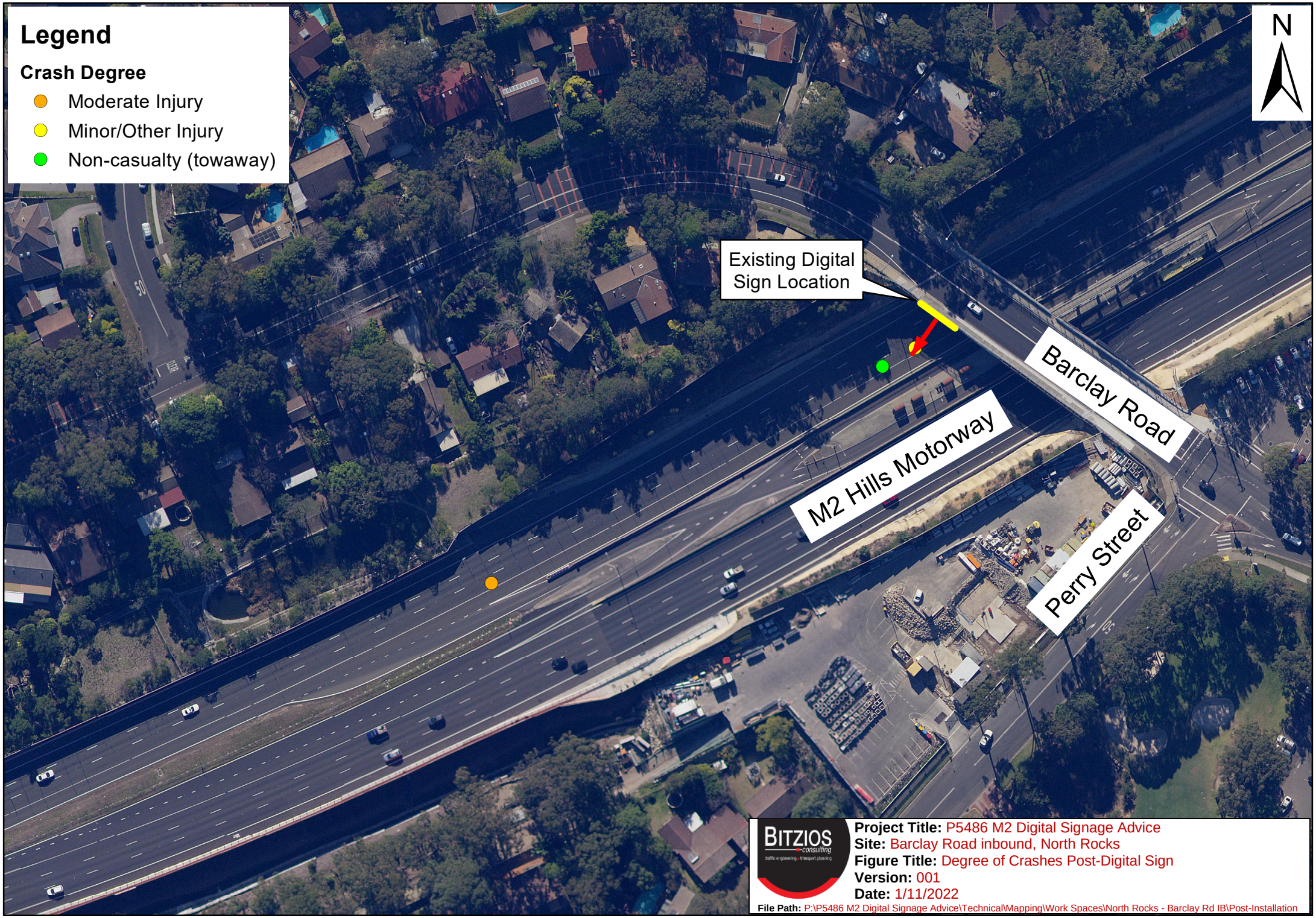

Legend
Crash Type (RUM Code Group)
Vehicles from same direction
Off path, on straight
Off path, on curve or turning
N
Pennant Hills Road
M2 Hills Motorway
Former Static Sign Location
BITZIOS consulting
traffic engineering - transport planning
Project Title: P5486 M2 Digital Signage Advice
Site: Pennant 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

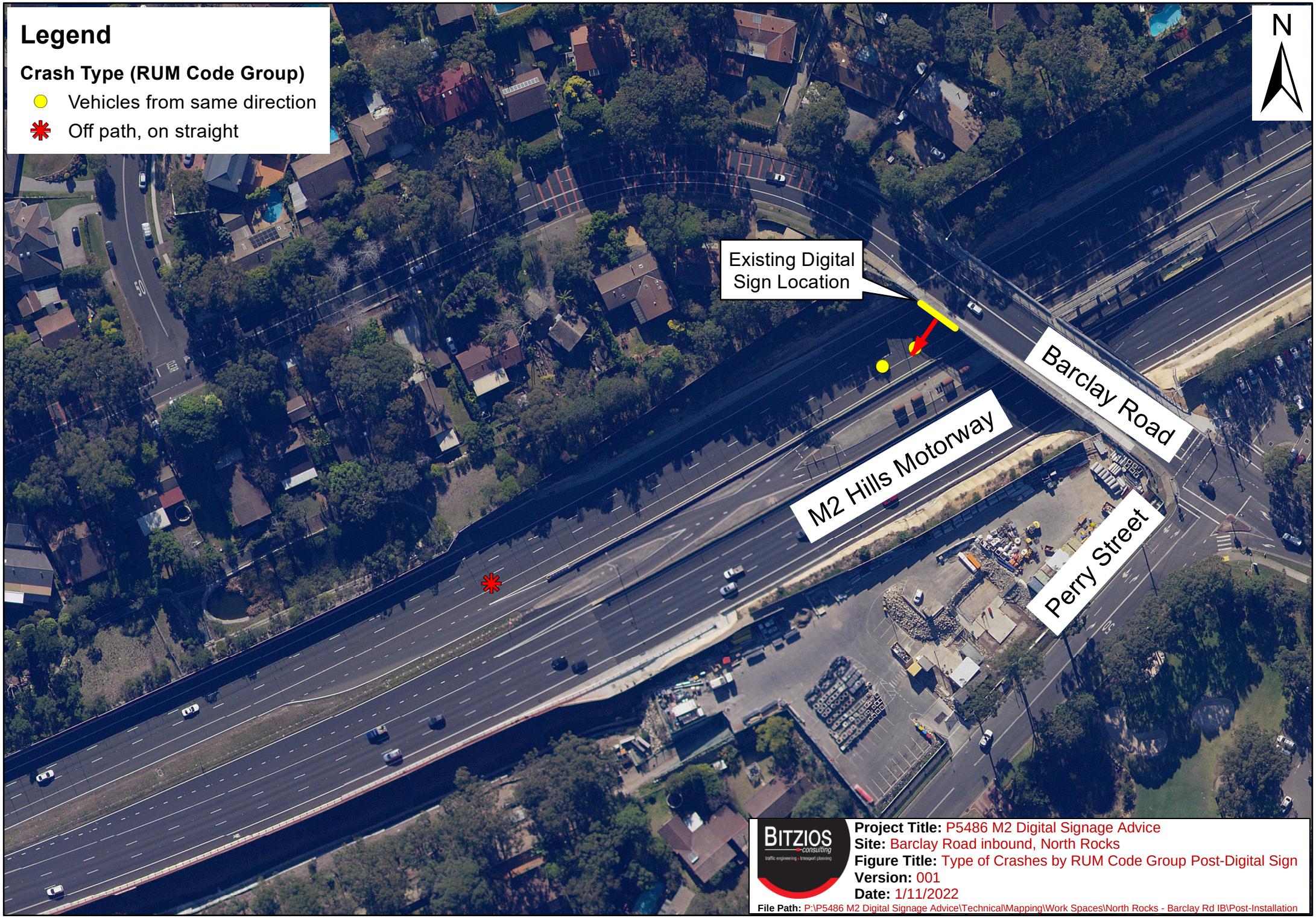
Project Title: P5486 M2 Digital Signage Advice
Site: Pennant Hills Road, Carlingford
Figure Title: Degree of Crashes Post-Digital Sign
Version: 001
Date: 1/11/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Carlingford - Pennant Hills Rd\Post-Installation

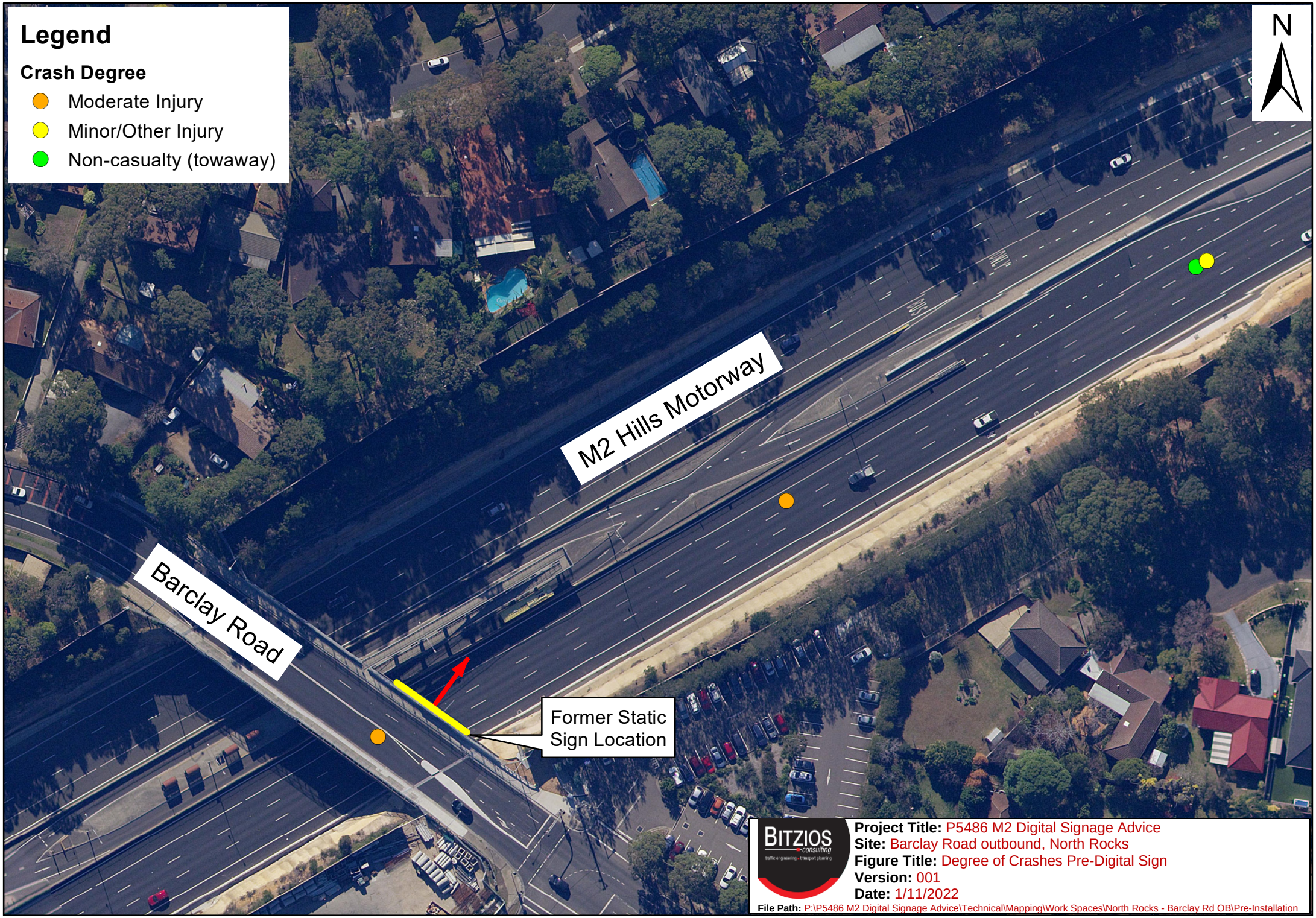
Project Title: P5486 M2 Digital Signage Advice
Site: Pennant Hills Road, Carlingford
Figure Title: Type of Crashes by RUM Code Group Post-Digital Sign
Version: 001
Date: 1/11/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Carlingford - Pennant Hills Rd\Post-Installation

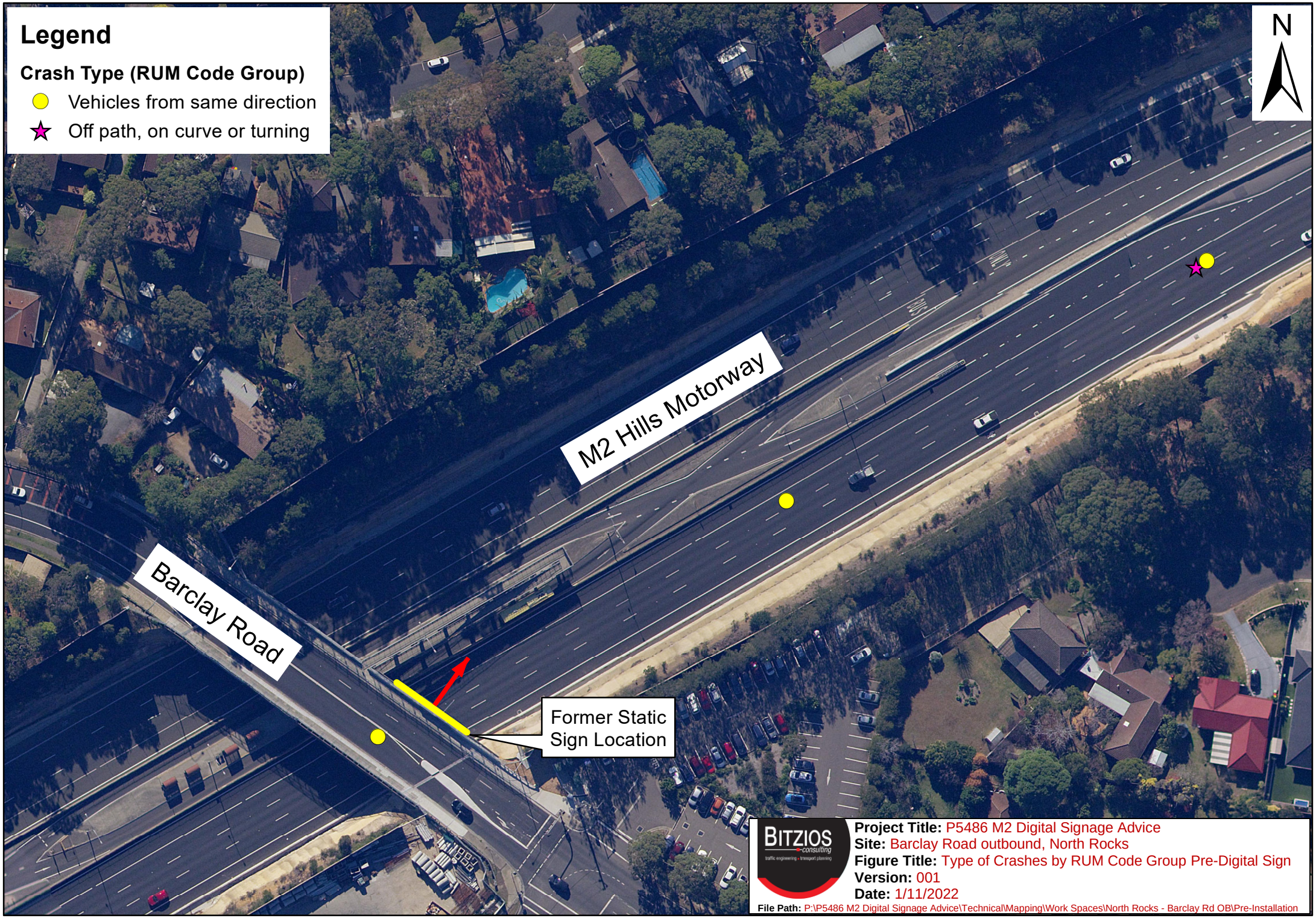

Legend
Crash Degree
Moderate Injury
Minor/Other Injury
Non-casualty (towaway)
N
Former Static Sign Location
Barclay Road
M2 Hills Motorway
Perry Street
50
Project Title: P5486 M2 Digital Signage Advice
Site: Barclay Road inbound, North Rocks
Figure Title: Degree of Crashes Pre-Digital Sign
Version: 001
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
N
Former Static Sign Location
Barclay Road
M2 Hills Motorway
Perry Street
BITZIOS consulting
traffic engineering - transport planning
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)
N
Existing Digital Sign Location
Barclay Road
M2 Hills Motorway
Perry Street
50
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
N
Existing Digital Sign Location
Barclay Road
M2 Hills Motorway
Perry Street
BITZIOS consulting
traffic engineering - transport planning
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)
N
M2 Hills Motorway
Barclay Road
Former Static Sign Location
BITZIOS consulting
traffic engineering - transport planning
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
N
M2 Hills Motorway
Barclay Road
Former Static Sign Location
BITZIOS consulting
traffic engineering - transport planning
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)
N
M2 Hills Motorway
Barclay Road
Existing Digtial Sign Location
BITZIOS consulting
traffic engineering • transport planning
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
N
M2 Hills Motorway
Barclay Road
Existing Digtial Sign Location
BITZIOS consulting
traffic engineering • transport planning
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

BITZIOS consulting
traffic engineering • transport planning

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

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 IB\Pre-Installation

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 IB\Post-Installation

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 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 IB\Post-Installation

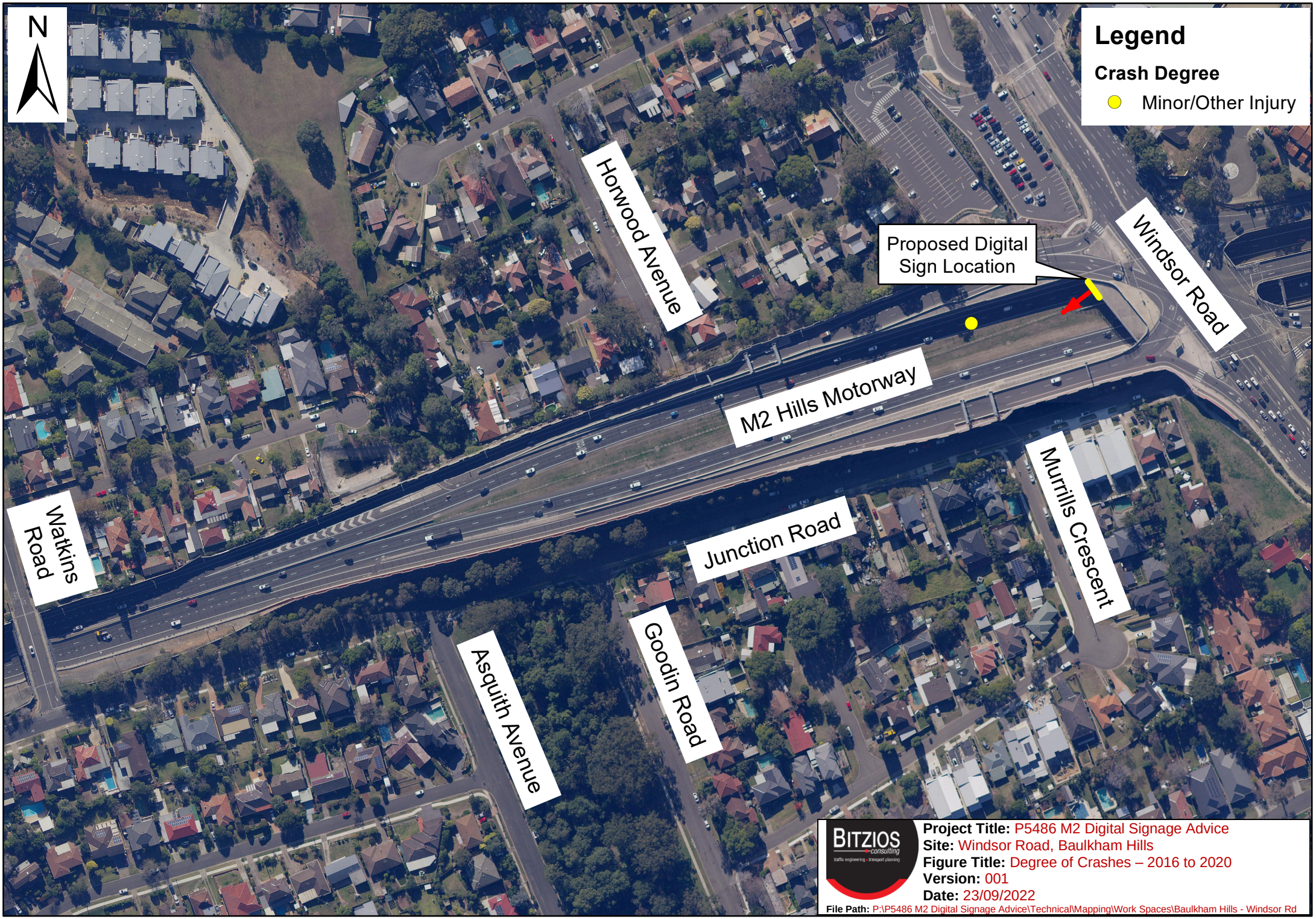
M2 overpass	Crash ID	Degree of crash - detailed	RUM - code	RUM - description	Year of crash	Month of crash	Day of week of crash	Time of crash	Surface condition	Weather	Natural lighting	Street of crash	Street type	Distance	Direction	Identifying feature	Identifying feature type	Town	Type of location	Latitude	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	151.014328	No or unknown	No or unknown	East
Barclay Road eastbound	1147385	Non-casualty (towaway)	73	Off rd rght => 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	1176863	Moderate Injury	73	Off rd right => obj	2018	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	1193898	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	151.015509	No or unknown	No or unknown	West
Barclay Road westbound	1157648	Non-casualty (towaway)	81	Off left/rt bnd=>obj	2017	December	Sunday	2210	Dry	Fine	Darkness	M2 HILLS	EXP	200	East	BARCLAY ROAD	OP	NORTH ROCKS	Dual freeway	-33.763697	151.016448	Yes	Yes	West
Barclay Road westbound	1165698	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	-33.763685	151.016473	No or unknown	No or unknown	West
Barclay Road westbound	1242467	Non-casualty (towaway)	39	Other same direction	2020	September	Friday	1610	Dry	Fine	Daylight	M2 HILLS	EXP	50	East	BARCLAY ROAD	OP	NORTH ROCKS	Dual freeway	-33.764373	151.015087	No or unknown	No or unknown	West
Delhi Road northbound	786444	Non-casualty (towaway)	30	Rear end	2012	February	Tuesday	1625	Dry	Overcast	Daylight	M2 HILLS	EXP	50	South	DEHLI ROAD	OP	NORTH RYDE	Dual freeway	-33.794464	151.136138	No or unknown	No or unknown	North
Delhi 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	DELHI ROAD	OP	NORTH RYDE	Dual freeway	-33.794024	151.136002	No or unknown	No or unknown	North
Delhi Road northbound	1155986	Minor/Other Injury	30	Rear end	2017	September	Friday	1500	Dry	Fine	Daylight	M2 HILLS	EXP	100	North	EPPING ROAD	OP	NORTH RYDE	Dual freeway	-33.795401	151.136532	No or unknown	No or unknown	North
Delhi 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	DELHI ROAD	OP	MACQUARIE PARK	Dual freeway	-33.793898	151.136065	No or unknown	No or unknown	South
Delhi Road southbound	1054881	Minor/Other Injury	30	Rear end	2014	October	Tuesday	0710	Dry	Overcast	Daylight	M2 HILLS	EXP	0	Right on the spot	DELHI ROAD	OP	MACQUARIE PARK	Dual freeway	-33.793890	151.136065	No or unknown	No or unknown	East
Delhi Road southbound	1104583	Serious Injury	30	Rear end	2016	March	Friday	0735	Dry	Fine	Daylight	M2 HILLS	EXP	100	North	DELHI ROAD	OP	MACQUARIE PARK	Dual freeway	-33.792986	151.135894	No or unknown	No or unknown	South
Delhi Road southbound	1115345	Moderate Injury	30	Rear end	2016	September	Thursday	1300	Dry	Fine	Daylight	M2 HILLS	EXP	200	North	DELHI	RD	MACQUARIE PARK	Other	-33.792203	151.135994	No or unknown	No or unknown	South
Delhi Road southbound	1184091	Moderate Injury	30	Rear end	2018	September	Tuesday	0707	Dry	Fine	Daylight	M2 HILLS	EXP	0	Right on the spot	DELHI ROAD	OP	NORTH RYDE	Dual freeway	-33.793955	151.136080	No or unknown	No or unknown	South
Delhi Road southbound	1193205	Serious Injury	30	Rear end	2019	January	Friday	0830	Dry	Fine	Daylight	M2 HILLS	EXP	50	North	DELHI ROAD	OP	MACQUARIE PARK	Dual freeway	-33.793453	151.135970	No or unknown	No or unknown	South
Delhi Road southbound	1203608	Serious Injury	40	U turn	2019	April	Saturday	2139	Dry	Fine	Darkness	M2 HILLS	EXP	50	North	DELHI	RD	MACQUARIE PARK	Other	-33.793515	151.136185	No or unknown	No or unknown	North
Delhi Road southbound	1236707	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	151.135962	No or unknown	No or unknown	East
Delhi Road southbound	1274709	Non-casualty (towaway)	30	Rear end	2021	October	Thursday	0655	Dry	Fine	Daylight	M2 HILLS	EXP	20	North	DELHI ROAD	OP	MACQUARIE PARK	Dual freeway	-33.793712	151.136022	No or unknown	No or unknown	South
Lane Cove Road westbound	1148232	Serious Injury	85	Off rt/lft 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	No or unknown	North
Lane Cove Road westbound	1177733	Non-casualty (towaway)	85	Off rt/lft bnd=>obj	2018	August	Monday	1850	Wet	Raining	Darkness	M2 HILLS	EXP	220	East	LANE COVE	RD	MACQUARIE PARK	Other	-33.782060	151.133184	Yes	No or unknown	East
Langdon Road eastbound	1035784	Minor/Other Injury	30	Rear end	2014	August	Thursday	0700	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	0720	Dry	Fine	Daylight	M2 HILLS	EXP	10	West	LANGDON ROAD	OP	BAULKHAM HILLS	Dual freeway	-33.770936	150.968262	No or unknown	No or unknown	East
Langdon Road eastbound	1204683	Moderate Injury	30	Rear end	2019	April	Monday	1350	Dry	Fine	Daylight	M2 HILLS	EXP	100	West	LANGDON ROAD	OP	BAULKHAM HILLS	Dual freeway	-33.770365	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	-33.770964	150.968305	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 RO	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	120	West	CUMBERLAND HIG	OP	WEST PENNANT H	Dual freeway	-33.758767	151.047578	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	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	0800	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 rt/lft bnd=>obj	2013	October	Tuesday	0945	Dry	Fine	Daylight	M2 HILLS	EXP	30	West	CUMBERLAND	HWY	CARLINGFORD	Dual freeway	-33.758672	151.048549	No or unknown	No or unknown	West
Pennant Hills Road eastbound	1065354	Non-casualty (towaway)	79	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	1139188	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	151.048582	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

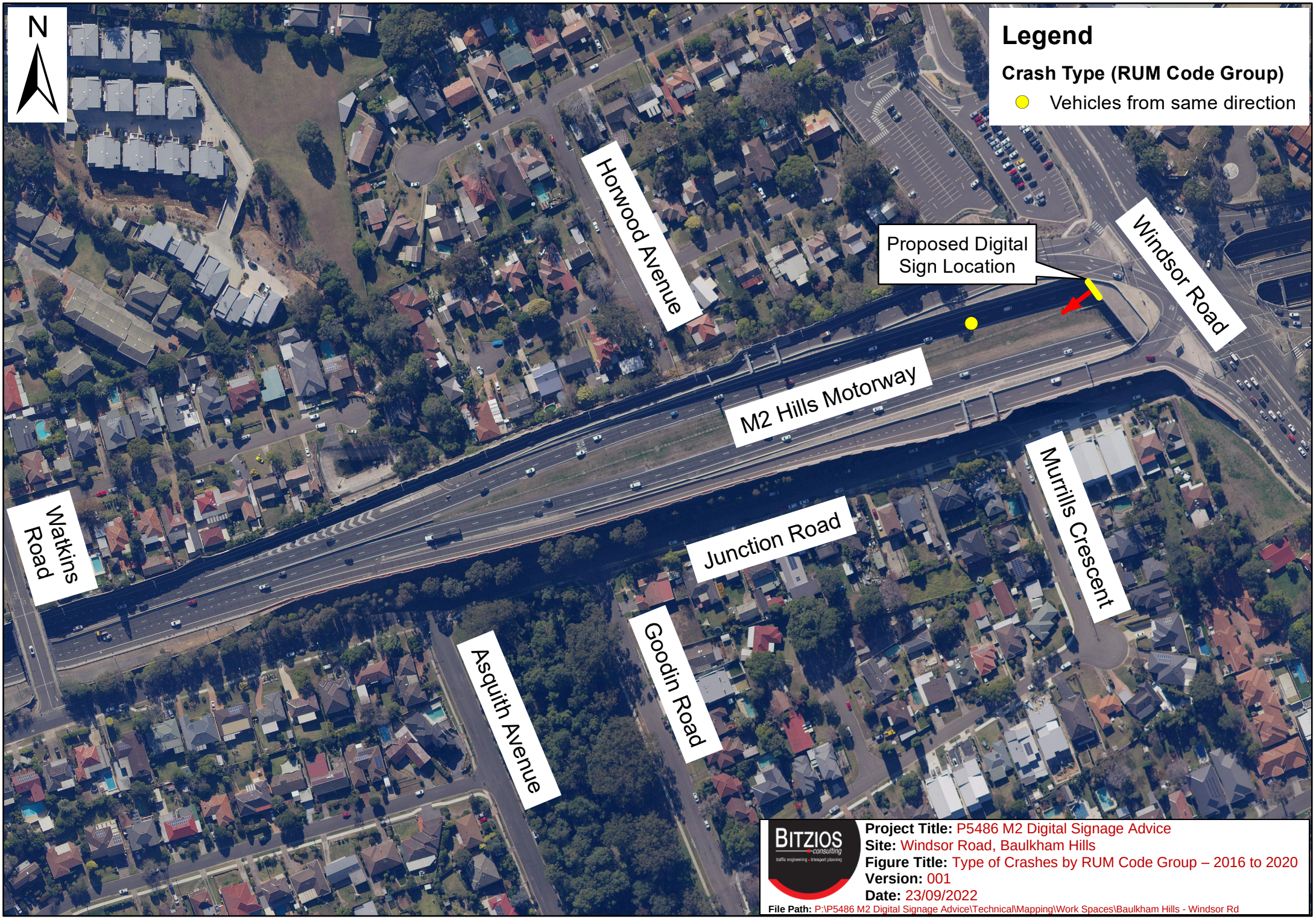
Appendix C: Photo Montages

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

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

Appendix D: Crash Data


N
Legend
Crash Degree
Minor/Other Injury
Proposed Digital Sign Location
Horwood Avenue
Windsor Road
M2 Hills Motorway
Watkins Road
Junction Road
Murrills Crescent
Asquith Avenue
Goodin Road
BITZIOS consulting
traffic engineering - transport planning
Project Title: P5486 M2 Digital Signage Advice
Site: Windsor Road, Baulkham Hills
Figure Title: Degree of Crashes – 2016 to 2020
Version: 001
Date: 23/09/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Baulkham Hills - Windsor Rd



BITZIOS consulting
traffic engineering - transport planning

Project Title: P5486 M2 Digital Signage Advice
Site: Windsor Road, Baulkham Hills
Figure Title: Type of Crashes by RUM Code Group – 2016 to 2020
Version: 001
Date: 23/09/2022
File Path: P:\P5486 M2 Digital Signage Advice\Technical\Mapping\Work Spaces\Baulkham Hills - Windsor Rd

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
1166413	Minor/Other Injury	30	Rear end	2018	March	Thursday	0627	Dry	Fine	Dawn	M2 HILLS	EXP	100	West	WINDSOR ROAD	OP	BAULKHAM HILLS	Dual freeway	-33.767954	150.997152	No or unknown	No or unknown	East